South African Public Relationship with Science: 2022 Survey Results

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Foreword/Dsi Minister

Acknowledgements

The results of the South African Public Relationship with Science (SAPRS): 2022 Survey are the culmination of more than four years of work, involving conceptualising the study, developing the instruments, collecting and analysing the data and writing the report.

The survey was a collaboration between the Science Promotion Unit at the Department of Science and Innovation (DSI) and the Equitable Education and Economies (EEE) Research Programme at the Human Sciences Research Council (HSRC). The DSI team was led by Mr Isaac Ramovha and the HSRC research team by Dr Vijay Reddy.

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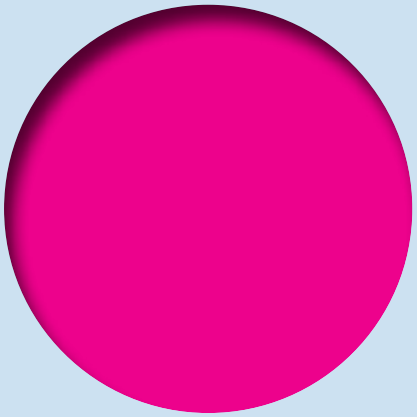

DR VIJAY REDDY
Principal Investigator of SAPRS survey
Human Sciences Research Council

Acronyms

4IR	Fourth Industrial Revolution
AAAS	American Association for the Advancement of Science
AI	Artificial intelligence
ANSSC	Albertina Nontsikelelo Sisulu Science Centre
CAPI	Computer-Assisted Personal Interviewing
DACST	Department of Arts, Culture, Science and Technology
DPME	Department of Planning, Monitoring and Evaluation
DSI	Department of Science and Innovation
DST	Department of Science and Technology
FEST	Foundation for Education, Science and Technology
HSRC	Human Sciences Research Council
ICT	Information and Communication Technology
NSI	National System of Innovation
NSTF	National Science and Technology Forum
OECD	Organisation for Economic Co-operation and Development
OLS	Ordinary Least Squares
PDA	Personal digital assistant
PISA	Programme for International Student Assessment
R&D	Research and Development
SAHRC	South African Human Rights Commission
SAL	Small Area Layers
SAPRS	South African Public Relationship with Science
SARS	South African Revenue Service
SASAS	South African Social Attitudes Survey
SEMEIIF	Science Engagement Monitoring and Evaluation Impact Indicator Framework
SES	Socioeconomic status
SKA	Square Kilometre Array
S&T	Science and Technology
SSH	Social Science and Humanities
STI	Science, Technology and Innovation
STEM	Science, Technology, Engineering and Mathematics
TIMSS	Trends in International Mathematics and Science Study
UK	United Kingdom
UNFCCC	United Nations Framework Convention on Climate Change
USA	United States of America

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The South African Public Relationship with Science fingerprint

The South African public relationship with science has a unique social fingerprint. The graph below presents the science attitude and engagement indicators, sub-indicator measures, mean scores and score variations (range) of this relationship. The mean scores ranged from a low of 23 (attendance at attraction-based events and participation in community engagements) to a high of 78 (promise of science and technology [S&T] skills for young people). The variation in scores ranged from a low of 9 (for transformation of cultures within science organisations) to a high of 70 (for daily use of the internet).

Science attitude and engagement indicators, sub-indicator measures, mean score and score variation

INDICATOR	SUB-INDICATOR MEASURES	MEAN SCORE	VARIATION CALCULATED BY DIFFERENCE BETWEEN HIGHEST AND LOWEST SCORES
Interest	Environmental concern	72	21
	Interest in science areas	67	22
	General interest in S&T	58	26
Knowledge	Environmental knowledge	67	18
	Perceived knowledge of science areas	61	25
	Formal science knowledge	60	23
Promise & Reservation	Reservation of S&T	69	12
	Promise of S&T	68	10
	Promise of traditional S&T	62	21
Trust	Trust in S&T information from universities	68	15
	Trust in work of scientists	69	13
	Transformation of cultures in science organisations	59	9
	Trust in S&T information sources	58	13
	Trust in government evidence-based decision making	50	17
S&T Information	Daily usage of the internet	50	70
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	Consumption of S&T news	39	20
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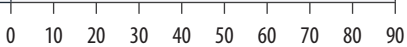


Promoting the South African public relationship with science

1 THE VIEWS OF SOUTH AFRICANS ARE THOUGHTFUL, CONSIDERED, BALANCED AND REFLECT AN AWARENESS OF S&T DEVELOPMENTS

We must change the narrative about how we characterise and describe the South African public. For almost half of the measures (promise, pride and trust) examined, the public displayed similar views, irrespective of their socio-demographic backgrounds. For the other measures, there were variations among the pubic that were largely due to differences in educational attainment, socio-economic status and access to resources, as well as population group identity and, in some cases, age and geographical location.

2 KNOWLEDGE IS POWER: YOU CAN'T GO WRONG WITH IMPROVING SCIENCE KNOWLEDGE

In addition to general educational attainment, those with higher science knowledge were more likely to have positive attitudes, greater access to S&T information and more positive science engagement behaviours and views. Over and above improving the schooling experience, we recommend a public science awareness and education programme to increase science knowledge among all sectors of society. Public science awareness programmes should be delivered through multiple traditional and social media platforms, embedding the science that is part of individuals' lived experience within the public discourse.

3 INCREASE INTEREST IN S&T AND BUILD A SOCIETY THAT PROMOTES A SCIENCE CULTURE

Interest in science is associated with science awareness and knowledge, as well as positive science attitudes and engagements. The scale and reach of present science engagement programmes must be expanded, and new programmes with relevant and engaging content should be initiated and communicated through various channels. These programmes should aim to instil a culture of scientific curiosity and inquiry in society at large. This culture begins in homes and carries through to adulthood.

4 KNOWLEDGE OF, INTEREST IN AND CONCERN TOWARDS S&T ARE STRONGLY INTER-RELATED AND INTERTWINED

To raise any one of knowledge, interest and concern will undoubtedly raise the others, irrespective of the individual and demographic characteristics accounted for. However, a focus on interest may be more amenable to intervention. This has the potential to create a virtuous cycle and the knock-on benefits and spillovers to the other measures are explored in this study.

5 HOME EDUCATIONAL INTERACTIONS AND ENGAGEMENTS MATTER

Throughout the analysis the standout indicator was home support for education in the form of encouraging reading, homework and discussion of the news as well as doing well and taking science subjects in school. Home education support is associated with knowledge, interest, promise and reservation towards modern and traditional S&T, trust in the work of scientists and government evidence-based decision making, use of online apps as well as valuing S&T experiences. This speaks to the importance of early exposure to and consumption of S&T information, and to attendance science-related events to inculcate an appreciation for science knowledge. Home education support shows the importance of intergenerational curiosity and knowledge building.

6 VIEWS ABOUT THE PROMISE OF, AS WELL AS PRIDE AND TRUST IN, S&T ARE EGALITARIAN IN CHARACTER

Irrespective of the diverse nature of South African society, there are views where all sectors of the public are closely aligned. To consolidate and further build on these views requires ensuring a cultural system that values, celebrates and promotes S&T. We should create a cultural milieu that showcases evidence-based decision-making processes, debates, critique and the contestation of ideas.

7 LEVELS OF SCIENCE KNOWLEDGE AND ACCESS, EXPOSURE TO AND CONSUMPTION OF S&T INFORMATION ARE DIVERSE IN CHARACTER

The main characteristics that inform this diversity are educational attainment, socioeconomic status and being a student or learner. We recommend continued supplementary tuition and public science awareness programmes to enhance S&T knowledge and interest. Increased science communication and engagements through multiple channels, from print to broadcast to social media, should be both encouraged and mandated. The zero rating of S&T-related educational sites, and the creation of content that is relevant to the life experiences of different segments of society, should be encouraged.

8 INCREASE ACCESS TO S&T INFORMATION

Three-quarters of the public have internet access. Presently, the main use of the internet is for communication and engaging with social media. The public trust S&T news presented by television and radio but are cautious about news on social media. S&T information should be communicated in easily understandable ways on television and radio. Only 5% of the public actively accessed S&T information. As in point 7, we need to infuse a culture of curiosity for information and an awareness of the rich information that can be found on the Internet.

9 LARGE DIFFERENCES IN SCIENCE ENGAGEMENT BEHAVIOUR PERSIST BUT CAN BE POSITIVELY INFLUENCED BY PROMOTING SCIENCE KNOWLEDGE AND INTEREST AND OVERCOMING STRUCTURAL BARRIERS TO ACCESS

Some of the largest differences evident among the public were in relation to different types of science engagement behaviour. Five types of engagement were examined: academic, event-based, community-based, information sharing, and the use of online apps. Generally low engagement levels were observed across all types, with the lowest for attraction-based events. Participation was shaped by age and socioeconomic status, the availability of S&T sites for attraction-based events nearby, science knowledge of and interest in, as well as exposure to, and active consumption of, S&T information. Campaigns to boost information consumption, interest and knowledge, combined with efforts to promote greater access to S&T sites and events, would be expected to have a positive effect on levels of science engagement.

10 EDUCATE THE PUBLIC ABOUT THE VALUE OF TRADITIONAL S&T

While the South African public reported moderate awareness and decreasing levels of reservations over time about traditional S&T, the characteristics of those who were more likely to see the promise of traditional S&T were largely Black African adults, those with less education, those from poorer homes and those living in rural areas. There is a need for a concerted effort to communicate, inform, educate, celebrate and create awareness about this rich field of S&T for the larger population.

Preface

Purpose of South African Public Relationship with Science survey

> *"One of the prerequisites for an effectively functioning National System of Innovation is a society that is aware of the value and potential dangers of science, is able to evaluate the products of science, uses the processes of science in their daily lives … and engages in debate on science-related matters of public interest" (DST, 2019b: 56).*

From its earliest days, the democratic South African state recognised the importance of the relationship between the public and the state, and that all South Africans should participate in the development of the National System of Innovation (NSI). In the context of a highly unequal society, the 1996 White Paper on Science and Technology recognised two parallel challenges that faced the NSI … "on the one hand, South Africa (should) use S&T to become economically competitive on a global scale, and on the other hand (S&T) to provide essential services, infrastructure and effective health care for all South Africans" (DACST, 1996: 4).

The relationship between the public and science was institutionalised through a set of policies and strategies, namely the Science Engagement Strategy (DST, 2015), the Science Engagement Strategy Monitoring and Evaluation Framework (DST, 2019a) as well as the Science Engagement Monitoring and Evaluation Impact Indicator Framework (DST, 2021).

The South African White Paper (DST, 2019b) on Science, Technology and Innovation (STI) again endorsed the policy of aiming for a science-literate and science-aware society. It also drew attention to the importance of increasing the reach of science awareness initiatives and stimulating access to science and technology (S&T) related information. The White Paper furthermore recognised the importance of measuring the nature of the relationship between science and society and advocated for the establishment of a set of indicators to measure this relationship. We describe the relationship using measures of science knowledge and attitudes, access to S&T information and science engagement outcomes in the form of activities, behaviours and views. This set of indicators was adopted to inform an "institutionalised survey on public perceptions of science" (2019b: 57).

The Human Sciences Research Council (HSRC) has been tasked with conducting a dedicated South African Public Relationship with Science (SAPRS) survey every five years. The purpose of the survey is to monitor the state of the public relationship with science as well as the patterns and tendencies relating to time periods and comparisons with other countries. The first survey was conducted in 2022. This report presents the picture of the publics' relationship with science.

The purpose of the SAPRS survey was to measure the distance that South Africa travelled on its journey towards a society that is more science-literate and science-aware. This information from the survey allowed us, firstly, to measure and describe the unique fingerprint of the South African public relationship with science. These results present the baseline values for the science attitude and engagement measures – they will be tracked every five years. Secondly, the data will be used to identify the socio-demographic characteristics that promote positive attitudes towards S&T, as well as higher science engagement actions and behaviours. Thirdly, we examined how the science attitude and engagement measures themselves promote positive attitudes towards S&T, as well as higher science engagement actions and behaviours.

These results are presented in subsequent chapters of this report. To better understand the South African public relationship with science, the report is presented in five sections. We start by presenting the voices of the public about their understanding of the terms *science* and *technology*. This is followed by Section A, which outlines the theoretical, policy and methodological framing of the study.

Section B presents the survey results for S&T knowledge and attitudes. In these three chapters, we report the attitudinal measures of knowledge of and interest in S&T, promise and reservation towards modern and traditional S&T and trust in science and science institutions. We then identified the socio-demographic characteristics associated with adults more and less likely to have higher science knowledge and interest, and more positive attitudes towards science and technology. Finally, we tested how the science attitudinal measures are interrelated.

Section C presents the results for science engagements by reporting on access to and trust in S&T information as well as the science engagement outcomes in the form of participation in activities and events and the views of pride, promise and priorities of the NSI. Again, we report on the science engagement measures and the socio-demographic characteristics associated with adults more and less likely to have higher access, participation and more positive views. Finally, we tested how access to and trust in S&T information influenced the science attitudinal measures.

In Section D, we synthesise the results from the six empirical chapters to present the mean score and overall variations for each of the science attitudinal and engagement measures. We segmented the results according to a high-low mean score and variation typology across the 27 identified science attitudes and engagement outcomes. We then identified the common features of the measures for each sector and socio-demographic characteristics to describe each of the four typologies. Drawing together results from across the study, we end section D with recommendations on improving the results for the science attitudinal and engagement measures.

As you read the report it is important to remember that the purpose of the indicators described here is to allow an evidence-based discussion of what South Africans think and know about topics and information related to science and technology. The emphasis is on between-group comparisons, over-time comparison, and, where possible, between-country comparisons. This report does not fully explain the patterns or mechanisms that underlie the trend of the science attitudes and engagement measures.

When you hear the word science or technology, what comes to mind?

At the start of each survey interview with adults over 16 years of age, we asked (i) when you hear the word SCIENCE, what comes to mind?; and (ii) when you hear the word TECHNOLOGY, what comes to mind? These questions were asked to ascertain the existing appreciation of these terms, as expressed in respondents' own words.

FIGURE 1: When you hear the word SCIENCE, what comes to mind?

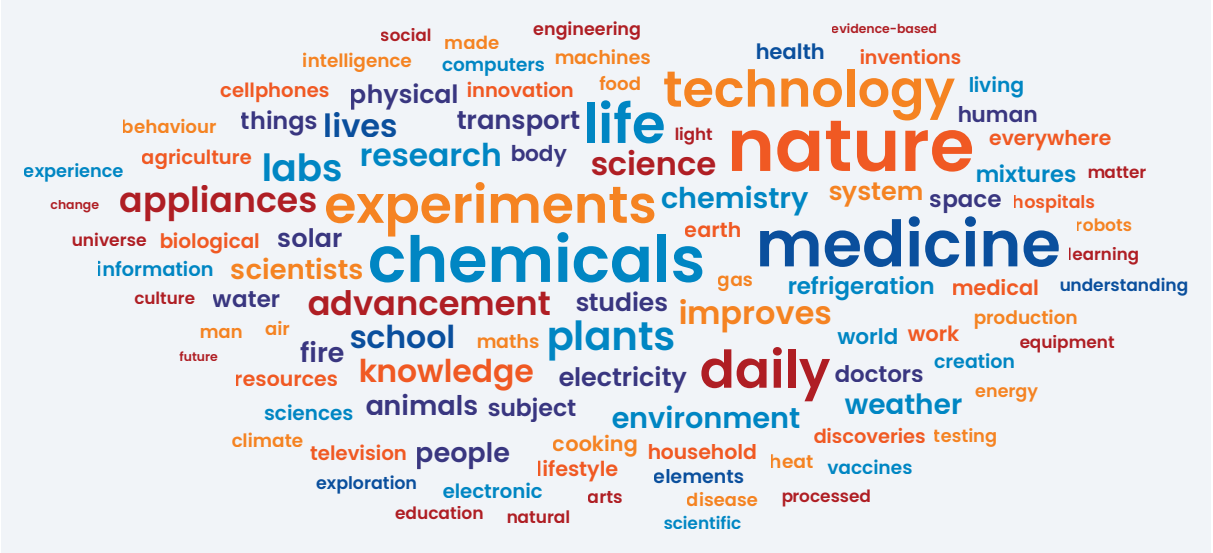
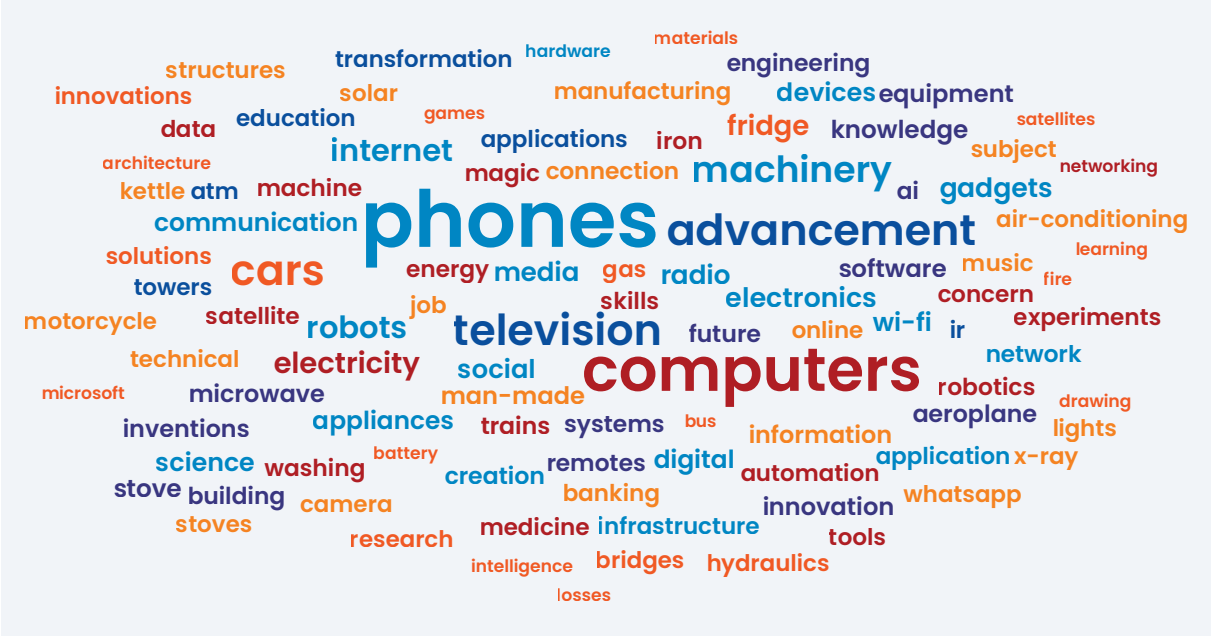


FIGURE 2: When you hear the word TECHNOLOGY, what comes to mind?



Close to 6 000 responses were received to each of these questions in the form of explanations or examples of science and technology. The data from these questions was captured, cleaned, coded and categorised using Microsoft Excel. The final set of words and phrases was imported into WordArt.com, to generate two word clouds[1] – one for science and one for technology. Figure 1 and Figure 2 capture the current views of South African adults about science and technology.

The coding of the science responses produced 191 distinct words or phrases. The most common associations that respondents made with the word *science* were related to nature, medicine, chemicals, the role of science in their daily lives and ways of improving lives. Technology and advancement (including progress, change, modern life, and development) were words also identified. Other frequent responses referred to laboratories/labs, appliances, school science, as well as research, knowledge and the environment. There was a small number of respondents who felt that science had negative connotations, associating the term with violence, brainwashing, destruction, exploitation and manipulation, as well as being "crazy" or against God or the Bible.

For technology, the coding of the public responses yielded 200 distinct words or phrases. The word cloud shows that phones, computers and advancement were the most common associations the public made with the term *technology*. This was followed by television, cars, radio, robots, machinery, devices, electronics, gadgets, and the internet. Many respondents also associated technology with appliances in general, while some named specific appliances, like stoves, microwaves, fridges and radios. A smaller portion of the public understood technology to refer to high-level technologies such as software, banks, satellites, Artificial intelligence (AI) and the Fourth Industrial Revolution (4IR), while others associated technology with job losses.

The word clouds for both science and technology revealed the breadth of understanding of both terms among the public and this provided an important starting point for exploring the South African public relationship with science.

1 A word cloud is an image made up of words in which the size of each word indicates its frequency or importance.

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SECTION A

Framing the Survey: Theory, Policy and Methodology

The public relationship with science and technology

- Theoretical approach underpinning the study
- How attitudes towards S&T inform the public relationship with science
- How science engagements inform the public relationship with S&T
- South African science engagement policy context
- The South African socio-demographic context
- A conceptual model to study the public relationship with science

Methodological approach

- Objectives of the survey
- The SAPRS instrument
- Sampling approaches
- Conducting the survey
- Data verification, cleaning and weighting
- Data analysis

CHAPTER 1

The Public Relationship with Science and Technology

It is broadly acknowledged that the goals of science should extend beyond the economic and technological impacts, to address the contemporary global and local challenges that impact our lives. By science we mean a systematic process that builds and organises knowledge in the form of explanations that can be tested and where we can make predictions about the world. The way science knowledge is generated elevates our understanding of the world, ourselves, and our existence (Miedema, 2022). We use the term *science* or *sciences* in this report to refer to knowledge production in all academic disciplines, comprising the natural sciences, life sciences, engineering, social sciences and humanities.

Since the 1960s, governments and societies have also recognised the role of the public in shaping the science and technology (S&T) agenda. In the context of the growing role of S&T, the global research agenda has expanded to include an understanding of what happens when science interfaces with the public, i.e. the public relationship with science.

A constructive relationship between science and the public ensures that the public are informed about how S&T may offer solutions to developmental challenges, supports the consolidation of democracy and citizenship, improves the quality of life and well-being of individuals, stimulates interest in science subjects and careers, encourages investment in research and development, and increases public participation in science policy formulation and adoption (Pereira et al., 2013; Reddy et al., 2013).

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Theoretical evolution of the study of the science and society interface

The study of how science interfaces with the public has evolved over the last 60 years.

The study of how science interfaces with the public has evolved over the last 60 years. Broadly speaking, the theoretical models to explain the public and science nexus have evolved from models that viewed the public as deficient in science knowledge or as not recognising the benefits of S&T, to one where there is a dialogical relationship between the public, or society, and science (Reddy et al., 2020).

In the mid-1950s and 1960s, there was a concern about the legitimacy of S&T in the United States of America (USA), as the sector felt its contribution was not appreciated by the public and policymakers, and there was limited support and funding (Bauer et al., 2007; DeBoer, 2000; Wolf & Barton, 2004). The S&T community viewed the public as lacking in science knowledge, and to gain public support, they advocated improving the education levels, and in particular, scientific literacy, of the public. This *scientific literacy model* adopted the maxim "the more they know, the more they will love science" (Bauer et al., 2007).

In the 1980s, there was concern in the United Kingdom (UK) that the critical stance of the public towards S&T placed the scientific community and its growth at risk. To mitigate this, the Royal Society and National Academy of Sciences recommended a better understanding of the public attitudes to science and an increased level of communication of science information to the public (Royal Society, 1985). This *public understanding of science model* was a significant advancement to the scientific literacy model, but this approach attributed the public with a deficit in their attitudes to science. The proposed solution to this deficit was an enhanced communication strategy from scientists to encourage the development of more positive public attitudes to science (Bauer et al., 2000).

Later, in the early 1990s, there were several science-based controversies (e.g. animal cloning, genetically modified foods, nuclear energy), both within the science community itself and in public spaces and popular media (Stastny, 2005). These controversies highlighted the need for the public to participate in shaping the science agenda. Consequently, the scientific literacy and public understanding models of science research agenda were expanded to include the role and influence of the public on science policy – broadly termed the *science in society* or *science and society models* (Bauer et al., 2000; Bauer et al., 2007).

This change in focus reframed the study of the public-science interaction to more of a dialogue. Miller (2001) asserted that knowledge flows had become increasingly bi-directional, and attitudes and perceptions of science were being shaped not only by scientific knowledge, but also by values, contexts and broader social influences. The science-in-society model emerged, positing that the connection between science and the public extends beyond mere literacy or attitudes, and is also influenced by the publics' social, cultural, and political contexts (Bauer et al., 2007; Reddy et al., 2013). This paradigm shifted the notion from a public knowledge deficit to a deficit within scientific institutions and their actors (Bauer, 2009). The *science-in-society* model explores avenues for institutional change that could enhance public participation and dialogue and argues that science should be undertaken with and for society (Bauer et al., 2000).

Reddy et al. (2009) proposed the term the *public relationship with science* to encompass the bi-directional and dialogical nature of the public-science interactions. On the one hand, the public receive and interpret scientific information, while on the other hand, the scientific community is made aware of the knowledge needs and priorities of the public.

The models presented above should be perceived as existing on a continuum of theoretical evolution, complementing each other, and collectively contributing to research on the public and science relationship (Bauer et al., 2007). In the following sections, we review the literature related to public attitudes towards S&T and the nature of science engagements, both of which shape the publics' relationship with science.

How attitudes towards S&T inform the public relationship with science

One element of the texture of the relationship between the public and science is the views, perceptions and attitudes that an individual holds toward S&T. An attitude is defined as the way in which a person views and evaluates something or someone, or a tendency to respond positively or negatively toward a certain idea, object, person or situation (Vargas-Sanchez et al., 2016: 1).

There is a close link between the three constructs: public opinion, attitudes and values. Worster (cited in Davison, 2023) characterises values as the "deep tides of public mood", and opinions as the "ripples on the surface of public mood", with attitudes falling between values and opinions. Values are slow to change, whereas opinions are more easily shifted.

Attitudes are shaped by a set of complex interrelated individual and societal factors which in turn depend on the general socio-environmental, political, and economic context as well as on pre-existing knowledge and values (Davison, 2023). In addition, the culture of the society plays a role in shaping attitudes towards S&T. The measurement of attitudes towards S&T provides an insight into the nature of the relationship between the public and science.

The fact that there is an evaluative dimension in an attitude suggests a link with education – a view corroborated by Diaz-Quijano et al. (2018), who argue that attitudes are driven by a person's beliefs and knowledge of a particular subject. Studies conducted in different contexts have shown the effects of socio-demographic factors in shaping attitudes towards S&T (Zambianchi et al., 2019). Other factors that influence the relationship between science and the public are the nature and culture of the society, socioeconomic status (SES) and culture, including science culture (Sharma, Akhter & Ahmad Mir, 2022; Trench et al., 2014).

A growing number of countries have conducted surveys to measure public attitudes towards S&T. Reddy et al. (2020) describe some of the surveys (published in English) conducted in approximately 20 countries including the United States of America (USA), European member states, China, India, Sweden and Malaysia. In South Africa, surveys were conducted by the Foundation for Education, Science and Technology (FEST), as well as the Human Sciences Research Council (HSRC). In addition to reporting the measurement of attitudes, this survey data allows for cross-country and trend analyses.

Globally, a set of items has been used to measure the attitudes of promise and reservation towards science. Scientific promise is an attitudinal construct associated with the view that S&T provides useful results and products for society, and that future benefits from S&T are likely. Scientific reservation reflects public concerns about the speed of change in modern life and a sense that S&T may pose too many risks or may conflict with traditional values or belief systems (Nisbet & Nisbet, 2019: 10). These measures provide a signal of the relationship between science and society.

While there are similarities and differences between countries in terms of the level of promise and reservation attitudes towards S&T, there nonetheless appears to be a difference in the aggregate pattern of views in countries with more advanced economies compared to low-income countries. Nisbet and Nisbet (2019: 13), for example, refer to this as a "post-industrial paradox" where, in contrast to those in low-income countries, citizens in more advanced economic conditions may no longer idealise S&T as necessary for economic growth. The authors argue that while they may still see the benefits of science, they also recognise the moral trade-offs and risks posed by scientific research.

Using data from the World Values Survey (2010–2014) from 54 countries and 81 000 survey respondents, Nisbet and Nisbet (2019) found that people living in what is called the Eastern bloc countries, Muslim countries and low-income countries were more optimistic and less concerned about S&T. In contrast, those from more developed countries, such as the UK and European countries, tended to be less optimistic and expressed greater reservations.

Another factor that is essential to foster positive overall attitudes is the level of trust and confidence in institutions that generate knowledge (European Commission Science and Technology Advisory Council, 2013). Trust has become increasingly critical due to the influence of digital sources of information, predominantly the internet and social media (Brossard, 2013; Guenther et al., 2022; Scheufele & Krause, 2019).

In South Africa, several socio-demographic factors have been shown to be related to positive public attitudes towards S&T. Reddy et al. (2013) showed that educational attainment was the strongest predictor of positive attitudes towards S&T, followed by age. Studies by Guenther and Weingart (2016) and Guenther et al. (2022) found that factors such as home location, degree of religiosity, interest, knowledge, sources of information, online engagement, and trust in science were associated with South African attitudes towards science.

How science engagements inform the texture of the South African public relationship with S&T

> *"The dissemination of information is the lifeblood of an informed and empowered society, as it ensures that knowledge, insights, and discoveries are accessible to all. By sharing information widely and transparently, we bridge gaps in understanding, stimulate innovation, and foster collaboration among individuals and communities. It empowers people to make informed decisions, advocate for their rights, and participate in the democratic process, ultimately promoting transparency, accountability, and social progress. In a world where access to information is a fundamental right, its dissemination becomes a cornerstone of equality, opportunity, and collective growth." (NSTF quoting Mutanga, 2023: 1)*

The second element of the relationship between the public and science interface is science engagements. *Science engagement* has been defined differently by different authors (Weingart et al., 2021). In this study, we use the term science engagement to describe access to S&T information, as well as S&T-related actions, behaviours and views of the public.

The research field of science communication is well-established globally, encompassing both empirical and applied studies, as well as theoretical reflections (Trench et al., 2014). Science communication refers to the use of relevant skills, media, activities, and dialogue to promote awareness, enjoyment, interest, opinion-forming and understanding of science (Burns et al., 2003). Through the evolution of the three theoretical paradigms of the public and science relationship outlined earlier, public engagement has come to the forefront of the argument for improving the public relationship with science (Bucchi & Trench, 2016). This has resulted in a shift in thinking from an instrumental communications approach in which the public is seen as a passive vessel for information to be transmitted to, to an approach which is dialogic and relational between the public and other S&T actors (Bastos et al., 2019). There are still times when information could be disseminated in a one-way direction, for example during the COVID-19 pandemic information was mostly disseminated in a one-way fashion from experts to the public.

Science engagement involves purposeful and significant interactions and practices that create channels to facilitate communication and mutual learning between science and the public, as well as promote science education and dissemination.

Science engagement involves purposeful and significant interactions and practices that create channels to facilitate communication and mutual learning between science and the public, as well as promote science education and dissemination. The American Association for the Advancement of Science (AAAS) describes public engagement with science as "intentional, meaningful interactions that provide opportunities for mutual learning between scientists and members of the public" (AAAS, 2016: 1). Mutual learning goes beyond the acquisition of knowledge to a bi-directional exchange of knowledge and views (Bastos et al., 2019; Ivani & Novaes, 2022; Karim, 2022; Limson, 2019; Renoe & Nelson, 2022).

The key ingredients for engagement are the provision of S&T information, and conducting S&T events and activities that the public can participate in. The intended impact of public engagements is changed actions and behaviours. Democratising the science-society interface includes informing the public about the relevance of S&T to their daily lives, exposing them to key S&T debates, as well as allowing them to participate in these debates. For the information to be used, the public must trust the S&T information that they receive from scientists and science institutions, as this will encourage effective engagement, rather than mistrust and disengagement.

Promoting science engagement is, however, not without challenges, including limited resources, competing priorities, low uptake of outcomes by decision-makers, and limited consensus or an exact definition regarding what is meant by *the public* (Ivani & Novaes, 2022; Mahony & Stephansen, 2017). Mahony and Stephansen (2017: 35) posited that "contemporary publics are dynamic, mediated, contextually variable and multidimensional entities", adding to the challenges of creating effective engagement opportunities. Furthermore, the language used for communication plays a role in shaping attitudes towards S&T. Science and technology information is often communicated in English, but increasing the use of local languages should be considered (Haworth & Dijkstra, 2019; Sobane & Lunga, 2019).

The media plays a critical role in science communication and engagements. Media encompasses all channels of communication, ranging from printed outputs to digital data. It includes news, art, educational content, and any information that can reach or influence people, including via television, radio, books, magazines and the internet. The basic function of the media is to provide audiences with information they need and want to know, both for informative and entertainment purposes.

In South Africa, public science communication faces further challenges and constraints, mostly related to cultural and language diversity, poor literacy levels and poverty, and limited resources and access to information in remote rural populations (Manzini, 2003). In addition, media coverage of S&T is insufficient as it often neglects reporting on scientific discoveries and developments (Claasen, 2011). Further, there has been a decrease in the number of specialist science journalists (Van Zuydam, 2018). There is growing pressure for science media coverage to become more accessible to the public (Heyl et al., 2020).

The advent of social media platforms and their increased usage are both an opportunity as well as a challenge for the communication of S&T information. Collins et al. (2016) suggested that social media be adopted as a tool for communication with the public due to its increasing influence and accessibility. The downside is that information on various online platforms is mostly unregulated and unchecked compared to traditional media distribution. Hence, there is a higher possibility of sharing fake news and misinformation on social media as information is believed to be true based on the number of engagements with posts, rather than the accuracy and reliability of the information (Di Domenico et al., 2021).

In 2020, when the world was faced with the coronavirus pandemic, the communication of information was critically important to educate and allay the fears of the public. While being one of the scariest periods in recent history, there are many lessons that can be learned about how to deliver effective communication relating to S&T. To deal with social distancing measures to prevent the spread of the virus, and the administration of vaccinations to minimise the health effects of the virus, the state and society had to rely on answers from science. During the first two years of the pandemic, the public were immersed in discussions and debates about scientific discoveries related to the coronavirus, behaviours to reduce risks and the legitimacy and safety of vaccinations (see, for example, Karim 2022). This immersion in a science and evidence-based culture is likely to have influenced the publics' views towards the pandemic. It is worth briefly mentioning here, that this first South African Public Relationship with Science (SAPRS) 2022 survey was conducted soon after the massive disruption of lives because of the pandemic from 2020 to 2022.

The South African policy context supporting the relationship between the public and science

The present Department of Science and Innovation (DSI), with its partners, is responsible for promoting science engagement programmes. A summary of the South African policies, strategies and plans related to the public and science interface is presented in Figure 3.

FIGURE 3: South African policies, strategies and plans related to the public and science interface

WHITE PAPER ON SCIENCE AND TECHNOLOGY (1996)

- A campaign to promote awareness and understanding of S&T and its importance will have two key elements: (i) promoting S&T literacy and (ii) promoting the power of S&T.
- Government will institute the delivery of S&T public awareness programmes in collaboration with institutions advancing science, professional institutions, academies of science, science museums, libraries, media etc. (DACST, 1996).

TEN-YEAR INNOVATION PLAN FOR SCIENCE AND TECHNOLOGY (2007)

- The success of the plan will be measured by how S&T enhances productivity, economic growth and socioeconomic development.
- It is essential "to support the public understanding of and engagement with science" (DST, 2007: 21).

SCIENCE ENGAGEMENT STRATEGY (2015)

- Provides the basis for the national coordination of science engagement initiatives that will build a knowledge intensive economy and a better life for all.
- The term 'science' adopts a broad notion of modern and traditional science.
- The four strategic aims of the Science Engagement Strategy are to (i) popularise science as attractive, relevant and accessible in order to enhance scientific literacy and awaken interest in relevant careers; (ii) develop a critical public that actively engage with and participate in the national science and technology discourse to the benefit of society; (iii) promote science communication that enhances science engagement in South Africa; and (iv) profile South African science and scientific achievements domestically and internationally (DST, 2015: 20).

SCIENCE ENGAGEMENT STRATEGY IMPLEMENTATION PLAN (2017)

- Projects and activities will build a society that is scientifically literate and knowledgeable about science and engages critically with science issues.
- The implementation plan requires four enablers for success: (i) an enabling legislative environment, (ii) enhanced access to science engagement infrastructure, (iii) enhanced capacity at the South African Agency for Science and Technology Advancement and (iv) a grant management system and a stable funding model for continued science engagement activities across the National System of Innovation (DST, 2017).

SCIENCE ENGAGEMENT MONITORING AND EVALUATION FRAMEWORK (2019)

- The Monitoring and Evaluation Framework (MEF) outlines performance indicators to establish whether the science engagement programme is realising its intentions.
- Baseline values will be recorded for specific indicators with items measured previously.
- The MEF will inform the development of the Science Engagement Information Management System (DST, 2019a).

WHITE PAPER ON SCIENCE, TECHNOLOGY AND INNOVATION (2019)

- Advocates for a "science-literate and science aware society" (DST, 2019b: 56), articulates a renewed focus on building science-society linkages through effective communication, capability building, adequate funding and citizen engagement.
- Recommends the establishment of a "set of indicators to measure the success of system-wide science engagement", which will inform "an institutionalised survey on public perceptions of science and country comparison studies" (DST, 2019b: 57)

To assess the progress towards achieving the desired science literate and aware society, the DSI, firstly, established a set of indicators to measure system-wide science engagement performance and, secondly, adopted the set of indicators to inform the institutionalised survey with the South African adult public to measure and monitor science knowledge, attitudes and engagement. This survey will be conducted every five years (see DSI, 2023 for details).

Table 1 presents the Science Engagement Monitoring and Evaluation Impact Indicator Framework (SEMEIIF) around the five identified impact themes: scientific literacy; knowledge of general and specific science areas; confidence in science and science institutions; attitudes to and perceptions of science; and science engagement behaviours. For each of the impact themes, we identified a set of impact measures. These latent measures were then associated with a set of observable and behavioural measures (DSI, 2021).

TABLE 1: SEMEIIF impact themes, measures and operational definitions

IMPACT THEMES	IMPACT MEASURES (LATENT)	OBSERVABLE AND BEHAVIOURAL MEASURES
1 CITIZENS' SCIENTIFIC LITERACY	1.1 Interest in selected scientific domains	Interest in scientific areas of importance in South Africa
	1.2 Informedness of selected scientific domains	Knowledge of scientific areas of importance in South Africa
	1.3 Interest in new scientific discoveries	Interest in South African S&T
	1.4 Recognition of different knowledge forms	Knowledge of, interest in, and views of traditional knowledge
	1.5 Sources of scientific information	Amount of S&T news received and sources of news
2 CITIZENS' KNOWLEDGE OF GENERAL AND SPECIFIC SCIENCE AREAS	2.1 Awareness of South African S& T discoveries	Knowledge of South African S&T and rating against other countries
	2.2 Awareness and informedness regarding natural phenomena	Knowledge of and concerns about natural and environmental events
	2.3 Science Knowledge Index	General science knowledge quiz
	2.4 Aspirations of youth to STEM studies and careers	Participation in school and post-school science subjects and interest in science careers
	2.5 Awareness and informedness of S&T	Knowledge of scientific areas of importance in South Africa
3 CITIZENS' CONFIDENCE IN SCIENCE & SCIENCE INSTITUTIONS	3.1 Trust in science	Views about the work of scientists
	3.2 Trust in media's science reporting	Views of S&T news reported in traditional and social media
	3.3 Trust in science institutions	Views about S&T information from various institutional sources
	3.4 Perceptions of transformation at science institutions	Views about changes in science organisations (race and sex, who sets the research agendas, traditional knowledge and knowledge production)
	3.5 Trust in government's evidence-based decision-making approach	Views on how government uses information and consults when making decisions
4 CITIZENS' ATTITUDES TO & PERCEPTIONS OF SCIENCE	4.1 Attitudes regarding the promise of science	Potential benefits of science
	4.2 Attitudes regarding reservation of science	Concerns about science
	4.3 Perceptions of the value of science to daily life	Use of science in home, social and civic life
	4.4 Public support of science	Pride in South African S&T
	4.5 Attitudes to past government and business S&T investments	Views about government and big business spending on S&T
	4.6 Attitudes to future government S&T investments	Rating future science priorities
	4.7 Personal interest in S&T engagement	Interest in attending S&T events or activities
5 CITIZENS' SCIENCE ENGAGEMENT BEHAVIOUR	5.1 Attendance at, or involvement in, public engagement activities	Participation in science engagement activities
	5.2 Adoption of technologies in personal, work and civic spaces	Use of technologies in different spaces, i.e. technology penetration
	5.3 Individual behaviour change	Displaying behaviours such as recycling, raising awareness and S&T activism
	5.4 Behaviours related to STEM information sharing	Practices that mediate STEM information acquisition and knowledge sharing

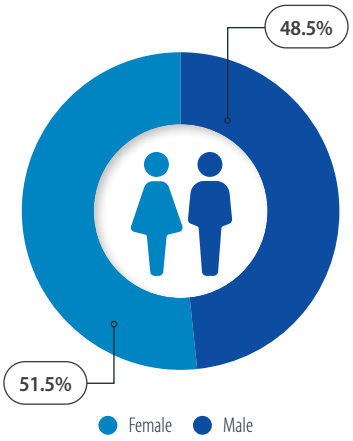
Source: DSI (2021)

The South African socio-demographic context

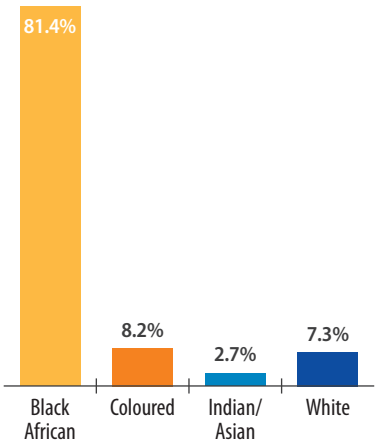
Science knowledge, attitudes and engagements are shaped by the socio-demographic characteristics and the context in which people live. The enduring legacy of the apartheid system of racial segregation, coupled with the ongoing contemporary structural challenges such as poverty, inequality and unemployment shape the life experiences of the South African population. There is diversity in terms of sex, population group, age, educational

Sex, population group and age

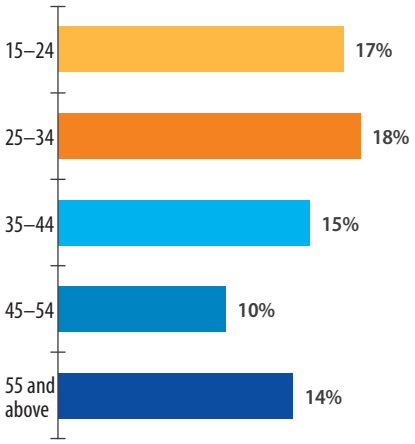
Sex



Population group



Age

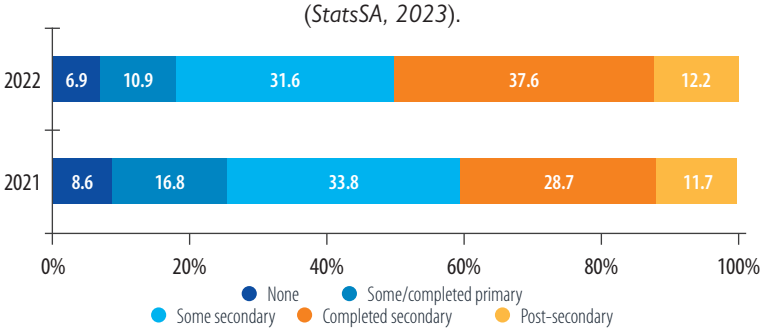


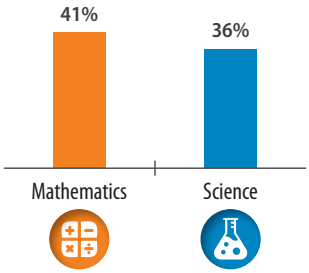
(*StatsSA, 2023a*)

Educational attainment

Educational attainment of population aged 20 years and older

In 2022 half the population had completed secondary education, compared to 40% in 2011. However, between 2011 and 2022 those with post-secondary education had increased by only 0.5 percentage points (*StatsSA, 2023*).

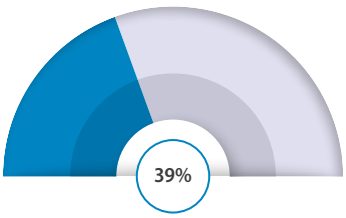




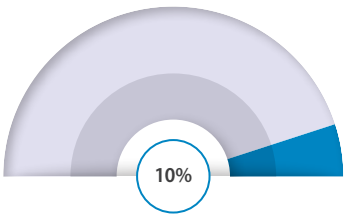
In addition, the quality and outcomes of schooling, especially for mathematics and science continue to be low and unequal. In TIMSS 2019, close to 4 in 10 learners had acquired basic knowledge in mathematics and science.

Socio-economic status and income inequality

South Africa's diverse public is characterised by identifiable differences based on education, employment, and income. These stratifications are the result of large inequalities between the country's rich and poor.



39% of the population can be classified as poor, with a monthly expenditure of less than R2 500 a month (*StatsSA, 2023b*).



At the other end of the spectrum, 10% of South Africans own 90% of the wealth in the country (*SAHRC, 2019*).

Employment status

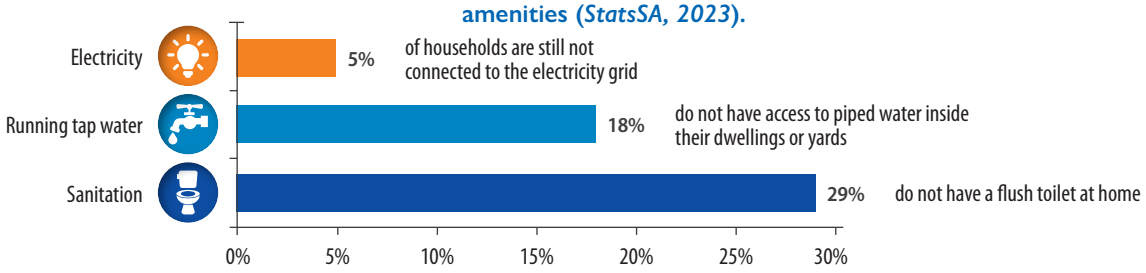
In 2022, the official unemployment rate was **33%**

Of those aged 15–24 years were not in employment, education or training. **35%**

attainment, SES, employment status, language spoken at home, the spatial location of where one lives, religiosity and access to the digital world. The infographic below describes the social and demographic characteristics of the South African population.The term *public* is used throughout the report. We recognise that there are multiple *publics* in South Africa based on the diversity of the society. Thus, the term public encompasses both the singular and multiple publics.

Access to basic services

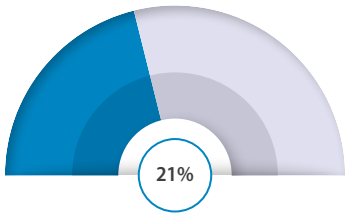
Although there is improved access to basic services, there are households that still lack access to these amenities (*StatsSA, 2023*).



Digital divide

Only 13.3% of households had an internet connection (excluding through mobile phones) (*StatsSA, 2023a*).

Internet access was higher in metropolitan areas (*StatsSA, 2023b*).



21.1% of the population had no access to any internet services (*StatsSA, 2023a*).

There are approximately

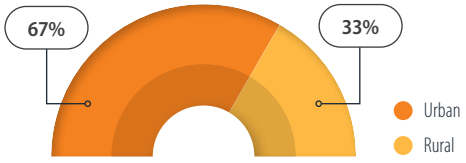
30.7 million Facebook users

4.3 million Twitter/ X users

7.2 million Instagram users

in South Africa (*Statista, 2023*).

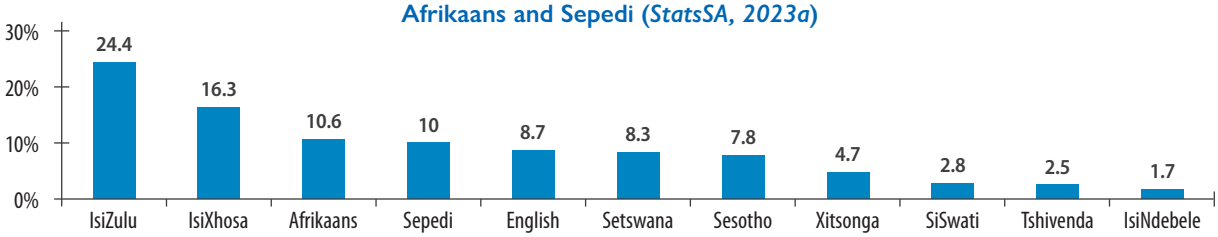
Urban versus rural population



The provinces with much higher urban populations in 2022 were Free State, Gauteng, Northern Cape and Western Cape; while Eastern Cape and Limpopo had higher rural populations. KwaZulu-Natal, Mpumalanga and North West had a more even distribution of the population between urban and rural areas (*DWS, 2023*).

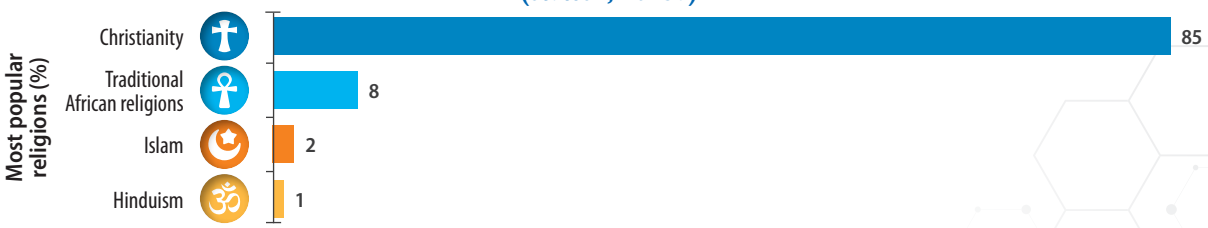
Languages spoken at home

The most commonly spoken language was isiZulu, followed by isiXhosa, Afrikaans and Sepedi (*StatsSA, 2023a*)



Religion

Smaller proportions of the population follow Judaism, while there are some who are atheist or agnostic (*StatsSA, 2023a*)



Conceptual model to understand the public relationship with science

The above theoretical, policy and socio-demographic context provides the background to inform South Africa's first comprehensive Public Relationship with Science survey. The HSRC is responsible for conducting the SAPRS survey.

The results from the SAPRS 2022 will, firstly, present the measures for the set of indicators that inform the nature and texture of the publics' relationship with S&T. These results establish a set of national baseline measures that will be tracked every five years. Secondly, the results will identify the characteristics of individuals that shape public attitudes to S&T, as well as science engagements to inform public policy.

We identified the following high-level research questions to guide the study:

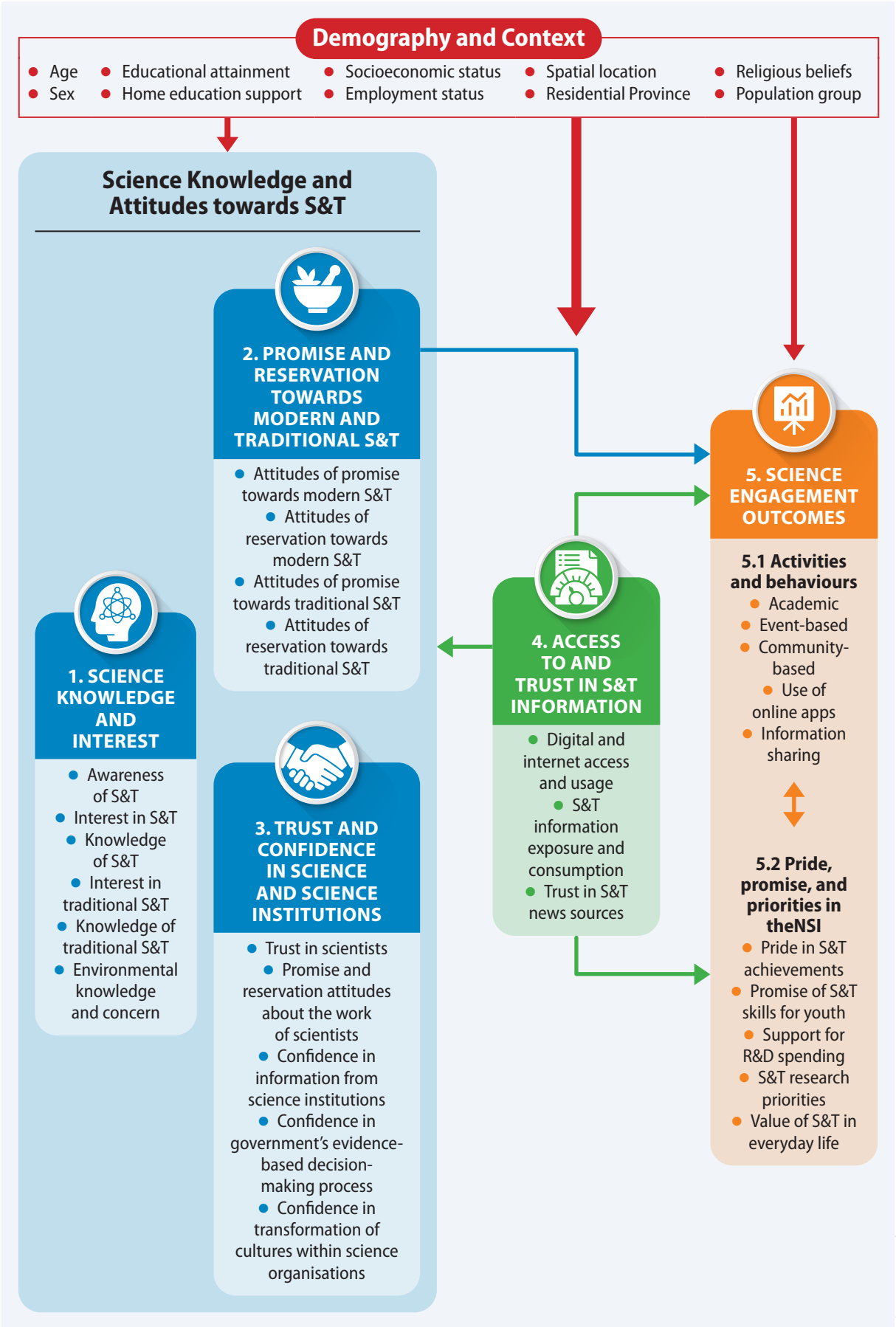
1. What are the levels of science knowledge, promise, reservation and trust attitudes towards S&T, access to and trust in S&T information, and science engagement outcomes in South Africa?
2. What are the characteristics of those who are more and less likely to have higher science knowledge, more positive attitudes towards S&T, higher access to S&T information, higher participation in science engagement activities, and more positive science engagement behaviours and views?
3. What is the relationship between the science attitudes and engagement measures themselves, namely how do S&T knowledge and interest, attitudes towards S&T, and access to S&T information influence science attitudes and engagement outcomes?

Based on the extant literature, we postulated the following relationships:

1. Socio-demographic characteristics of South Africans shape their knowledge of, and interest in S&T, attitudes of promise and reservation towards modern and traditional S&T, trust in science and science institutions, access and trust in scientific information as well as the science engagement outcomes of actions, behaviours and views.
2. Science knowledge of and interest in S&T shape the promise and reservation attitudes towards S&T as well as trust attitudes in science and science institutions.
3. Access to and trust in scientific information shape S&T knowledge and interest, attitudes of promise, reservation and as well as trust attitudes.
4. Science knowledge of and interest in S&T, promise and reservation attitudes, as well as access to and trust in S&T information shape the science engagement outcomes.

In Figure 4, we represent the conceptual model in a schematic form, showing the hypothesised relationships among the impact themes and measures. Testing these associations will be a notable objective throughout the analytical chapters in this report.

FIGURE 4: The model for the South African public relationship with science, with hypothesised relationships among the measures



CHAPTER 2
Methodology to Conduct the Survey

The South African Public Relationship with Science (SAPRS) was investigated through a dedicated survey instrument included in Round 19 of the South African Social Attitudes Survey (SASAS) in late 2022. SASAS is an annual household survey conducted by the Human Sciences Research Council (HSRC) and is administered to a nationally representative sample of adults, aged 16 years or older. This chapter outlines the objectives for the study, the instrument development, the survey sample, as well as how we conducted the survey and analysed the data, to provide credible measures of the SAPRS.

The objectives of the survey were as follows:

1. To produce nationally representative measures of science and technology (S&T) knowledge and interest, promise and reservation attitudes towards modern and traditional S&T, and trust and confidence in science and science institutions;
2. To identify the personal characteristics of adults (age, socioeconomic status [SES], sex, population group, years of education attained, home education support, employment status, home spatial location, religiosity) who were more and less likely to have higher levels of science knowledge and positive attitudes towards S&T;
3. To measure access to and trust in scientific information and identify the characteristics of adults who were more and less likely to have higher access to and trust in, S&T information;
4. To assess levels of participation in activities and behaviours related to five types of S&T engagements (academic, event-based, community-based, daily-life online and sharing information) and to identify the characteristics of adults who were more and less likely to have higher levels of engagement;
5. To measure the public views of pride and promise in the National System of Innovation,
6. To assess changes in South Africans' science knowledge and promise and reservation attitudes over time;
7. To compare, where possible, South African science knowledge and attitudes with select other countries; and
8. To measure the public relationship with S&T in two special supplementary samples:[2]
   - 8.1 Four main towns in the Square Kilometre Array (SKA) footprint area in the Northern Cape (Carnarvon, Brandvlei, Vanwyksvlei and Williston); and
   - 8.2 The town of Cofimvaba and environs in the Chris Hani Municipality District in the Eastern Cape, which houses the Albertina Nontsikelelo Sisulu Science Centre (ANSSC).

2 The results from the two supplementary samples will appear in a separate report.

The instrument

The Science Engagement Monitoring and Evaluation Impact Indicator Framework (SEMEIIF) (DSI, 2021) and the South African Public Relationship with Science Survey Framework (DSI, 2023) informed the development of the SAPRS survey instrument.

The SEMEIIF identified five impact themes: (1) scientific literacy; (2) knowledge of general and specific science areas; (3) confidence in science and science institutions; (4) attitudes to and perceptions of science; (and 5) science engagement behaviours. Based on these themes, we constructed a survey instrument to collect social data to measure the public relationship with S&T.[3]

The final SAPRS instrument consisted of 200 items related to the public relationship with science (including five SKA items fielded only in the Northen Cape), and 28 demographic and contextual items.

The intended and realised sample

The SAPRS survey was designed to yield a representative sample of adult South African citizens aged 16 and older (with no upper age limit), in households geographically spread across the country's nine provinces. The SAPRS survey was administered to a targeted 7 000 randomly selected individuals aged 16 years and older living in private residence countrywide. The target population was comprised of people living in private households (this included apartments, free-standing houses, hostels and other structures). People living in special institutions, such as hospitals and prisons, were excluded from the sample.

The sampling frame used for the survey was based on the 2011 census and a set of Small Area Layers (SALs). Thus, the first stage of the sampling process was the selection of 500 SALs, which are the primary sampling units for the survey. Three stratification variables were used to draw the SALs, namely province, geographic type and majority population group. SALs were drawn with probability proportional to size, using the estimated number of dwelling units in a SAL as a measure of size. The distribution of the SALs in South Africa is represented in Figure 5.

The second stage of the sampling process was a random selection of 13 visiting points from each SAL. A visiting point was defined as a separate (non-vacant) residential stand, address, structure, flat, homestead, etc. The third stage was the random selection of one person from each visiting point[4] who was aged 16 years and older and resided in the household at least 15 days in the month prior to surveying. The realised sample was 6 400 respondents, resulting in a 91.4% response rate, and the intended and realised samples are presented in Table 2.

3 For details of the process, see pages 10 to 18 of the SAPRS Survey Framework (DSI, 2023).
4 For details of the process, see pages 19 and 20 of the SAPRS Survey Framework (DSI, 2023).

FIGURE 5: Graphical representation of the 500 sampled Small Area Layers

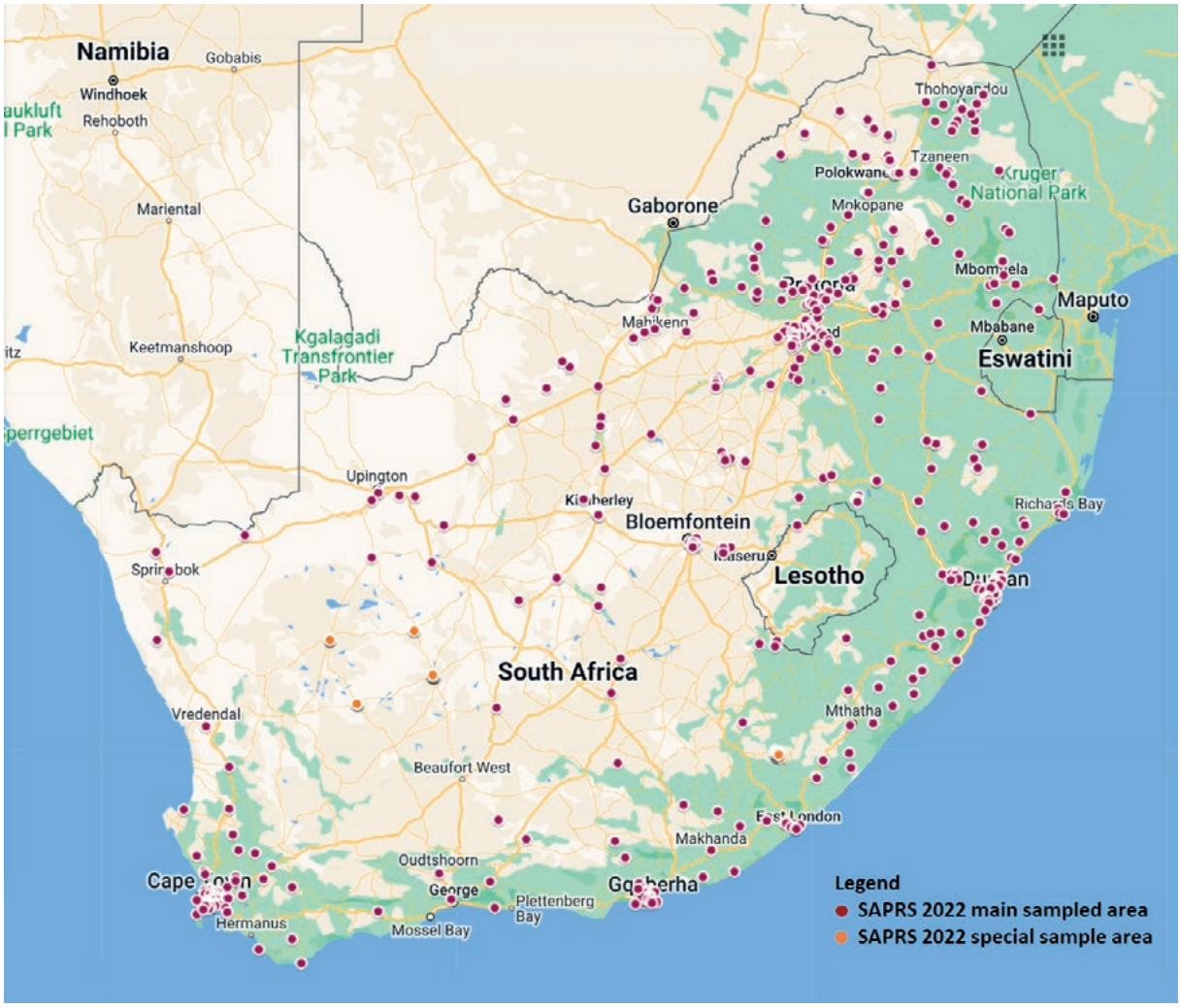


TABLE 2: Number of Small Area Layers, intended and actual respondents by province

PROVINCE	SMALL AREA LAYERS	INTENDED SAMPLE	ACTUAL SAMPLE	PERCENTAGE REALISED
Eastern Cape	65	845	701	83
Free State	38	494	485	98
Gauteng	83	1 079	862	80
KwaZulu-Natal	93	1 209	1 099	91
Limpopo	44	572	757[5]	132
Mpumalanga	38	494	505	102
North West	37	481	384	80
Northern Cape	37	481	373	78
Western Cape	65	845	792	94
TOTAL (excluding special samples)	**500**	**6 500**	**5 960**	**92**
Cofimvaba special sample (EC)	…	250	233	93
SKA footprint area special sample (NC)	…	250	249	99
TOTAL (including special samples)	**…**	**7 000**	**6 442**	**92**

5 This was due to the accidental oversampling of urban respondents in Limpopo. Subsequently, we addressed this through additional surveying of rural adults in the province – hence the higher sample size.

Apart from the 6 500 respondents (500 SALs times 13 randomly selected respondents) that were targeted through the approach described above, 250 interviews were targeted in each of the two special subsamples that were additionally included in the study, namely the SKA footprint area (Northern Cape) and the Cofimvaba locality (Eastern Cape). Within each geographic area, the SALs, visiting points and respondents were all randomly selected in the general manner as the national sample. Since the two special samples were purposively selected, they were not integrated and analysed as part of the main sample, but rather analysed separately. The pattern of findings in the subsamples can be compared to the provincial averages on key measures in order to determine points of similarity and variation.

The fieldwork

The SAPRS survey was one of the instruments included in the SASAS series for 2022. Fieldwork companies with strong provincial surveying expertise were appointed, and fieldworkers were trained to conduct the household survey. The training focused on understanding the questionnaire as well as the selection and sampling of households, fieldwork operating procedures, research protocol and ethical considerations. Fieldworkers and supervisors were required to notify the relevant local authorities when they were working in the specific area. Verbal and written consent was secured from respondents before interviews commenced. SASAS collected data electronically through the use of hand-held devices, known as tablets. The face-to-face interviews were captured directly on the devices and transmitted to the central and secure platform or server.[6]

Data verification, cleaning and weighting

The final dataset was subjected to a data verification and cleaning process. The data was checked and edited for logical consistency, for permitted ranges, for reliability on derived variables and for filter instructions. Using the cleaned dataset, the HSRC statistician benchmarked and weighted the data to reflect the population distribution of the country.[7] The weighting reflected the relative selection probabilities of the individual at the three main stages of selection. The characteristics of the final dataset (unweighted and weighted) are presented in Table 3.

6 For more information on the fieldwork, see pages 21 and 22 of the SAPRS Survey Framework (DSI 2023).

7 See DSI (2023); pages 21 to 23 for details.

TABLE 3: Survey sample characteristics (unweighted and weighted)

	UNWEIGHTED N	PERCENT	WEIGHTED N	PERCENT
South Africa	5 960	100.0	42 486 208	100.0
Sex				
Male	2 811	47.4	20 456 131	48.2
Female	3 125	52.6	22 030 053	51.9
Age				
16–24	1 408	23.6	8 674 633	20.4
25–34	1 445	24.2	10 799 895	25.4
35–44	1 212	20.3	9 163 294	21.6
45–54	823	13.8	5 989 003	14.1
55+	1 072	18.0	7 859 383	18.5
Population group				
Black African	3 812	64.6	33 530 379	78.9
Coloured	1 050	17.8	3 841 876	9.0
Indian/Asian	545	9.2	1 242 454	2.9
White	492	8.3	3 871 439	9.1
Education level				
Primary or no formal schooling	918	15.6	6 149 153	14.6
Incomplete secondary	1 669	28.4	11 232 048	26.7
Matric or equivalent	2 395	40.7	17 991 095	42.7
Tertiary certificate/diploma	517	8.8	4 157 540	9.9
Advanced diploma/bachelors or higher	386	6.6	2 563 197	6.1
Employment status				
Employed	2 064	34.8	14 536 812	34.2
Unemployed	1 655	27.9	12 168 989	28.6
Student/learner	806	13.6	5 366 849	12.6
Other labour inactive	1 414	23.8	10 413 538	24.?
Socioeconomic status (SES)				
Poorest SES quintile	1 128	18.9	8 156 966	19.2
Second SES quintile	1 237	20.8	10 252 844	24.1
Middle SES quintile	1 073	18.0	8 122 400	19.1
Fourth SES quintile	1 264	21.2	8 250 717	19.4
Richest SES quintile	1 258	21.1	7 703 282	18.1
Geographic type				
Urban formal	4 323	72.5	27 525 691	64.8
Urban informal	245	4.1	2 406 718	5.7
Rural	1 392	23.4	12 553 799	29.6
Province				
Western Cape	792	13.3	5 362 191	12.6
Eastern Cape	701	11.8	4 352 954	10.3
Northern Cape	373	6.3	905 536	2.1
Free State	485	8.1	2 044 829	4.8
KwaZulu-Natal	1 099	18.4	7 719 479	18.2
Northwest	384	6.4	2 913 056	6.9
Gauteng	864	14.5	12 071 861	28.4
Mpumalanga	505	8.5	3 300 781	7.8
Limpopo	757	12.7	3 815 521	9.0
Religiosity				
Low religiosity	1 622	27.4	11 781 409	27.8
Medium religiosity	2 208	37.4	16 362 126	38.7
High religiosity	2 082	35.2	14 178 419	33.5
Home education support				
Very low home education support	406	6.9	2 760 482	6.5
Low home education support	852	14.4	6 081 684	14.4
Medium home education support	1 442	24.3	10 282 434	24.3
High home education support	1 725	29.1	12 734 527	30.1
Very high home education support	1 500	25.3	10 495 630	24.8

Note: In addition, special samples were included in the survey where data was collected in Cofimvaba, Eastern Cape (N=233) and the SKA, Northern Cape (N=249). Details on how these variables are measured are provided in Appendix 1: Readers' Guide.

Interpretation of results

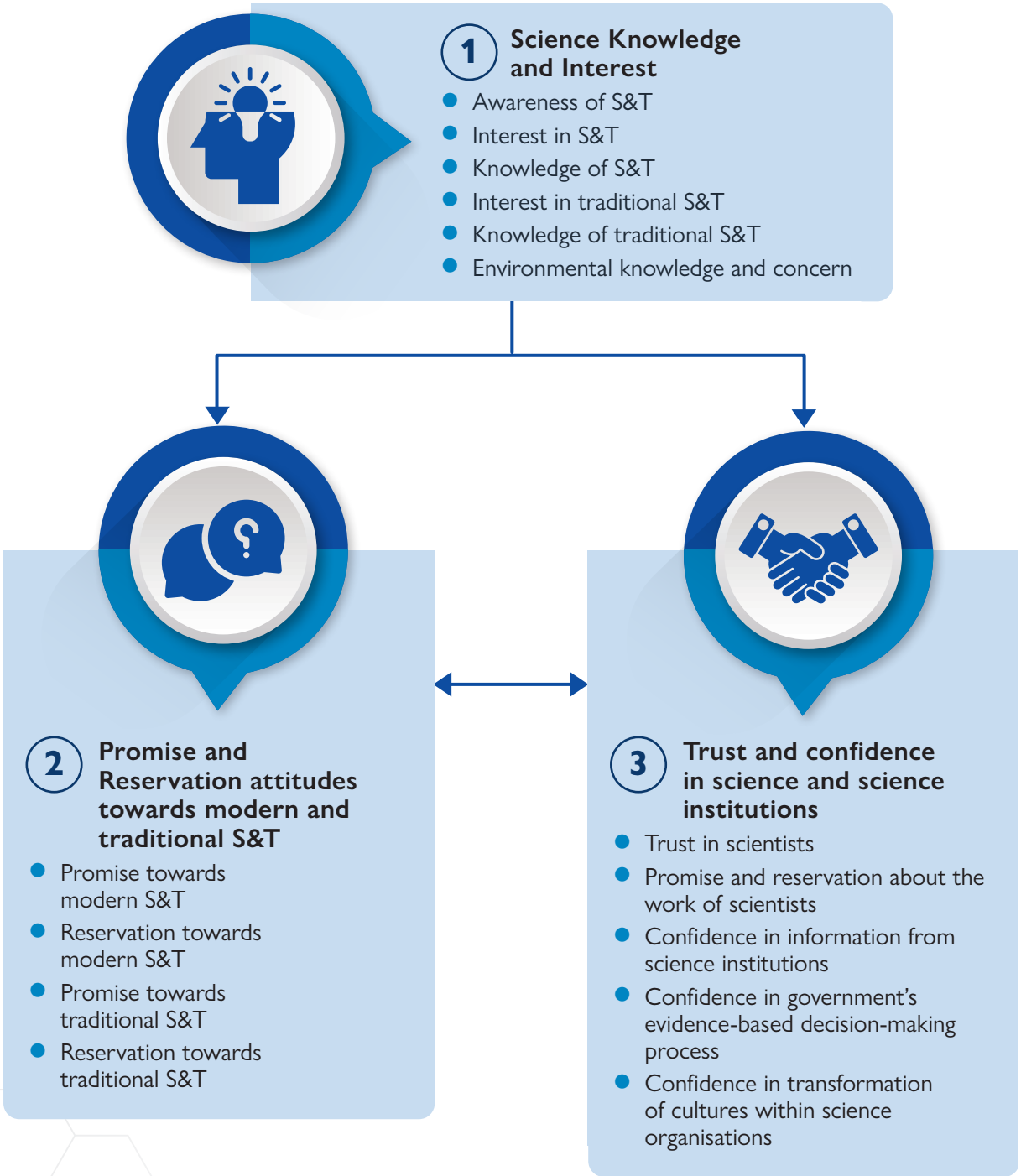
The data presented in the rest of the report comprises weighted estimates, reflective of the South African national population aged 16 years and older. When analysing the differences in the results, and specifically for the bivariate analysis, only statistically significant results are reported. These differences are identified at the 95% confidence level and account for variations in the sample size.

Rounding decimals

Results are typically presented as whole numbers. When rounding to the nearest whole numbers, the totals may be slightly higher or lower than 100%.

SECTION B

Science and Technology Knowledge and Attitudes



CHAPTER 3

Interest in, and Knowledge of, Science and Technology and the Environment

Existing empirical evidence from different contexts around the world indicates that interest in, and knowledge of, science and technology (S&T) are two indicators that provide an insight into the nature of the relationship between the public and science, and further influence the extent of science engagement (Bastos et al., 2019; Losi, 2023). By *interest* we mean wanting to know or learn about something, *knowledge* refers to the information one possesses, while *awareness* indicates being informed about something, though not necessarily understanding it.

This chapter reports on the levels of S&T awareness, interest and knowledge among the public in South Africa; and the characteristics of adults who are more and less likely to positively engage with it. More specifically, we report on:

- Awareness of, and interest in, S&T achievements in contrast to creative arts achievements, as well as the characteristics of those who were more and less likely to be interested in South African S&T;
- Science knowledge and the characteristics of the public associated with higher science knowledge, as well as the changes in levels of science knowledge over time and comparisons with other countries;
- Interest in, and knowledge of, the priority science areas in the country, and the characteristics of the public who were more and less likely to be interested in and knowledgeable of these areas; and
- Knowledge of and concern about natural and environmental events, and the characteristics of those who were more and less likely to have higher knowledge of and concern about these events.

Existing empirical evidence from different contexts around the world indicates that interest in, and knowledge of, science and technology (S&T) are two indicators that provide an insight into the nature of the relationship between the public and science, and further influence the extent of science engagement (Bastos et al., 2019; Losi, 2023).

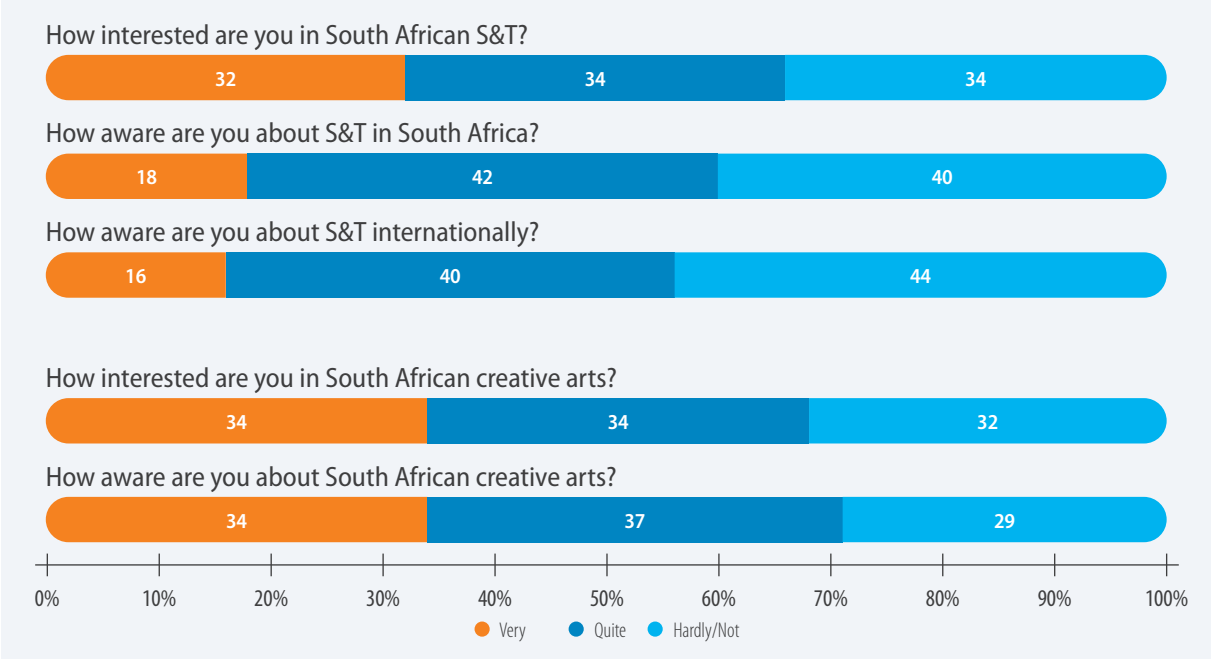
Awareness of, and interest in, S&T and creative arts achievements

The sciences and the creative arts represent different forms of knowledge. Science is the study of the natural and social world through observation and experimentation, while the arts (e.g. music, dance, painting etc.) is the expression and application of creative skills and imagination. The extent of public awareness and support of S&T developments could contribute to increased recognition of this domain.

Figure 6 reports the awareness of, and interest in, S&T as well as creative arts achievements. Close to three-fifths of the public reported that they were "very" or "quite" aware of S&T developments both internationally (56%) and domestically (60%). However, this means that close to 40% of the public were less aware of S&T developments. On the other hand, there was a higher awareness of South African creative arts, with 71%, of the public being "very" or "quite" aware of achievements in these areas.

There was higher interest in S&T developments than there was awareness. Two-thirds of the public reported that they were "very" or "quite" interested in South African S&T (66%) and creative arts (68%) achievements, while one-third were less interested.

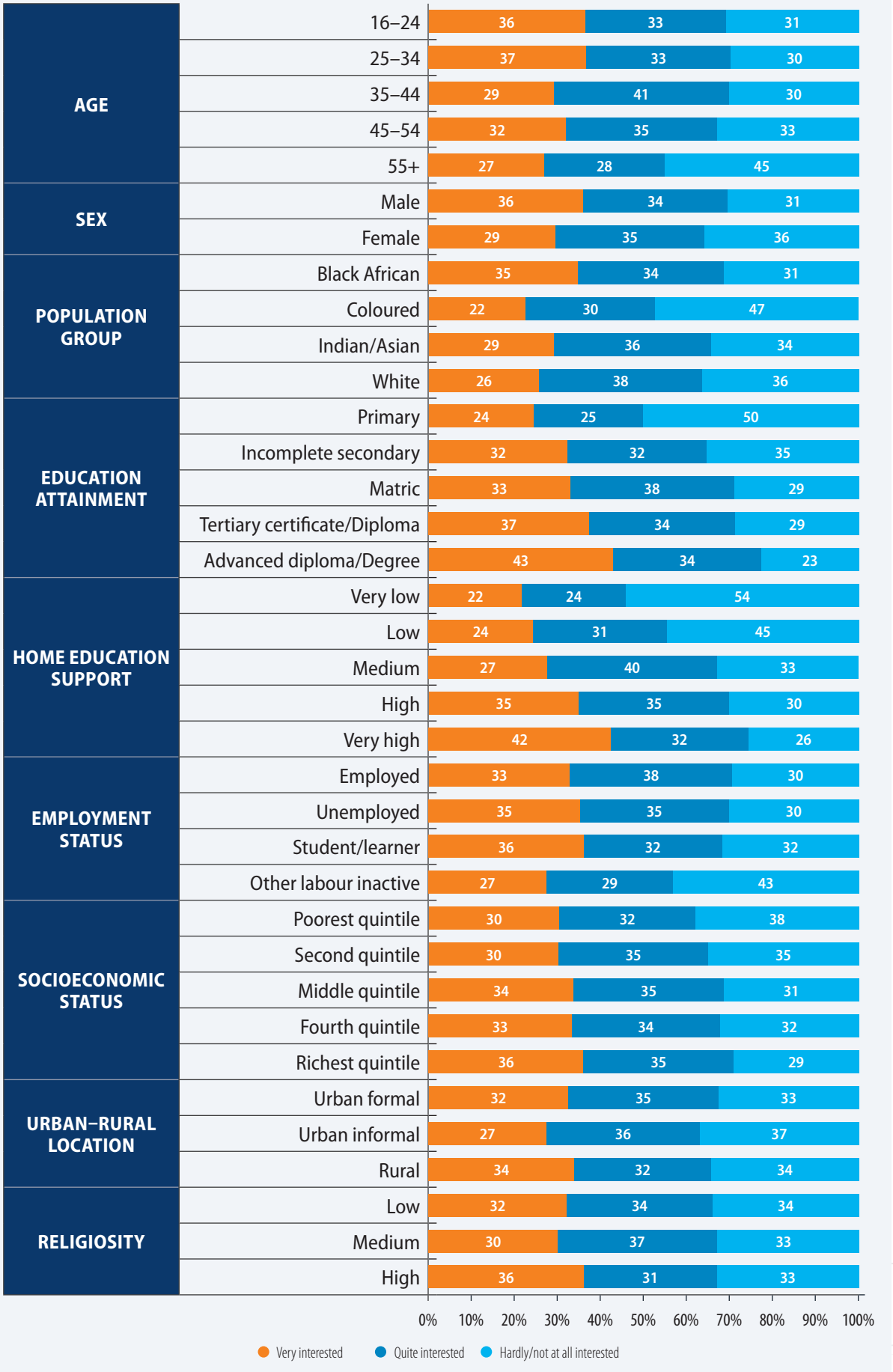
FIGURE 6: Awareness of, and interest in, achievements in S&T and the creative arts



Who was more and less likely to be interested in South African S&T?

To answer the above question, we first present the differences in interest in South African S&T by socio-demographic characteristics. The share that indicated they were very interested ranged from a low of 22% to a high of 43% across all the observed sub-groups. The highest levels of interest were found among those with an advanced diploma or degree or tertiary certificate/diploma, those who experienced very high home education support, those aged 16 to 34 years, males, Black African adults, as well as those in the richest SES quintile and persons reporting high religiosity. Those with the lowest reported levels of interest in S&T were those with very low or low home education support, those with a primary school or no formal education, the labour inactive, as well as Coloured adults, and those aged 55 years and older.

FIGURE 7: Patterns of interest in South African S&T developments by select characteristics (percentage)



The South African Public Relationship with Science (SAPRS) survey included several items to measure the level of science knowledge among the public.

To test whether the group differences in interest presented in Figure 7 were significant, One-way ANOVA tests were first conducted. For this, the responses to the question were reversed, with don't know responses removed, and the scaling transformed into a 0–100 scale for ease of interpretation. Higher scores represent a greater degree of interest in South African S&T. Significant differences in the average level of interest were found based on all characteristics apart from religiosity and rural-urban location. In Table 4, a summary of significant sub-group differences in the average levels of interest is presented.

TABLE 4: Who was more and less likely to be interested in South African S&T?

SIGNIFICANTLY HIGHER INTEREST	SIGNIFICANTLY LOWER INTEREST	F	SIG.	RANGE
16–24, 25–34, 35–44, 45–54	55+	25.9	***	54–66
Male	Female	41.8	***	60–65
Black African, Indian/ Asian and White adults	Coloured adults	21.4	***	52–64
Advanced diploma/ degree, tertiary certificate/diploma, matric, incomplete secondary	Primary or less schooling	43.4	***	50–71
Employed, students/ learners, unemployed	Other labour inactive	27.3	***	55–65
Very high or high home education support	Very low or low home education support	60.3	***	45–69
Richest SES quintile	Poorest, second poorest SES quintiles	6.7	***	59–66

Note: The F-statistic is a measure used to determine whether the mean scores between groups are significantly different from one another. Higher F-statistic values suggest that there may be significant differences between group mean scores. Statistical significance is denoted as * $p<0.05$ (95% level), ** $p<0.01$ (99% level), *** $p<0.001$ (99.9% level). The range of values reflects the minimum and maximum index values on the index for the specific personal attribute from 0 to 100, where higher scores reflect greater interest in South African S&T.

Science knowledge

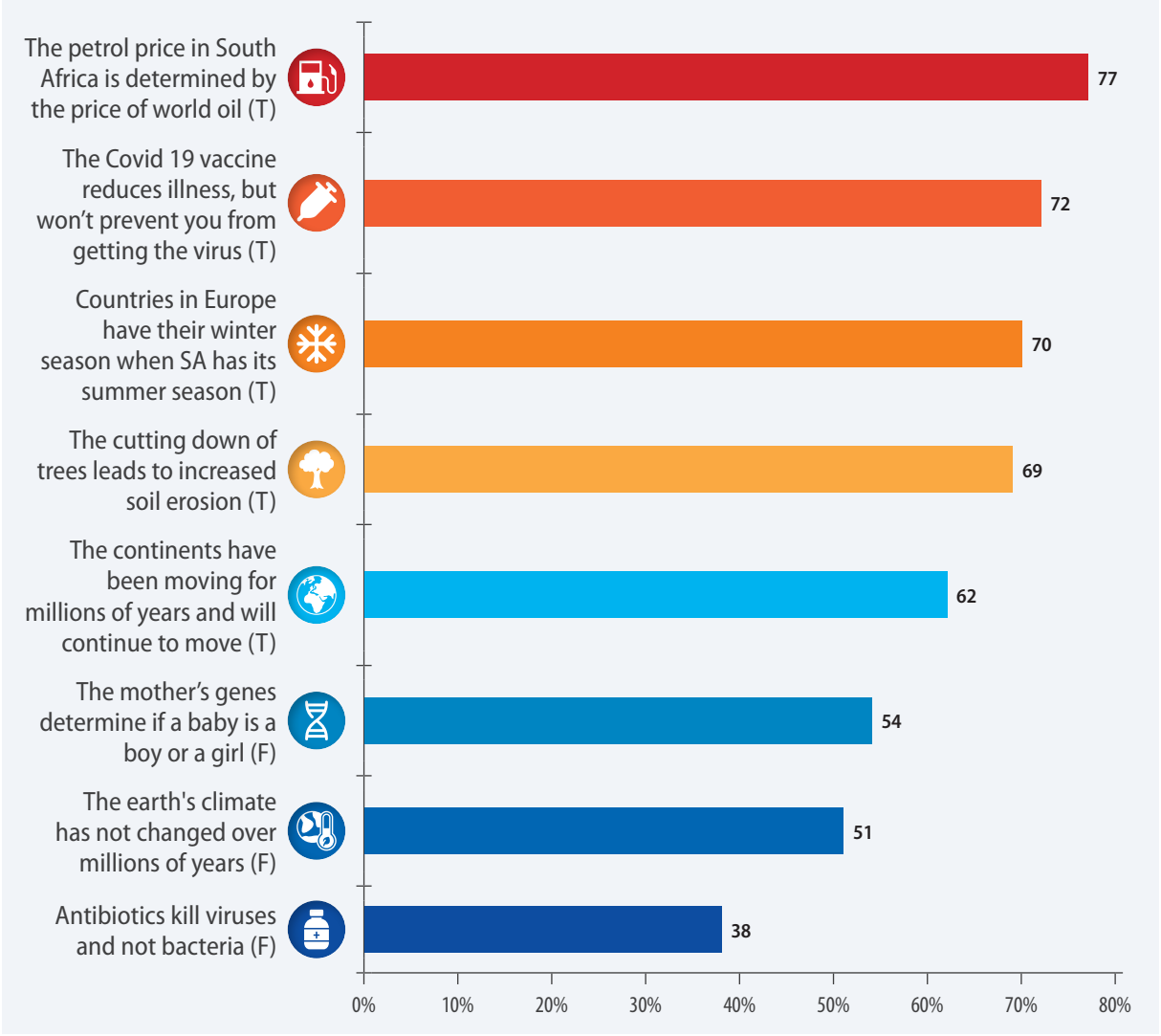
The South African Public Relationship with Science (SAPRS) survey included several items to measure the level of science knowledge among the public. To establish how well the public understood science facts and concepts, we administered a science knowledge quiz consisting of nine statements. Survey participants had to indicate whether each statement was "True" or "False" or whether they were uncertain of the answer. The statements related to basic scientific constructs needed to engage with contemporary debates in the public domain. Figure 8 presents the frequency of correct responses for each of the nine statements.

The frequency of correct responses to each of the items ranged from a low of 38% to a high of 77%. The average frequency of correct answers across the set of nine items was 60%. The fact that, on average, three-fifths of the public were able to correctly answer these questions – whether based on knowledge or educated guesses – would imply that this knowledge quiz was a relatively simple one overall.[8]

The true/false statements that received the lowest percentage of correct responses were the more cognitively demanding ones, such as "antibiotics kill viruses and not bacteria". The items with the highest level of correct responses were those that had dominated the news cycles ahead of the survey period, for example, the items about the COVID-19 vaccine and rising petrol prices. The relatively high share of the population that correctly answered these two items highlights how the public consumed information of direct relevance to their lives.

The results of the more cognitively demanding quiz items indicate that there remains a fair way yet to go in terms of raising the general level of science knowledge among the South African adult public.

FIGURE 8: Correct responses to True (T) and False (F) science knowledge items



8 More respondents correctly answered the statements that were true, suggesting a bias in the responses. For further discussion on selection bias see *Nadeau and Niemi (1995)*.

Who was more and less likely to achieve high science knowledge scores?

There is an extant literature identifying the characteristics of learners in the schooling system who achieve high science scores. Analysis using large scale achievement datasets such as the Trends in International Mathematics and Science Study (TIMSS) and the Programme for International Student Assessment (PISA) has been instructive in identifying the factors that promote higher science performance (for example see OECD, 2023a; Reddy et al., 2022).

We created a *science knowledge index* for each participant by adding the number of correct responses, ranging from a minimum of 0 to a maximum score of 9. We then defined four knowledge categories: very low knowledge, low knowledge, medium knowledge, and high knowledge. The distribution of this measure is presented in Table 5.

The mean science knowledge score was 5.5 out of 9. Only 13% of South African adults were categorised as having high science knowledge (answering all, or 8 out of the 9, questions correctly), 41% had moderate knowledge (6 or 7 items answered correctly), while 33% had low (4 or 5 items correct) and 14% very low (0 to 3 items correct) science knowledge.

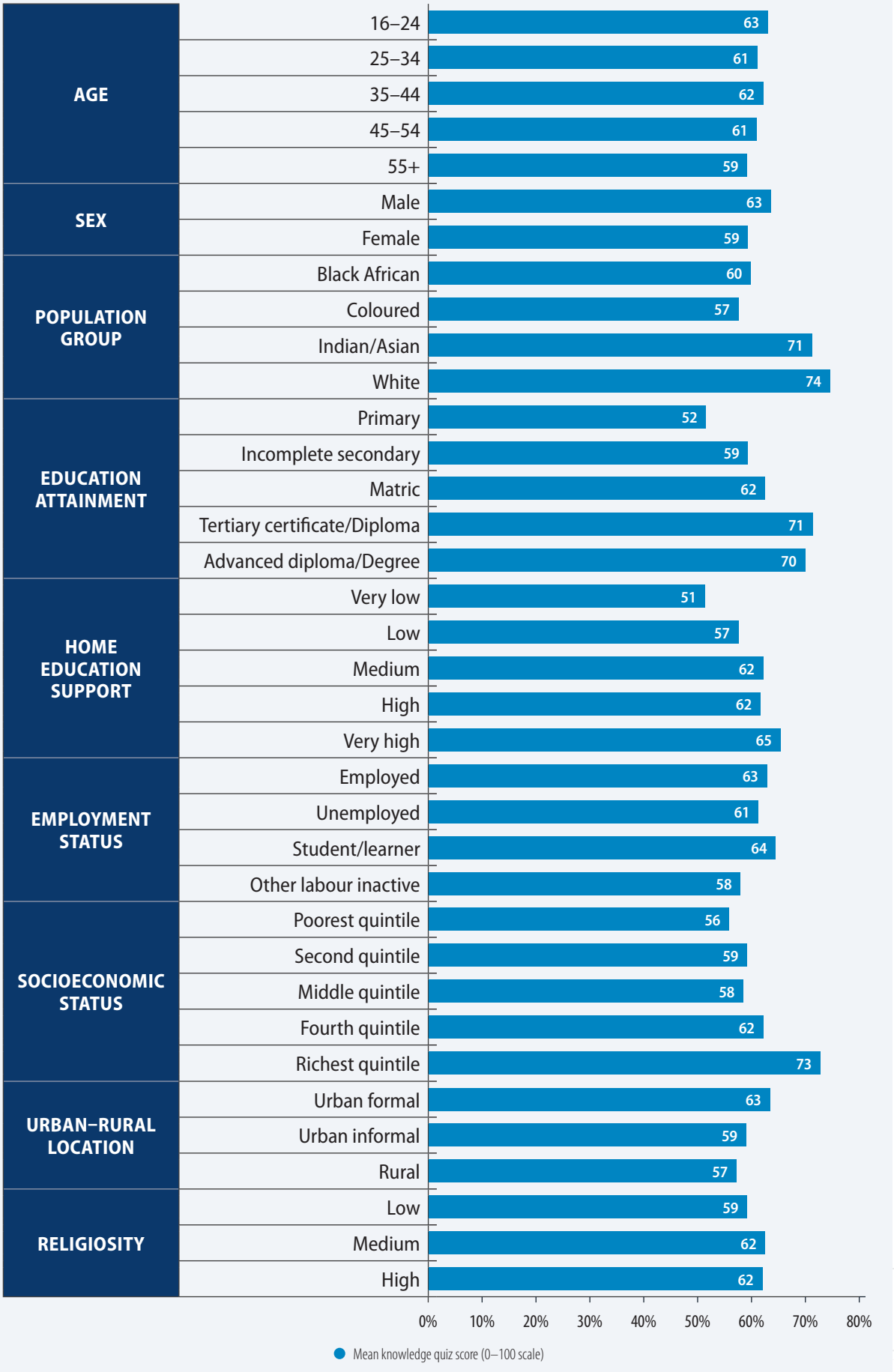
TABLE 5: Levels of science knowledge (row percentage)

VERY LOW KNOWLEDGE (0 TO 3 CORRECT)	LOW KNOWLEDGE (4 OR 5 CORRECT)	MEDIUM KNOWLEDGE (6 OR 7 CORRECT)	HIGH KNOWLEDGE (8 OR 9 CORRECT)	TOTAL	MEAN SCORE (0 TO 9 SCALE)
14	33	41	13	100	5.5

For ease of interpretation, the 0–9 science knowledge score was subsequently transformed into a 0–100 scale, with 0 representing no correct responses to the quiz and 100 representing that all nine quiz items were correctly answered. The mean index score on this transformed scale was 60 out of 100. The differences in the knowledge quiz scores are presented across different personal characteristics in Figure 9. The mean knowledge quiz scores across all the observed sub-groups ranged from a low of 51 to a high of 74, out of 100. This wide range reflects the diversity in South Africans' science knowledge and the role of socio-demographic characteristics in predicting knowledge levels.

The highest mean S&T quiz scores were found among White and Indian/Asian adults, those with an advanced diploma or degree or tertiary/diploma, those in the richest SES quintile, as well as those with very high home education support. The lowest quiz scores were evident among those with very low or low home education support, those with only a primary education, Coloured adults, those in the poorest SES quintile, as well as rural residents.

FIGURE 9: Patterns of functional science knowledge by select characteristics (percentages)



To test whether the group differences in S&T knowledge presented in Table 6 were significant, One-way ANOVA tests were first conducted using the 0–100 science quiz scale. Significant differences in the knowledge levels were found for all the characteristics examined. In, a summary of significant sub-group differences in the knowledge quiz score is presented.

TABLE 6: Who was more and less likely to perform well in the S&T knowledge quiz?

SIGNIFICANTLY HIGHER KNOWLEDGE	SIGNIFICANTLY LOWER KNOWLEDGE	F	SIG.	RANGE
16–24	55+	6.1	***	59–63
Male	Female	64.8	***	59–64
White and Indian/Asian adults	Black African and Coloured adults	107.5	***	57–74
Advanced diploma/degree, tertiary certificate/diploma	Primary or no formal schooling, incomplete secondary, matric	114.2	***	52–71
Students/learners, employed, unemployed	Other labour inactive	23.6	***	58–64
Very high, high, medium home education support	Very low or low home education support	46.6	***	51–65
Richest SES quintile	Poorest, second poorest SES quintiles	126.9	***	56–73
Urban formal	Urban informal, rural	59.1	***	57–63
High, medium religiosity	Low religiosity	15.0	***	59–62

Note: The F-statistic is a measure used to determine whether the mean scores between groups are significantly different from one another. Higher F-statistic values suggest that there may be significant differences between group mean scores. Statistical significance is denoted as * $p<0.05$ (95% level), ** $p<0.01$ (99% level), *** $p<0.001$ (99.9% level). The range of values reflects the minimum and maximum index values on the index for the specific personal attribute.

Changes in science knowledge

We now narrow our focus to report on certain knowledge quiz items administered in previous nationally representative South African surveys. Although the items may have been worded slightly differently, the comparisons still provide an opportunity for analysing trends over time.

Table 7 examines the change in the share of the population providing correct responses for two items fielded in both the IPSOS Khayabus Survey 2015 (Parker 2017) and the SAPRS 2022 Survey, to analyse the emerging trend between 2015 and 2022. In addition, we consider a further two items fielded in SASAS 2010 and the SAPRS 2022 survey to analyse the change between 2010 and 2022.

The change for the first two knowledge items, from 2015 to 2022, was an improvement of 9 and 7 percentage points, respectively. The correct responses to the two SASAS items improved by 0 and 5 percentage points between 2010 and 2022. We were unable to test for statistical significance between the IPSOS 2015 and SAPRS 2022 findings, as we do not have access to the IPSOS data to conduct the tests. However, considering sample sizes and margins of error on point estimates for both surveys, the scale of difference is likely to be statistically significant at the 95% ($p<0.05$) confidence level.

While the share of respondents correctly responding to the item about antibiotics has remained static at a relatively low level (38%), the observed increase in the share correctly responding to the earth rotation question in 2022 was statistically significant.

Considering the pattern of change for the four survey items presented in Table 7, the general trend appears to be one of modest improvement over time. The scale of improvement, considering survey margins of error, is notable but relatively slight in character.

TABLE 7: Trends in correct response to true (T) and false (F) science knowledge items (percentage)

IPSOS KHAYABUS SURVEY 2015	SAPRS 2022	2015	2022	CHANGE FROM 2015 TO 2022
The earth's climate has NOT changed over millions of years (F)	The earth's climate has not changed over millions of years (F)	42	51	+9 percentage points
The father carries the genetic material that will determine if a baby is a boy or a girl (T)	The mother's genes determine if a baby is a boy or a girl (F)	47	54	+7 percentage points
SASAS 2010	**SAPRS 2022**	**2010**	**2022**	
Antibiotics kill viruses as well as bacteria (F)	Antibiotics kill viruses and not bacteria (F)	38	38	0 percentage points
The sun rotates around the Earth (F)	The sun travels around the earth once a year (F)	42	47	+5 percentage points**

Note: (1) The SASAS 2010 and SAPRS 2022 data was pooled and both independent group t-test and logistic regression analyses were performed. (ii) ** $p<0.01$.

Science knowledge: Comparison with other countries

We also compared science knowledge across select countries using similar survey items, namely the United Kingdom (UK), United States of America (USA), Malaysia and China. The UK and USA represent the highly industrialised Western countries where the public relationship with science agenda emerged in the 1960s. In contrast, Malaysia is an emerging economy like South Africa, and has been conducting public awareness of S&T surveys since the 1990s. China has recently recognised the importance of bringing science to the public and now conducts surveys to measure science attitudes (Qui, 2020).

Table 8 presents the percentage of correct responses to a set of items fielded in South Africa in 2022 and in the select countries across various years. Methodologically, comparisons are difficult as the item may be phrased slightly differently, the sample or interview mode may be different in each of the countries, and the interpretations are likely to be dependent on the context and culture of each country. However, the data presented in the table does provides an indication of how South African S&T knowledge compares to that of other countries.

While the correct responses to the knowledge items in the USA and UK are higher than in other countries, there was no obvious pattern in the responses to items across these countries. It may be that international studies measuring school science achievement are better instruments to compare the science knowledge levels of different countries.

TABLE 8: Correct responses to items fielded in science knowledge quiz in select countries (percentage)

SCIENCE KNOWLEDGE ITEMS (AS IN SAPRS 2022)	SOUTH AFRICA (2022)	UK	MALAYSIA (2019)	UNITED STATES	CHINA (2015)
Antibiotics kill viruses and not bacteria (F)	40	55[9] (2021)	16	50 (2018)	24
The sun travels around the earth once a year (F)	47		71[10]	72[11] (2018)	
The mother's genes determine if a baby is a girl or a boy (F)	54	66[12] (2020)	40[13]	59[14] (2018)	49
The continents which we live on have been moving for millions of years and will continue to move (T)	62	82 (2021)	52	79 (2018)	51
The cutting down of trees leads to increased soil erosion (T)	69			60 (2019)	

Note: The footnotes in the table report how the items were phrased in other countries.
Sources: Chinese Association for Science and Technology (2015); (UK) Department for Business, Energy and Industrial Strategy (2020); European Commission (2021); (Malaysian) Ministry of Science, Technology and Innovation (2019); (US) National Science Board (2020); Pew Research Center (2019).

Interest in and knowledge of priority science areas

In addition to measuring general interest in and knowledge of S&T developments in South Africa, we explored the public interest in and knowledge of contemporary societal challenges that require an S&T response, as well as two cutting-edge science areas – advanced technologies involving the Fourth Industrial Revolution (4IR) and the study of space and the stars.

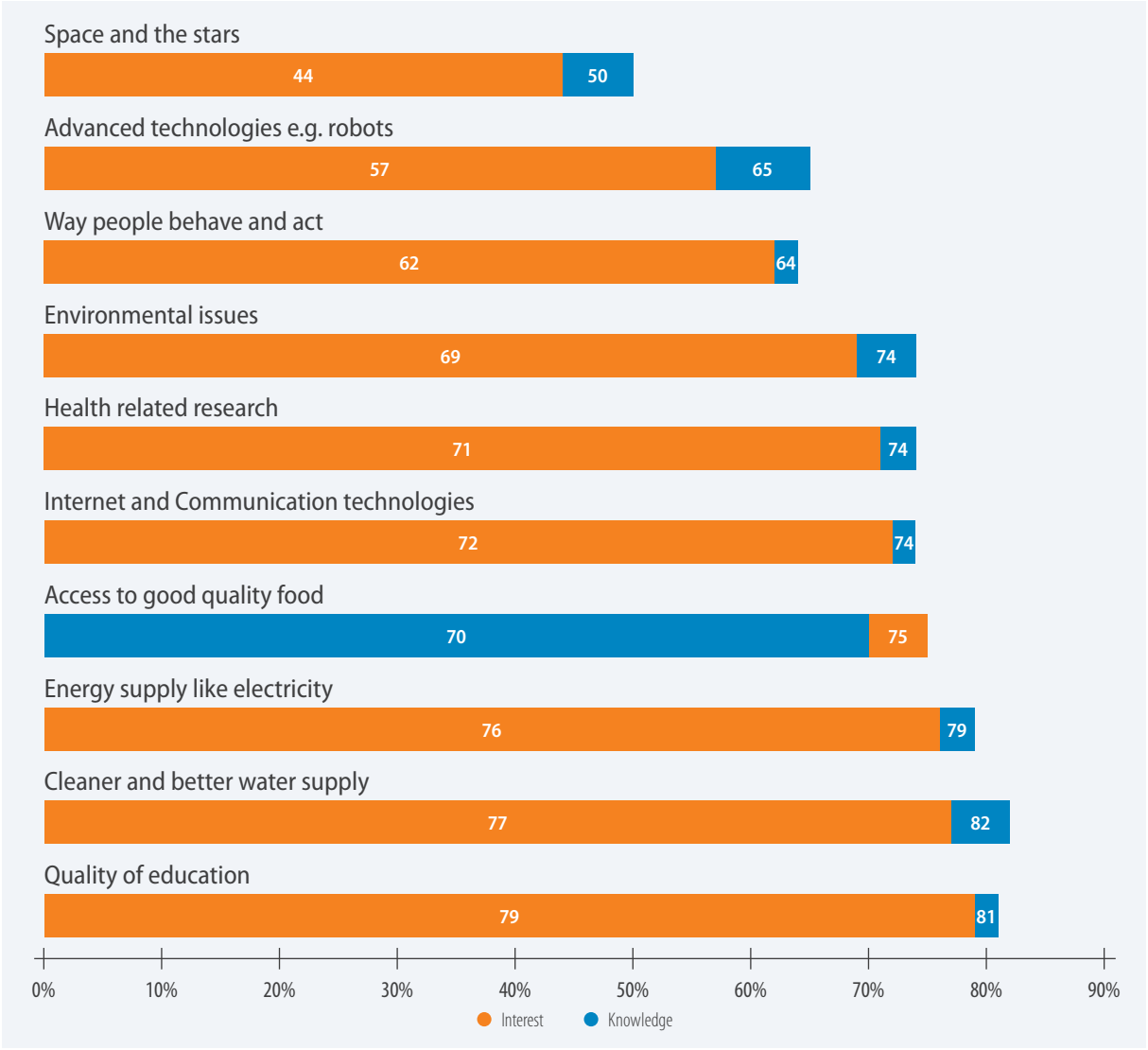
Figure 10 reports the results of the public levels of interest[15] in, and perceived knowledge[16] of, a set of priority science areas in South Africa. We collapsed the "very" and "somewhat" response categories to create the categories of interest and perceived knowledge for each topic.

The results show that the patterns and levels of interest in, and knowledge of, each of the priority science topics were similar, and they were strongly correlated. The top three areas that more than three-quarters of the public reported being knowledgeable about were quality of education (79%), a cleaner and better water supply (77%), and energy and electricity supply (76%). The pattern was similar for interest, with a cleaner and better water supply (82%), quality of education (81%) and energy and electricity supply (79%) as the top three choices. These responses reflect some of the unmet basic needs of the public related to service delivery that inform their daily experiences, as well as topics that dominate news cycles and social discussions.

9 Phrased as: *Antibiotics kills viruses as well as bacteria* (F) in other countries.
10 *The earth travels around the Sun* (T).
11 *Does the Earth go around the Sun, or does the Sun go around the Earth.*
12 *It is the mother's genes that determine the sex of the child* (F).
13 *A baby's gender is determined by its father's gene* (T).
14 Phrased as: *It is the father's gene that decides whether the baby is a boy or a girl* (T) in USA and China.
15 Respondents answered on a 4-point scale (very, somewhat, hardly and not at all interested).
16 This was a self-reported assessment on a 4-point scale (very, somewhat, not very and not at all aware) – hence this is referred to as perceived knowledge.

The two areas with the lowest levels of knowledge and interest were topics that are far removed from the daily lives of most of the public: namely, the study of space and the stars and advanced technologies like the 4IR. Half of the public (50%) were, at least, "somewhat" interested in space and the stars, while close to two-thirds (65%) were at least "somewhat" interested in advanced technologies. A slightly lower 44% and 57% reported being "somewhat" or "very", respectively, knowledgeable about these areas.

FIGURE 10: Interest in and perceived knowledge of priority science areas (percentage)



Who was more likely to have higher knowledge of, and interest in, the priority science areas?

We wanted to identify the key characteristics of adults who were typically more knowledgeable of and interested in the priority S&T areas. We, firstly, created an *Index of perceived knowledge of priority science areas* and an *Index of interest in priority science areas* by reverse scaling and averaging out the responses to the ten items (Figure 10) and then transforming the resultant index into a 0–100 scale. On each scale, greater scores represented higher knowledge and interest. We computed inter-item correlations for all variables within the knowledge and interest batteries, and then produced the Cronbach alpha statistic to test the reliability of the scale. The results of this test confirmed the reliability of the index construction (α = 0.887 for interest, and α = 0.863 for knowledge).

Having constructed the two indices, categorical versions of these multi-item measures were then prepared by dividing the scale scores into five categories to show the distribution of science knowledge and interest levels: very low, low, medium, high and very high (Table 9).

The mean index scores for knowledge of, and interest in, priority science areas were 61 and 67 out of 100, respectively. On this scale, 47% of the public rated themselves as having high knowledge in contrast to 57% having high interest.

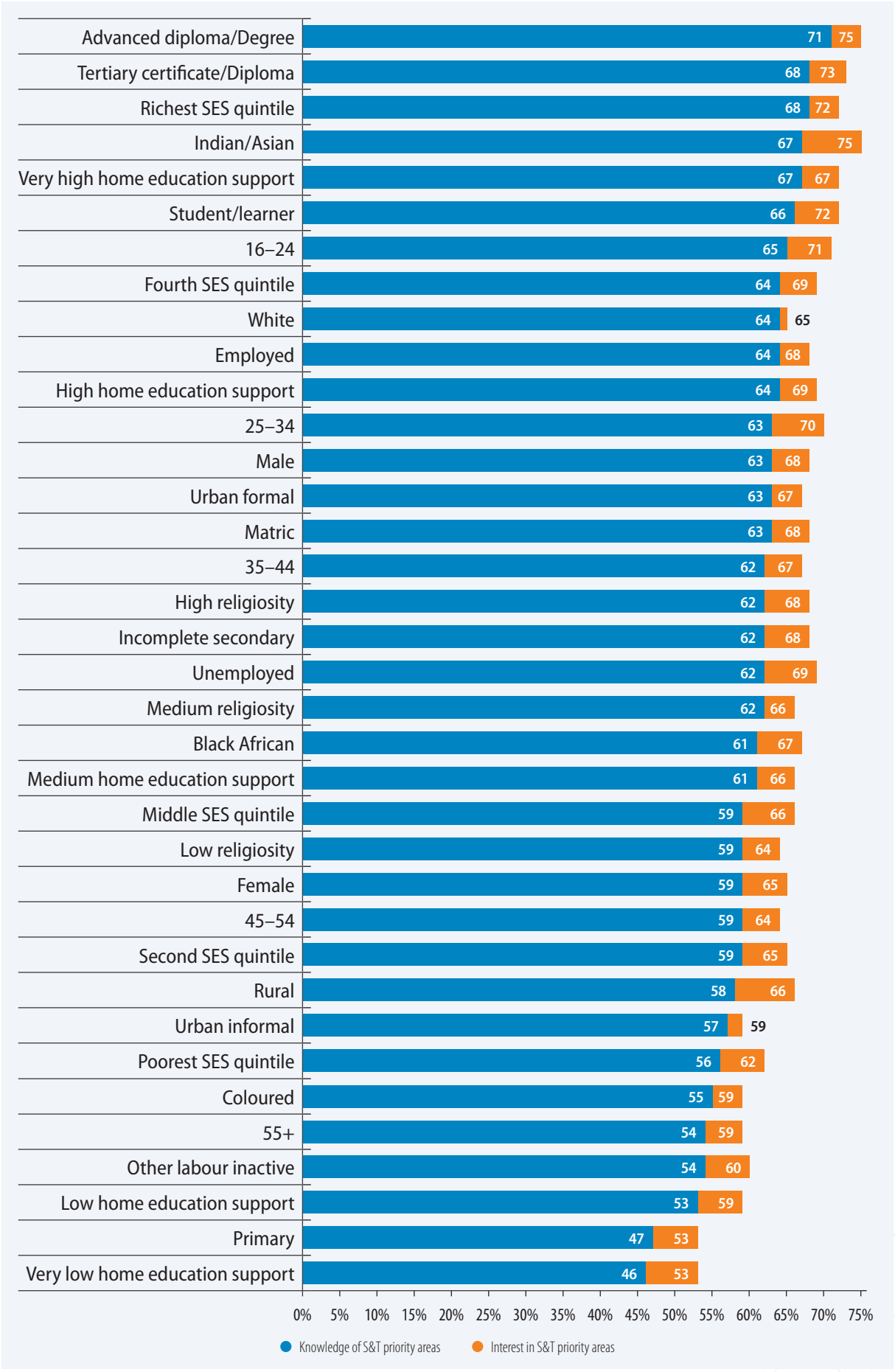
TABLE 9: Levels of perceived knowledge of, and interest in, priority science areas (row percentage)

	VERY LOW 0–33	LOW 34–49	MEDIUM 50–65	HIGH 66–80	VERY HIGH 81–100	TOTAL	MEAN INDEX SCORE
Perceived knowledge	11	14	29	31	16	100	61.2
Interest	10	10	23	29	28	100	66.6

In Figure 11, the differences in mean scores of the perceived knowledge of, and interest in, priority science areas are presented across different sub-groups based on their personal characteristics. The average knowledge scores across all the observed sub-groups ranged from a low of 46 to a high of 71 out of 100, while the mean interest scores ranged between 53 and 75. In all instances, interest scores exceeded knowledge scores, indicating that a subset of the population remains curious or intrigued by priority science areas, but lacks a deep understanding of or expertise in them. Furthermore, the pattern across sub-groups in terms of who displayed higher and lower knowledge and interest was largely consistent.

The highest knowledge of priority science areas was found among those with an advanced diploma or degree or tertiary certificate/diploma, those in the richest SES quintile, and with very high home education support, as well as Indian/Asian adults, students/learners and those aged between 16 and 24 years. The lowest perceived knowledge scores were evident among those with very low or low home education support, with a primary or no formal education, as well as among Coloured adults, those aged 55 years and older and the labour inactive (mostly pensioners).

FIGURE 11: Patterns of knowledge of, and interest in, priority science areas, by select characteristics (percentage, ranked by Knowledge of S&T priority areas)



To test whether the group differences in knowledge and interest scores presented in Figure 11 were statistically significant, One-way ANOVA tests were conducted using the mean scores based on the 0–100 indices. Significant differences in the average level of interest and knowledge were found based on all characteristics tested. In Table 10, a summary of significant sub-group differences in perceived knowledge and interest is presented.

TABLE 10: Who was more and less likely to display higher knowledge of, and interest in, priority science areas?

PERCEIVED KNOWLEDGE OF PRIORITY SCIENCE				
Significantly higher knowledge	**Significantly lower knowledge**	**F**	**Sig.**	**Range**
16–24, 25–34	35–44, 45–54, 55+	48.9	***	54–65
Male	Female	56.8	***	59–63
White and Indian/Asian adults	Black African and Coloured adults	24.0	***	55–67
Advanced diploma/degree, Tertiary certificate/diploma	Primary or no formal schooling, incomplete secondary, matric	163.1	***	47–71
Students/learners, employed	Unemployed, Other labour inactive	99.2	***	54–66
Very high, high, medium home education support	Very low or low home education support	136.5	***	46–67
Richest and fourth SES quintiles	Poorest, second poorest SES quintiles	66.9	***	56–68
Urban formal	Urban informal, rural	34.0	***	57–63
High, medium religiosity	Low religiosity	8.9	***	59–62
INTEREST IN PRIORITY SCIENCE				
Significantly higher interest	**Significantly lower interest**	**F**	**Sig.**	**Range**
16–24, 25–34	45–54, 55+	56.4	***	59–71
Male	Female	22.5	***	65–68
Indian/Asian, Black African and White adults	Coloured adults	34.0	***	55–75
Advanced diploma/degree, tertiary certificate/diploma	Primary schooling, incomplete secondary, matric	122.6	***	53–75
Students/learners, unemployed	Other labour inactive	71.7	***	60–72
Very high, high, medium home education support	Very low or low home education support	97.8	***	53–73
Richest and fourth SES quintiles	Poorest, second poorest SES quintiles	39.8	***	62–72
Urban formal, rural	Urban informal	20.9	***	59–67
High religiosity	Low religiosity	15.2	***	64–68

Note: The F-statistic is a measure used to determine whether the mean scores between groups are significantly different from one another. Higher F-statistic values suggest that there may be significant differences between group mean scores. Statistical significance is denoted as * $p<0.05$ (95% level), ** $p<0.01$ (99% level), *** $p<0.001$ (99.9% level). The range of values reflects the minimum and maximum index values on the index for the specific personal attribute.

To further identify the groups who were more and less likely to exhibit higher knowledge and interest levels, we ran a series of multivariate models using a linear regression approach. The outcome variables used for this analysis were the two indices (on a 0–100 scale) of knowledge of, and interest in, priority science areas. As before, all models contain the standard socio-demographic controls (see Table 3). Table 11 presents data regarding the factors that remained significant when they were considered simultaneously.

The relationships between the socio-demographic variables and knowledge of, and interest in, priority science areas are explored in Models I and II in Table 11. In Models I and II, years of educational attainment, home education support and SES, were shown to have a strong relationship with knowledge of, and interest in, science areas. These positive relationships make sense: those who have sought or been able to access higher levels of education and those who grew up in homes where they were encouraged to read, discussed news events and took science subjects at school (i.e. Home Education Support) are more likely to have developed greater knowledge of and interest in key science areas.

Males as well as those reporting higher religiosity are positively associated with knowledge of and interest in S&T, but here their observed associations were smaller. In contrast, those who were labour inactive (relative to the employed) and Coloured adults (relative to Black Africans) were less likely to report high levels of science knowledge and interest.

In Models I and II, the socio-demographic variables explained nearly a fifth of the variation (R-squared = 0.19 and 0.18, respectively) in the levels of knowledge and interest in science areas. Therefore, the unexplained variance is large, indicating that other factors not included in the model have an influence on knowledge and interest.

In Model III, knowledge of priority science areas is again the outcome (as per Model I). In line with our conceptual framework, this model tested how interest in science areas, in addition to the socio-demographic variables, influenced levels of science. The explanatory power of the model more than doubled from 0.19 in Model I to 0.49 in Model III. This, and the high beta coefficient of 0.605 for interest in S&T, shows that interest in S&T was highly associated with science knowledge in this model.

TABLE 11: Perceived knowledge of and interest in priority science areas: Summary of Ordinary Least Squares (OLS) models

Full model, including all controls, showing only significant associations and their direction, and beta coefficients: green = positive; red = negative

	OLS REGRESSIONS		
	Model I	Model II	Model III
OUTCOME VARIABLE	**Knowledge of priority science areas**	**Interest in priority science areas**	**Knowledge of priority science areas *(with interest as a predictor)***
PREDICTOR VARIABLES			
Age (years)		**–0.070****	
Female	**–0.044 ***	**–0.039***	
Population group (Ref: Black African)			
Coloured	**–0.033***	**–0.043***	
Indian/Asian			
White		– 0.085***	
Years of education	**0.136*****	**0.121*****	**0.061****
Home education support	**0.151*****	**0.128*****	**0.074*****
Employment status (Ref: Employed)			
Unemployed			
Student/learner			
Labour inactive	**–0.105*****	**–0.063****	**–0.070****
Geographic type (Ref: Urban formal)			
Urban Informal		**– 0.042***	
Rural	**0.062****		**0.041***
Religiosity scale (low to high)	**0.037***	**0.049****	
Socioeconomic status (low to high)	**0.127*****	**0.161*****	
Interest in priority science areas	…	…	**0.605*****
R-squared	0.19	0.18	0.49
N	5 799	5 801	5 795

Notes: *** p<.001; ** p<.01; * p<.05. The symbol '… ' indicates the variable is not included in the model. Analyses are weighted. Province of residence is included in all models as a control variable. The regression coefficients displayed in the models are standardised Betas.

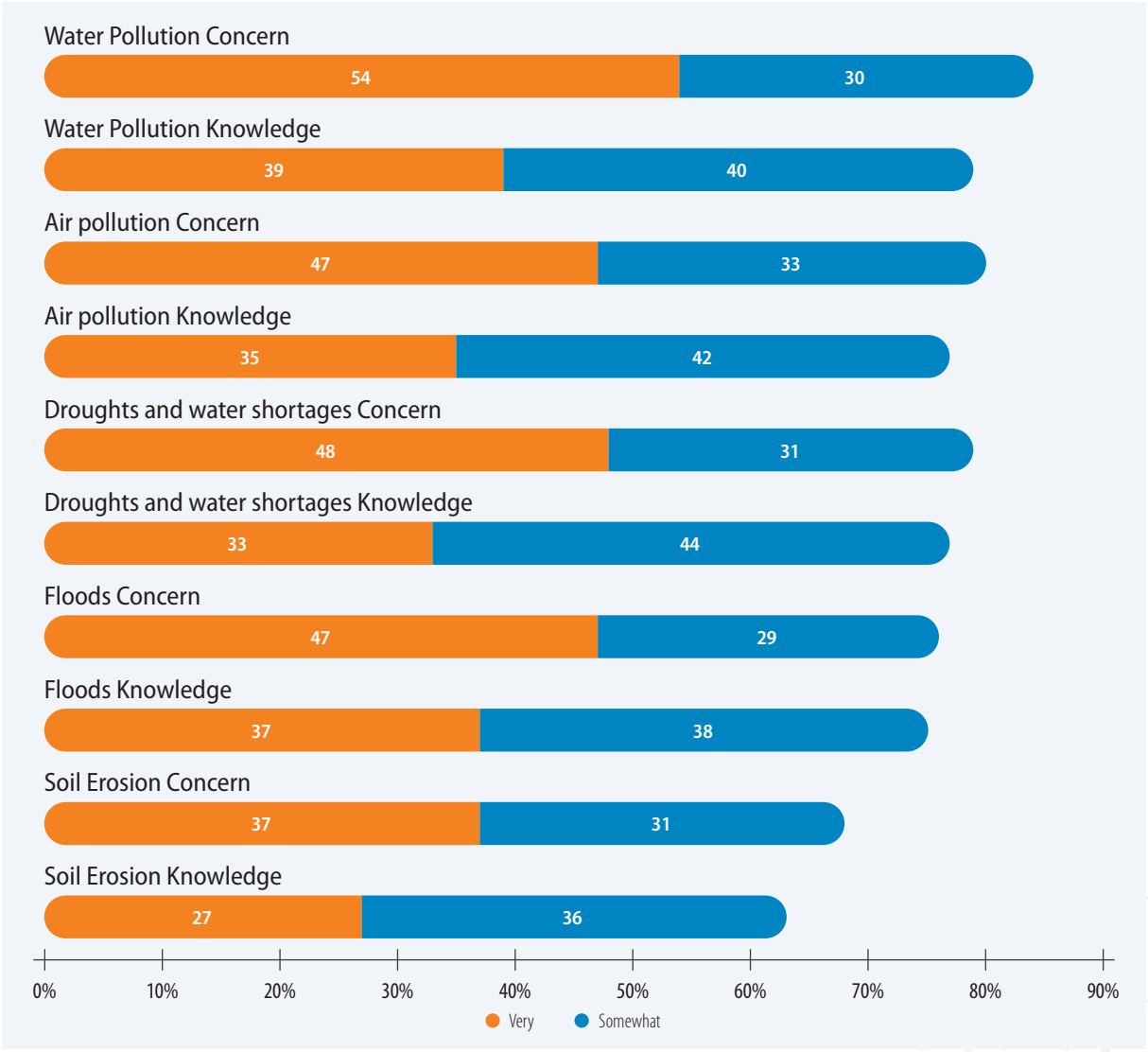
Knowledge and concern about natural and environmental events

The effects of climate change and environmental events are a global concern and a priority for organisations such as the United Nations; and many governments, including South Africa, are signatories to global declarations such as the Paris Agreement, an international treaty on climate change (UNFCCC, 2015). Recognising the national and global importance of environmental challenges, the SAPRS 2022 survey included items that focused on the public rating their levels of knowledge and concern about current natural and environmental events facing South Africa (Figure 12).

The public reported high levels of both environmental knowledge and concern. Close to three-quarters of the public reported being, at least "somewhat" knowledgeable about water (79%) and air (77%) pollution, droughts and water shortages (77%), as well as floods (75%). A similar share of the public were at least "somewhat" concerned about water pollution (84%), air pollution (80%), droughts and water shortages (79%), and floods (76%). A slightly lower share of the public reported being at least "somewhat" knowledgeable (63%) and concerned (68%) about soil erosion.

Close to half of the public were "very" concerned about water pollution (54%), air pollution (47%), droughts and water shortages (48%), as well as floods (47%) – these are catastrophic events that significantly affected many parts of South Africa in the years leading up to the survey round.

FIGURE 12: Knowledge of and concerns about natural and environmental events (percentage)



Who was more and less likely to have higher knowledge and concern of environmental events?

We wanted to identify the characteristics of adults who typically reported higher knowledge and concern about natural and environmental events. We therefore created an *Index of environmental knowledge* and an *Index of environmental concern,* by reverse scaling and averaging out the responses to the five items listed in Figure 12. We then transformed the indices into a 0–100 scale, with greater scores representing higher knowledge or concern. We computed inter-item correlations for all variables within the knowledge and concern batteries of items, and then produced the Cronbach alpha statistic to test the reliability of the scale. The results of this test confirmed the reliability of the index construction ($\alpha = 0.839$ for knowledge and $\alpha = 0.871$ for concern).

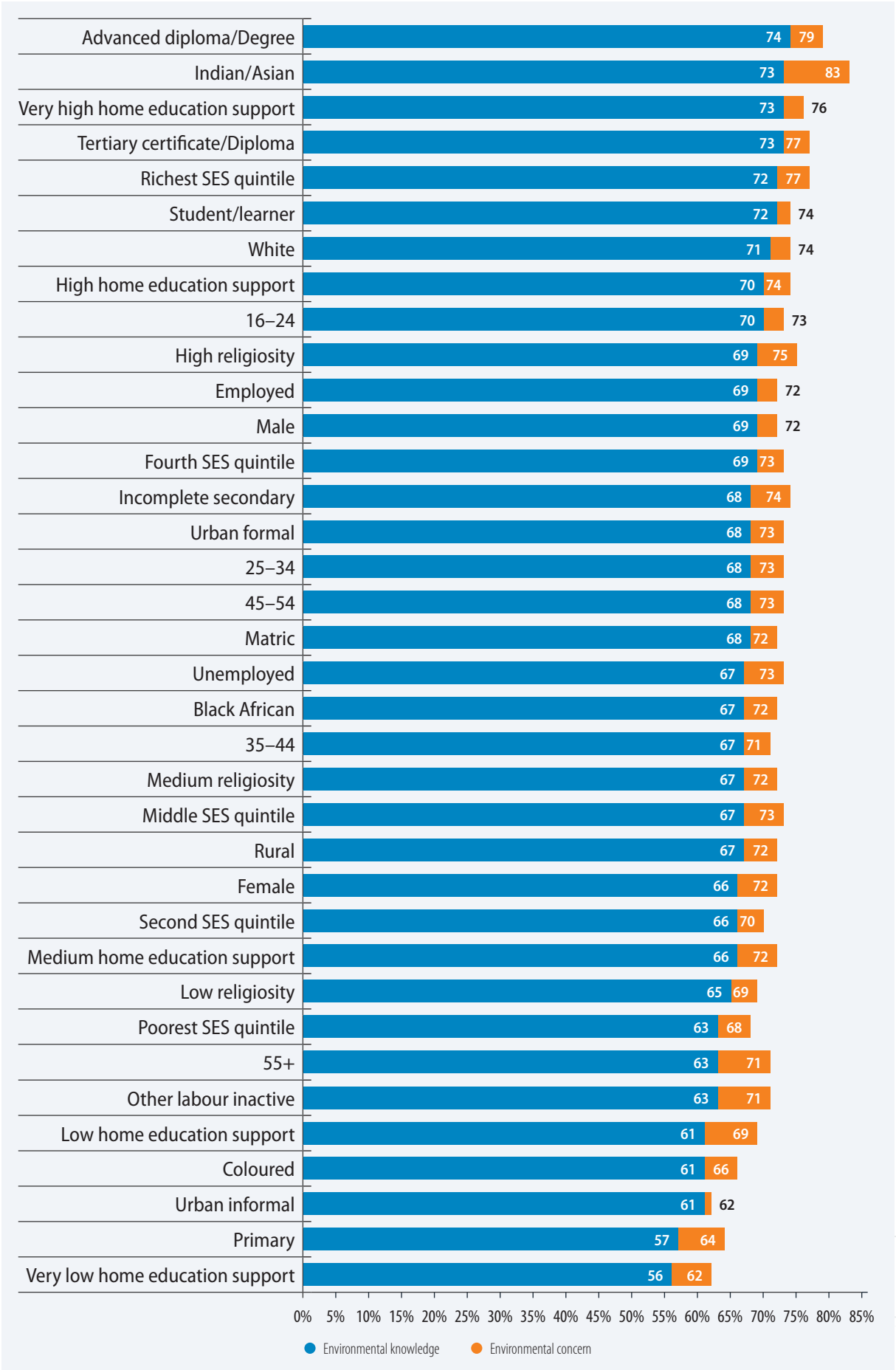
Categorical measures were then produced from the two indices, by reducing the scale scores into five categories to map the distribution of the levels of environmental knowledge and concern: very low, low, medium, high and very high (Table 12). On this scale, there were high levels of environmental knowledge and concern, with mean index scores of 67 and 72, respectively. Six in every ten members of the public rated their environmental knowledge as "high" or "very high" (62%), while a slightly higher seven in ten members rated their environmental concern as "high" or "very high" (70%).

TABLE 12: Levels of environmental knowledge and environmental concern (row percentage)

	VERY LOW (0–33)	LOW (34–49)	MEDIUM (50–65)	HIGH (66–80)	VERY HIGH (81–100)	TOTAL	MEAN INDEX SCORE
Environmental knowledge	11	10	17	34	28	100	67.3
Environmental concern	11	7	13	30	40	100	72.2

In Figure 13, the differences in mean scores of the environmental knowledge and environmental concern indices are presented across different sub-groups based on their personal characteristics. The average knowledge scores across all the observed sub-groups ranged from a low of 56 to a high of 74 out of 100, while the concern scores ranged between 62 and 83. For all sub-groups in the bar chart, concern scores exceed knowledge scores, indicating that a subset of the population remains concerned about environmental challenges despite a lack of an in-depth understanding of these issues.

FIGURE 13: Level of environmental knowledge and environmental concern, by select socio-demographic characteristics (Percentage)



The highest environmental knowledge scores were found among those with an advanced diploma or degree or tertiary certificate/diploma, in the richest SES quintile, and with very high home education support, as well as Indian/Asian and White adults, and students and learners. The lowest knowledge scores were evident among those with very low or low home education support, with a primary or no formal education, living in informal urban areas, as well as among Coloured adults, those aged 55 years and older and the labour inactive.

To test whether the group differences in environmental knowledge and concern scores presented in Figure 13 were statistically significant, One-way ANOVA tests were conducted using the mean scores based on the 0–100 scale. Significant differences were found based on all characteristics tested in the case of environmental knowledge, and all variables except for age and sex in the case of environmental concern. In Table 13, a summary of significant sub-group differences in knowledge and concern is presented.

TABLE 13: Who was more and less likely to display higher environmental knowledge and concern?

ENVIRONMENTAL KNOWLEDGE				
Significantly higher knowledge	**Significantly lower knowledge**	**F**	**Sig.**	**Range**
16–24, 25–34, 35–44, 45–54	55+	12.6	***	63–70
Male	Female	18.5	***	66–69
White and Indian/Asian adults	Black African and Coloured adults	21.9	***	61–73
Advanced diploma/degree, tertiary certificate/diploma	Primary or no formal schooling, incomplete secondary, matric	62.7	***	57–74
Students/learners, employed	Unemployed, Other labour inactive	32.3	***	63–72
Very high, high, medium home education support	Very low or low home education support	70.6	***	56–73
Richest SES quintile	Poorest, second poorest SES quintiles	22.5	***	63–72
Urban formal, rural	Urban informal	18.1	***	61–68
High religiosity	Low religiosity	14.3	***	65–69
ENVIRONMENTAL CONCERN				
Significantly higher concern	**Significantly lower concern**	**F**	**Sig.**	**Range**
Indian/Asian, White and Black African adults	Coloured adults	21.2	***	66–83
Advanced diploma/degree, tertiary certificate/diploma	Primary or no formal schooling, matric	34.6	***	64–79
Students/learners	Other labour inactive	4.1	**	71–74
Very high, high home education support	Very low or low home education support	29.3	***	62–76
Richest, fourth and middle SES quintiles	Poorest, second poorest SES quintiles	21.7	***	68–77
Urban formal, rural	Urban informal	33.0	***	62–73
High religiosity	Medium, low religiosity	27.4	***	69–75

Note: The F-statistic is a measure used to determine whether the mean scores between groups are significantly different from one another. Higher F-statistic values suggest that there may be significant differences between group mean scores. Statistical significance is denoted as * $p<0.05$ (95% level), ** $p<0.01$ (99% level), *** $p<0.001$ (99.9% level). The range of values reflects the minimum and maximum index values on the index for the specific personal attribute.

Next, we ran a series of multivariate models using a linear regression approach where the outcome variables of interest were the *index of environmental knowledge* and *index of environmental concern*. All models contain the standard socio-demographic controls. Table 14 presents the results from the regression modelling, showcasing which factors remained significant when they were considered simultaneously.

In Models I and II, we explored the relationships between socio-demographic variables and environmental knowledge and concern. In Model III, environmental concern is again the outcome variable (as per Model II), but environmental knowledge is included as a predictor variable. This configuration of the models is crucial if we are to adequately test the assertion in our conceptual framework that higher levels of environmental knowledge are associated with greater environmental concern, and vice versa.

From Models I and II, it is evident that those with more years of educational attainment, higher level of home education support and higher religiosity were more likely to have higher levels of environmental knowledge and concern. Educational attainment and home education support had a strong association with environmental knowledge and concern. Those with higher SES were more likely to report a greater degree of environmental concern. Coloured adults (relative to Black Africans) and those living in urban informal areas (relative to those in urban formal areas) were less likely to report high levels of environmental knowledge and concern, but these associations were relatively small.

In Models I and II, the socio-demographic factors explained only a tenth of the variation (R-squared = 0.11 in each model) in environmental knowledge and concern. The unexplained variance was very large, indicating that other factors not included in Models I and II were responsible for shaping public environmental knowledge and concern.

In the case of Model III, when we included environmental knowledge as a predictor variable of environmental concern, we found a large and significant relationship. The explanatory power of the model increased more than four-fold (from 0.11 in Model I to 0.46 in Model III) and the association between environmental knowledge and concern is large ($\beta = 0.627$). This shows that there is a strong relationship between knowledge and concern about environmental matters in the country. We do not know the directionality of the relationship, but adults with higher environmental knowledge are more likely to have higher environmental concern, and vice versa.

TABLE 14: Environmental knowledge and concern: Summary of OLS models

Full model, including all controls, showing only significant associations and their direction, and beta coefficients: green = positive; red = negative

OUTCOME	Environmental Knowledge	Environmental Concern	Environmental concern *(with environmental knowledge as a predictor)*
PREDICTORS			
Age (years)			
Female	**–0.048***		
Population group (Ref: Black African)			
Coloured	**0.047***	**–0.039***	
Indian/Asian			
White			
Years of education	**0.099*****	**0.082****	
Home education support	**0.129*****	**0.075****	
Employment status (Ref: employed)			
Unemployed			
Student/learner			
Labour inactive	**–0.073****		
Geographic type (Ref: urban formal)			
Urban Informal	**–0.052***	**–0.069****	
Rural			
Religiosity scale (low to high)	**0.066***	**0.072*****	**0.031***
Socioeconomic status		**0.105*****	**0.074*****
Environmental knowledge	…	…	**0.627*****
R-squared	0.11	0.11	0.46
N	5 799	5 797	5 794

Notes: *** p<.001; ** p<.01; * p<.05. The symbol '…' indicates the variable is not included in the model. Analyses are weighted. Province of residence is included in all models as a control variable. The regression coefficients displayed in the models are standardised Betas.

Key results: Science knowledge and interest

This chapter, firstly, reported the levels of awareness, interest, knowledge and concern of S&T and the environmental events. Secondly, we identified the characteristics of those who were more likely to be interested in and knowledgeable about the science and environmental topics. Thirdly, we investigated the relationship between interest in and knowledge of S&T and knowledge and concern about the environment.

LEVELS OF KNOWLEDGE, INTEREST AND CONCERN ABOUT SCIENCE AND THE ENVIRONMENT

- Six in ten South African adults reported an awareness of South African S&T achievements as well as knowledge of S&T. The public were more knowledgeable on items that had dominated the news cycles ahead of the survey (namely Covid-19 vaccines and rising petrol prices).
- Where science knowledge items had been fielded previously in national surveys, a modest improvement over time was evident.
- Two-thirds of the public were interested in South African S&T achievements.
- The public were more knowledgeable and interested in topics that reflect some of their unmet basic needs, such as quality of education, a cleaner and better water supply, energy and electricity supply and quality food supply. The lowest levels of knowledge and interest were found for topics more removed from the daily lives of most of the public, namely the study of space and stars and advanced technologies like 4IR.
- Just over two-thirds of the public were knowledgeable and concerned about the environment.
- In all instances, interest and concern mean scores exceeded knowledge mean scores, indicating that a subset of the population remains curious or concerned about science areas and the environment, even if they lack a deep understanding of or expertise in them.

SOCIO-DEMOGRAPHIC CHARACTERISTICS OF THOSE WHO WERE MORE LIKELY TO BE KNOWLEDGEABLE OF, AND INTERESTED IN, THE SCIENCE AND ENVIRONMENTAL TOPICS

- The mean scores, by sub-groups, for general and specific interest in S&T ranged from 45 to 71 and 53 to 75, respectively. The general characteristics of adults who were more interested in S&T were those with higher levels of educational attainment, higher home support for education and those from higher SES homes, Black African, Indian and White adults and students and learners. Males were more likely to be interested, although their mean score differences to women were less notable.
- Across the sub-groups, formal knowledge scores ranged from 51 to 74. Characteristics of adults with higher science knowledge were those with tertiary education and high home education support, those from a higher SES home, and White and Indian/Asian adults. Males, the youth, students, learners, employed and unemployed adults, as well as those living in urban formal areas and those reporting higher religiosity also demonstrated higher formal science knowledge, although the mean differences within sub-groups were less notable.
- The mean environmental knowledge scores, for the subgroups, ranged from 56 to 74, while environmental concern was slightly higher from 62 to 83. The characteristics of those with higher environmental knowledge and concern were those with tertiary education attainment and higher home education support, White, Indian/Asian and Black African adults, those from the richest home quintiles and students, learners and the employed and those residing in urban formal areas.

ROLE OF THE SCIENCE ENGAGEMENT MEASURES IN EXPLAINING KNOWLEDGE OF AND INTEREST IN S&T

- Socio-demographic factors explained just under 20% of the variation in S&T knowledge and interest, and slightly more than 10% of the variation in environmental knowledge and concern. This indicates that factors beyond socio-demographic characteristics come into play to explain knowledge and interest towards S&T and knowledge and concern about environmental events.
- The key socio-demographic factors influencing the four outcomes are educational attainment, home education support, SES of the home, population group identity, age and labour market status.
- We also found that interest and knowledge of S&T, as well as environmental knowledge and concern, are strongly correlated. We are unable to pronounce on the direction of that relationship: Those with higher knowledge also had higher interest and concern, and vice versa.

CHAPTER 4

Promise and Reservation Attitudes Towards Modern and Traditional Science and Technology

Globally, a set of items has been used to measure the attitudes of promise and reservation towards science. *Scientific promise* is an attitudinal construct associated with the view that science and technology (S&T) provides useful results and products for society, and that future benefits from S&T are likely. *Scientific reservation* is a separate construct that reflects public concern about the speed of change in modern life and a sense that S&T may pose too many risks or may conflict with traditional values or belief systems. Together, these measures provide an important signal of the relationship between science and society.

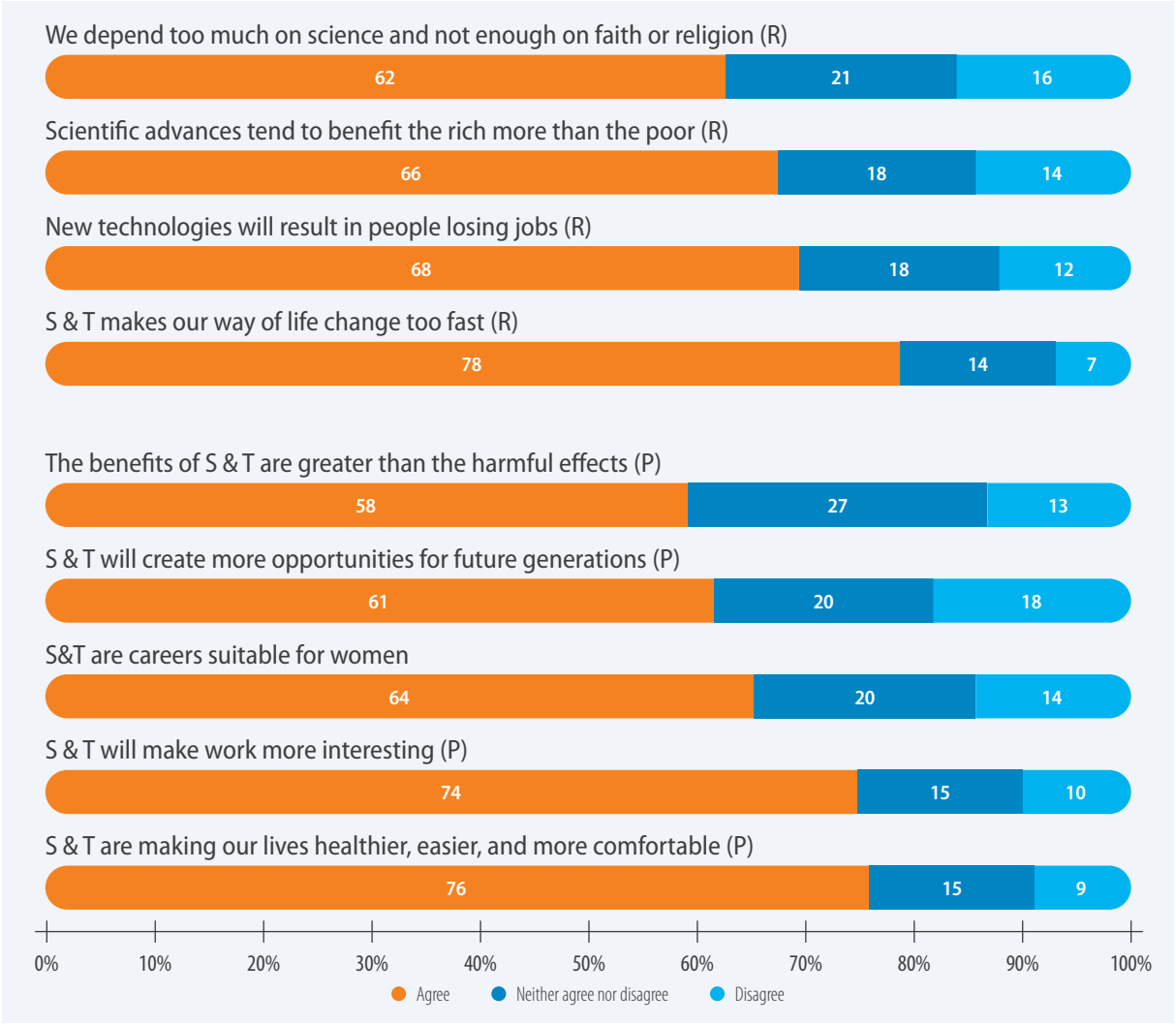
- In South Africa, studies by Pouris (1991, 1993), Reddy et al. (2013) and Guenther and Weingart (2016) have reported on the levels of promise and reservation attitudes towards S&T. While we have measured promise and reservation attitudes towards modern science, less is known about the publics' views about traditional S&T. In this chapter, we use the South African Public Relationship with Science (SAPRS) 2022 data to report on:
- Attitudes of promise and reservation towards modern S&T, as well as attitudinal trends and comparisons with select countries;
- Characteristics of the public who are more and less likely to have higher promise and higher reservation towards modern S&T;
- Knowledge of, and interest in, traditional S&T;
- Attitudes of promise and reservation towards traditional S&T, as well as attitudinal trends; and
- Characteristics of the public who are more and less likely to have higher promise and reservation towards traditional S&T.

Attitudes of promise and reservation towards modern S&T

We included a set of promise and reservation items in the SAPRS 2022 survey (some items have been used internationally and some were newly developed). This battery of items included five items which aimed to measure attitudes of promise about science (potential benefits) and four items which aimed to measure reservations about science (concerns, fears and risks).

This set of nine attitudinal items was answered using a conventional five-point rating scale, ranging from *strongly agree* to *strongly disagree*. We combined the *strongly agree/agree* and *strongly disagree/disagree* categories for interpretive ease. Each of these items is an indicator of attitudes towards a particular aspect of science, providing insight into the publics' views towards the promises of, and reservations about, S&T (Figure 14).

FIGURE 14: Attitudes of promise (P) and reservation (R) towards S&T



The South African public acknowledged both the promises of, as well as concerns about, S&T. Three-quarters of the public (76%) agreed that S&T is making our lives healthier, easier and more comfortable. However, at the same time, a comparable share (78%) of the public was concerned that S&T makes our way of life change too fast.

Similarly, while nearly three-quarters of the public (74%) agreed that S&T will make work more interesting, almost two-thirds (68%) expressed concern that new technologies will result in people losing jobs.

Overall, close to 60% of the public agreed that S&T will create more opportunities for the future (61%) and that the benefits of S&T are greater than the harmful effects (58%).

While extolling the promises of science, two-thirds of the public were concerned that S&T advances will contribute to further inequality, as they felt that scientific advances tend to benefit the rich more than the poor (66%). Almost two-thirds of the public were also concerned that we depend too much on science and not enough on faith (62%).

Two-thirds of the public (64%) agreed that S&T careers are suitable for women. This indicates a shift away from traditional view of Science, Technology, Engineering and Mathematics (STEM) as career pathways that are better suited for men.

Who was more likely to report high promise and reservations towards S&T?

As in the preceding chapter, we wanted to identify the characteristics of individuals with views of high promise and high reservation towards S&T. We created an *Index of Promise of S&T* (Cronbach $\alpha = 0.623$) and an *Index of Reservation towards S&T (*Cronbach $\alpha = 0.640$)[17] by averaging out the constituent items and then transforming them into a 0–100 scale, with larger scores representing higher promise or reservation. The scale scores were then divided into five categories (very low, low, medium, high and very high) to show the distribution of the measure (Table 15).

In line with the summary statistics presented in Table 15, comparison of these indices shows that the promise of, and reservation about, S&T were similar with mean scores of 68 and 69 (out of 100), respectively. Six in ten of the public acknowledged high promise (62%) and high reservations (64%) about S&T.

TABLE 15: Promise of and reservation about S&T (row percentage)

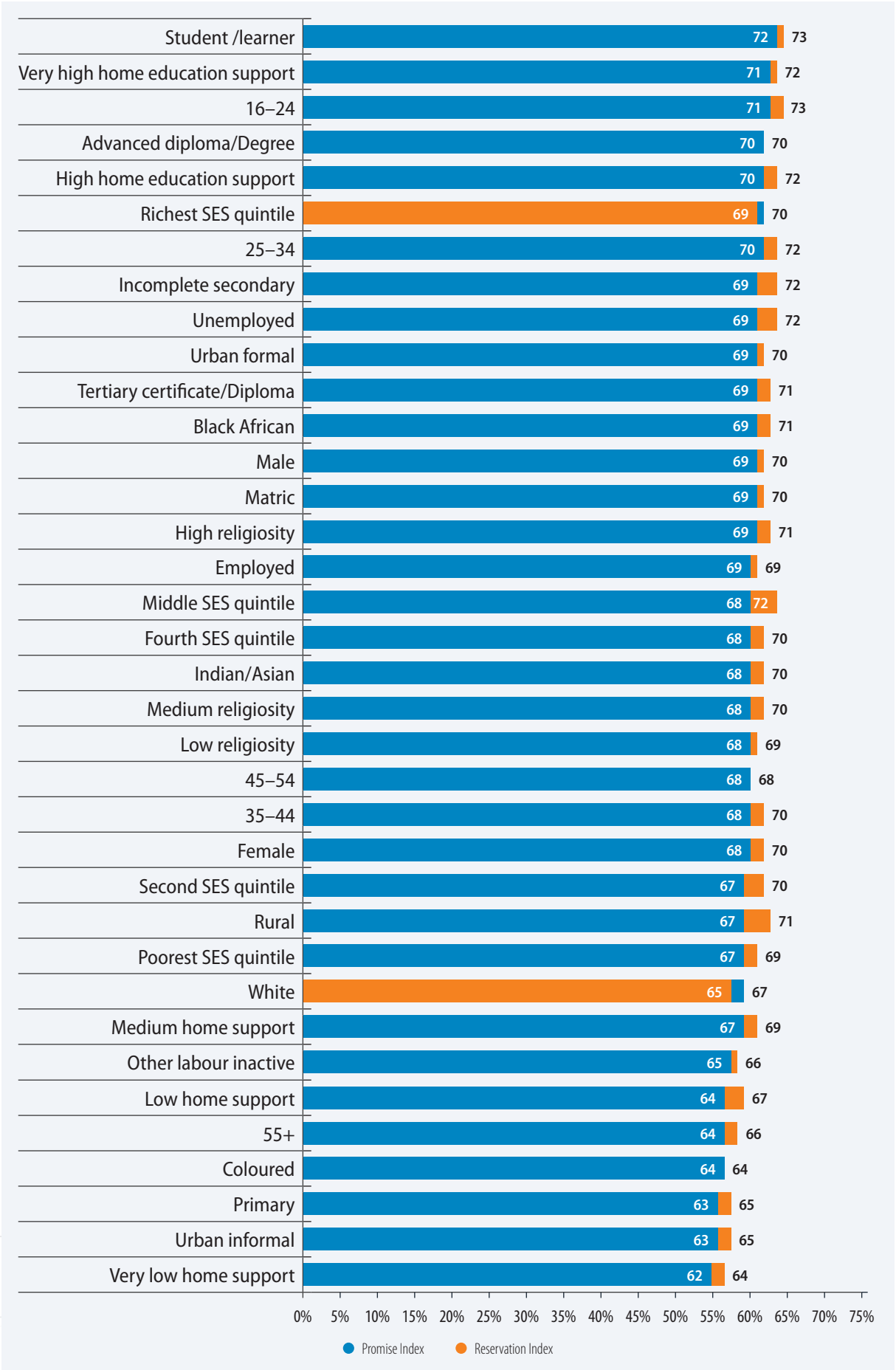
	VERY LOW (0–33)	LOW (34–49)	MEDIUM (50–65)	HIGH (66–80)	VERY HIGH (81–100)	TOTAL	MEAN INDEX SCORE
Promise Index	4	7	28	36	26	100	68.1
Reservation Index	4	5	26	33	31	100	69.1

In Figure 15, the average promise and reservation index scores are presented for various social and demographic characteristics. The bar chart is ranked from highest to lowest based on the promise index values. The level of promise of S&T evident among the public varied within a relatively narrow range of mean scores between 62 and 72 across the different characteristics examined. This suggests that, on average, South Africans tend to adopt a broadly favourable view of S&T, irrespective of their diverse backgrounds. The highest average levels of promise were evident among students and learners, those aged 16–24 years, those who reported very high levels of home education support, those with an advanced diploma or degree and those from the richest SES quintile. Conversely, lower average promise scores were found among those residing in urban informal areas, those with limited home education support and primary or no formal schooling, as well as Coloured adults and those aged 55 years or older.

The average S&T reservation scores, which are superimposed over the promise scores in Figure 15, show clearly that S&T is not viewed in an uncritical manner. We do not find a situation of blind promise, where high levels of promise are accompanied by low levels of reservation. Instead, views on the promise and reservation of S&T tend to go hand-in-hand: South Africans with higher levels of promise are inclined to also report higher levels of reservation. For most of the sub-groups that we looked at, the average reservation score slightly exceeded the promise score, indicating that South Africans from different backgrounds tend, on balance, to be marginally more critical of S&T than positive. The only cases where promise slightly exceeded reservation were among White adults, those with an advanced diploma or degree, and those falling in the richest SES quintile.

17 The results of this test for promise and reservation, while lower than we would have liked, still confirmed the validity of the index construction.

FIGURE 15: Differences in attitudes towards the promise (P) and reservation (R) of S&T, by select socio-demographic attributes (percentage)



To test whether the group differences in promise and reservation scores presented in Figure 15 were significant, One-way ANOVA tests were first conducted. With regard to promise, significant differences in the index scores were found based on all characteristics apart from religiosity, while sex was barely significant. As for reservation, significant index score differences were observed for all attributes tested, apart from sex.

In Table 16, a summary of significant sub-group differences in the average levels of promise and reservation is presented. In many instances, the same sub-groups tended to exhibit higher (or lower) promise and reservation, which confirms the finding that South Africans tend to recognise both the benefits and potential pitfalls of S&T.

TABLE 16: Personal characteristics associated with promise and reservation about S&T (One-way ANOVA comparison of mean scores)

PROMISE OF S&T				
Significantly higher promise	**Significantly lower promise**	**F**	**Sig.**	**Range**
16–24, 25–34, 35–44, 45–54	55+	27.6	***	64–71
Male	Female	6.36	*	68–69
Black African, Indian/Asian and White adults	Coloured adults	14.4	***	64–69
Advanced diploma/degree, tertiary certificate/diploma, matric, incomplete secondary	Primary or no formal schooling	24.2	***	63–70
Students/learners, unemployed	Employed, other labour inactive	45.6	***	65–72
Very high or high home education support	Very low, low or medium home education support	33.7	***	62–71
Richest asset quintile	Poorest, second poorest quintiles	4.0	***	67–70
Urban formal	Rural, urban informal	29.4	***	63–69
RESERVATION TOWARDS S&T				
Significantly higher reservation	**Significantly lower reservation**	**F**	**Sig.**	**Range**
16–24, 25–34	55+, 45–54, 35–44	27.3	***	66–76
Black African, Indian/Asian adults	Coloured, White adults	40.4	***	64–72
Advanced diploma/degree, tertiary certificate/diploma, matric, incomplete secondary	Primary or no formal schooling	22.2	***	65–72
Very high or high home education support	Very low, low or medium home education support	28.6	***	64–72
Students/learners, unemployed	Employed, other labour inactive	36.3	***	67–73
Middle SES quintile	Poorest, fourth, richest SES quintile	6.0	***	69–72
High religiosity	Low religiosity	5.2	**	69–71
Urban formal, rural	Urban informal	14.9	***	65–71

Note: The F-statistic is a measure used to determine whether the mean scores between groups are significantly different from one another. Higher F-statistic values suggest that there may be significant differences between group mean scores. Statistical significance is denoted as * $p<0.05$ (95% level), ** $p<0.01$ (99% level), *** $p<0.001$ (99.9% level). The range of values reflects the minimum and maximum index values on the index for the specific personal attribute.

To further identify the personal characteristics of those who were more and less likely to report higher promise and higher reservation about S&T, we ran a series of multivariate models using a linear regression approach. Promise of S&T and reservation towards S&T were the outcome variables of interest. All models contained the standard socio-demographic controls. Table 17 presents data on the factors that remained significant when all were considered jointly.

We explored the role of personal characteristics in shaping the attitudes of promise (Model I) and reservation (Model III). In line with our conceptual model, in Models II and IV, attitudes of promise and reservation, respectively, were again the outcome of interest, but we also included knowledge of and interest in science areas in each instance as predictor variables to test their role in shaping attitudes of promise and reservation towards S&T.

In Models I and III, higher home education support as well as those living in urban formal areas (when compared to those in urban informal settlements and rural areas) were more likely to report higher promise and reservation about S&T.

Even though the associations were small, the population group identity was found to be correlated with promise and reservation towards S&T. Coloured adults (relative to Black African adults) were less likely to report higher promise towards S&T. At the same time, Black Africans, relative to the three other population groups, were also more likely to report higher reservations towards S&T. Two of the four reservation items focused on inequalities in the country. Black Africans are the most economically and educationally disadvantaged group and are the most vulnerable to changes in the workplace.

In Models I and III, the socio-demographic factors explained only around a tenth or less of the variation in the attitudes towards promise and reservation (R-squared = 0.07 and 0.10, respectively). In other words, the unexplained variance was over 90%, indicating that other factors not included in Models I and III played a larger role in shaping promise and reservation attitudes.

In the case of Models II and IV, when we included the indices of knowledge of and interest in science areas as a predictor of promise and reservation, the explanatory power of the model increased from 0.07 to 0.16 for promise and from 0.10 to 0.17 for reservation.

While the explanatory power of the model is still low, interest in priority science areas was found to be strongly associated with both promise (β = 0.267) and reservation (β = 0.282) attitudes. However, knowledge of science was found to have a weak association with promise (β = 0.096), while there was no association with reservation attitudes.

TABLE 17: Promise and reservation towards S&T: Summary of OLS models

Full model, including all controls, showing only significant associations, their direction and Beta coefficients: green = positive; red = negative

	MODEL I	MODEL II	MODEL III	MODEL IV
OUTCOME VARIABLE	**Promise of S&T**	**Promise of S&T** *(with knowledge of and interest in science areas as predictors)*	**Reservation toward S&T**	**Reservation towards S&T** *(with knowledge of and interest in science areas as predictors)*
PREDICTOR VARIABLES				
Age (years)				
Female				
Population group (Ref: Black African)				
Coloured	0.046*		–0.037*	
Indian/Asian			–0.056***	–0.055***
White			–0.079***	–0.054*
Years of education				
Home education support	0.106***	0.057**	0.074**	
Employment status (Ref: employed)				
Unemployed				
Student/learner				
Labour inactive	–0.052*		–0.048*	
Geographic type (Ref: urban formal)				
Urban Informal	–0.084***	–0.072***	–0.061**	–0.049*
Rural	–0.047*	–0.061**	–0.062**	–0.070**
Religiosity scale (low to high)				
Socioeconomic status (low to high)				
Knowledge of priority science areas	…	0.096***	…	
Interest in priority science areas	…	0.267***	…	0.282***
R-squared	0.07	0.16	0.10	0.17
N	5 784	5 768	5 789	5 773

Notes: *** p<.001; ** p<.01; * p<.05. The symbol '…' indicates the variable was not included in the model. Analyses were weighted. Province of residence was included in all models as a control variable. The regression coefficients displayed in the models are standardised Betas.

Trends in attitudes of promise and reservation towards S&T

To assess trends of promise and reservation attitudes over time, we compared the results from SASAS 2013 and SAPRS 2022 on eight items that were fielded in both surveys. Table 18 reports the results from each study, the difference between the two time periods and whether the change was statistically significant.

TABLE 18: Agreement with the promise (P) or reservation (R) statement in 2013 and 2022 (percentage)

PROMISE AND RESERVATION ITEM	2013	2022	CHANGE 2013 TO 2022	ONE-WAY ANOVA
Scientific advances tend to benefit the rich more than the poor (R)	50	67	+17 percentage points	***
We depend too much on science and not enough on faith or religion (R)	56	63	+7 percentage points	***
S&T makes our way of life change too fast (R)	73	78	+5 percentage points	***
The benefits of S&T are greater than the harmful effects (P)	49	58	+9 percentage points	***
S&T will make work more interesting (P)	67	74	+7 percentage points	***
S&T is making our lives healthier, easier, and more comfortable (P)	76	76	0 percentage points	
S&T careers are suitable for women# (P)	66	64	–2 percentage points	
S&T will create more opportunities for future generations (P)	72	61	–11 percentage points	***

Notes: *** p<.001; ** p<.01; * p<.05. # item worded slightly differently in 2013 and 2022

The response patterns to the promise items, over the two time periods, were mixed. For two items the level of promise was significantly higher in 2022 than in 2013, while for another two items there was marginal or no change over this time. For one item the level of promise significantly decreased in 2022. The public increasingly recognised the potential benefits of S&T, as well as how S&T will change the nature of work – the *benefits of S&T are greater than the harmful effects* and *S & T will make work more interesting* – with the results increasing by a significant 9 and 7 percentage points, respectively.

However, at the same time, the response to the item *S&T is making our lives healthier, easier, and more comfortable* remained constant while the publics' views about S&T as careers for women remained virtually unchanged. This speaks to the durability of public attitudes about these issues over time. For the item *S&T will create more opportunities for future generations,* the results decreased by a significant 11 percentage points, pointing to growing scepticism about the promise of S&T.

The level of reservations towards S&T significantly increased between 2013 and 2022. There was increased concern, with widening inequalities (*scientific advances tend to benefit the rich more than the poor* increased by 17 percentage points), loss of faith in religion (*we depend too much on science and not enough on religion* increased by 7 percentage points), and the pace of change (*S&T makes our way of life change too fast* increased by 5 percentage points).

Overall, it appears that there were higher levels of reservation in relation to the role and impact of S&T in 2022 than in 2013. This likely reflects a growing mood of pessimism in the country over this period, given the increasing levels of poverty, unemployment, and ever more challenging everyday conditions.

Promise and reservation attitudes compared with select countries

Many of the promise-reservation items have also been fielded in surveys in other countries. We compared South Africans' views with those from select countries who had fielded similar items to examine the similarities and differences in attitudes (Table 19).

It is difficult to make strong claims from these observations because the conditions vary from country to country and the timing of the surveys differ. Furthermore, the latest data we could access for some countries was from surveys fielded before the coronavirus outbreak in 2020. Broadly these comparisons suggest that the more industrialised countries, where scientific activity and technological development were the most intense and productive (UK, USA, Australia), reported higher optimism and lower reservations towards S&T; whereas the more emerging economies, with generally higher levels of inequality (South Africa, Turkey, Malaysia), reported both high optimism and high reservations towards S&T.)

TABLE 19: Promise (P) and reservation (R) towards S&T in select countries (percentage)

	SOUTH AFRICA (2022)	UK	MOROCCO (2021)	TURKEY (2021)	ZIMBABWE (2020)	MALAYSIA (2019)	UNITED STATES	AUSTRALIA (2023)
We depend too much on science and not enough on faith or religion (R)	63	14 (2021)	48	44	42	30	30 (2017)	17
S & T makes our way of life change too fast (R)	78	27 (2021)		81		62	42[18] (2021)	39
Scientific advances tend to benefit the rich more than the poor (R)	67	45[19] (2021)		68				
The benefits of S & T are greater than the harmful effects (P)	58	52 (2019)					74 (2018)	53
S & T is making our lives healthier, easier, and more comfortable (P)	76	79 (2021)	81	85	78		64 (2017)	70
S & T will create more opportunities for future generations (P)	61	57[20] (2019)	71		77	61[21]	92 (2021)	67

Notes: *The footnotes present how the items were administered in other country surveys.
Sources: ANU Centre for Social Research and Methods (2023); Department for Business, Energy and Industrial Strategy (2020); European Commission (2021); Haerpfer, Inglehart, Moreno, Welzel, Kizilova, Diez-Medrano, Lagos, Norris, Ponarin and Puranen (Eds) (2020); Ministry of Science, Technology and Innovation Malaysia (2019); National Science Board (2020); National Science Board (2024).

18 *Science makes our way of life change too fast.*
19 For the UK and Turkey, this item was phrased as: *S&T could improve everyone's lives, but mostly improve the lives of people who are already better off.*
20 For UK, Morocco, Zimbabwe and USA, this item was phrased as: *Because of science and technology there will be more work opportunities for the next generation.*
21 *STI creates more opportunities for the next generation.*

Traditional knowledge and traditionalness

There is a growing recognition that modern science (which favours analytical and reductionist methods) is not the only knowledge form, and that community and traditional knowledge (which favours intuitive and holistic approaches) is also valued and should be promoted. By *traditional knowledge*, we mean the knowledge and skills that have been passed on from generation to generation within a community.[22]

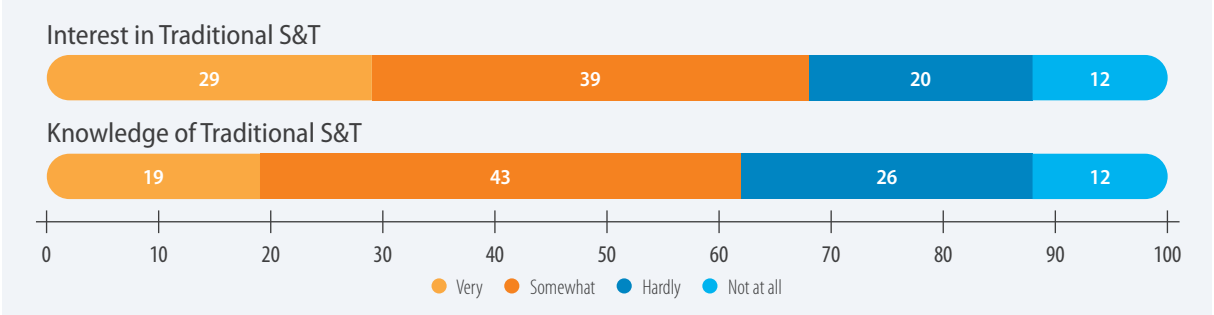
Table 20 presents the results of how the public rated their level of traditionalness in terms of how closely they followed cultural practices. Six in ten (61%) of the public reported that they were moderately ("slightly" or "somewhat") traditional. On either end, equal shares – two in ten adults – rated themselves as "extremely" traditional (19%) and "not at all" traditional (19%).

TABLE 20: Levels of traditionalness (row percentage)

NOT AT ALL TRADITIONAL	SLIGHTLY TRADITIONAL	SOMEWHAT TRADITIONAL	EXTREMELY TRADITIONAL	TOTAL
19	22	39	19	100

Figure 16 presents levels of self-assessed knowledge of, and interest in, traditional S&T among the public in 2022. Close to two-thirds of the public reported that they were, at least "somewhat", knowledgeable about (62%) and interested in (68%) traditional S&T. On the other hand, four in ten adults were "hardly" or "not at all" knowledgeable (38) and three in ten (32%) were "hardly" or "not at all" interested in traditional S&T.

FIGURE 16: Perceived knowledge of, and interest in, traditional S&T



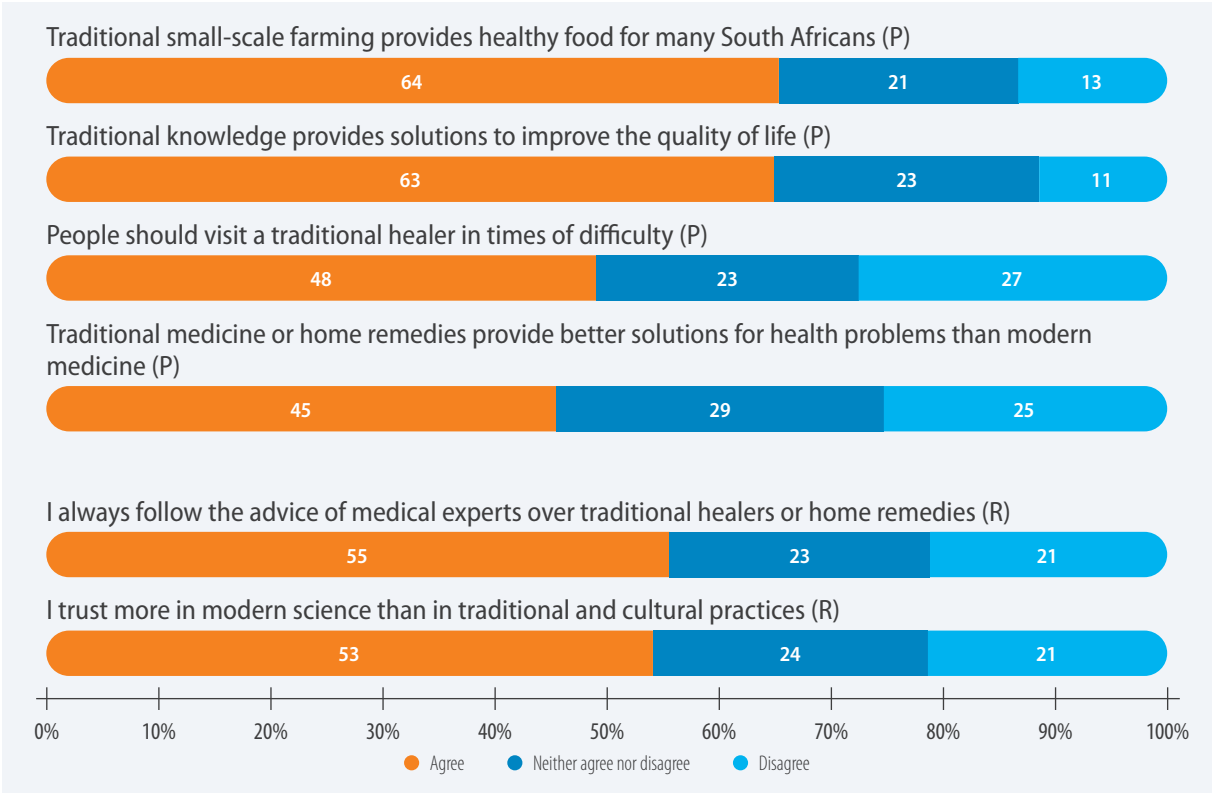
22 We chose the term traditional knowledge rather than indigenous knowledge, as this term encompassed knowledge passed on through generations in all communities. Also, survey pre-testing found that the public more consistently understood the term 'traditional knowledge' than 'indigenous knowledge'.

Promise and reservation attitudes towards traditional S&T

In addition to eliciting the views of the public towards modern science, we asked the public about their views of promise and reservation towards traditional S&T. Figure 17 reports the views of the public, in response to a battery of six items, towards traditional knowledge in comparison to modern science. The items were categorised as expressing either promise (P: 4 items) or reservation (R: 2 items) towards traditional S&T.

While there was a moderately positive view of the promise of traditional S&T, with close to two-thirds of the public agreeing that traditional knowledge (63%) and traditional small-scale farming (64%) are beneficial, less of the public looked to traditional science and medicine for solutions. Slightly less than half the public recognised the role of traditional medicine (45%) and traditional healers (48%), while slightly more than half reported that they trusted more in modern science than in cultural and traditional practices (53%), and more in medical experts than traditional leaders or home remedies (55%).

FIGURE 17: Promise (P) and reservation (R) toward traditional S&T



Who was more and less likely to express high levels of promise towards traditional S&T?

We wanted to identify the personal characteristics of those who expressed views of high promise and high reservation towards traditional S&T. We therefore created an *Index of Promise towards traditional S&T* (Cronbach $\alpha = 0.634$), by averaging out the constituent items and then transforming them into a 0–100 scale, with larger scores representing higher promise. We did not create an *Index of Reservation toward traditional S&T* as the Cronbach alpha for the two reservation items was very low indicating that the items do not hang together well.

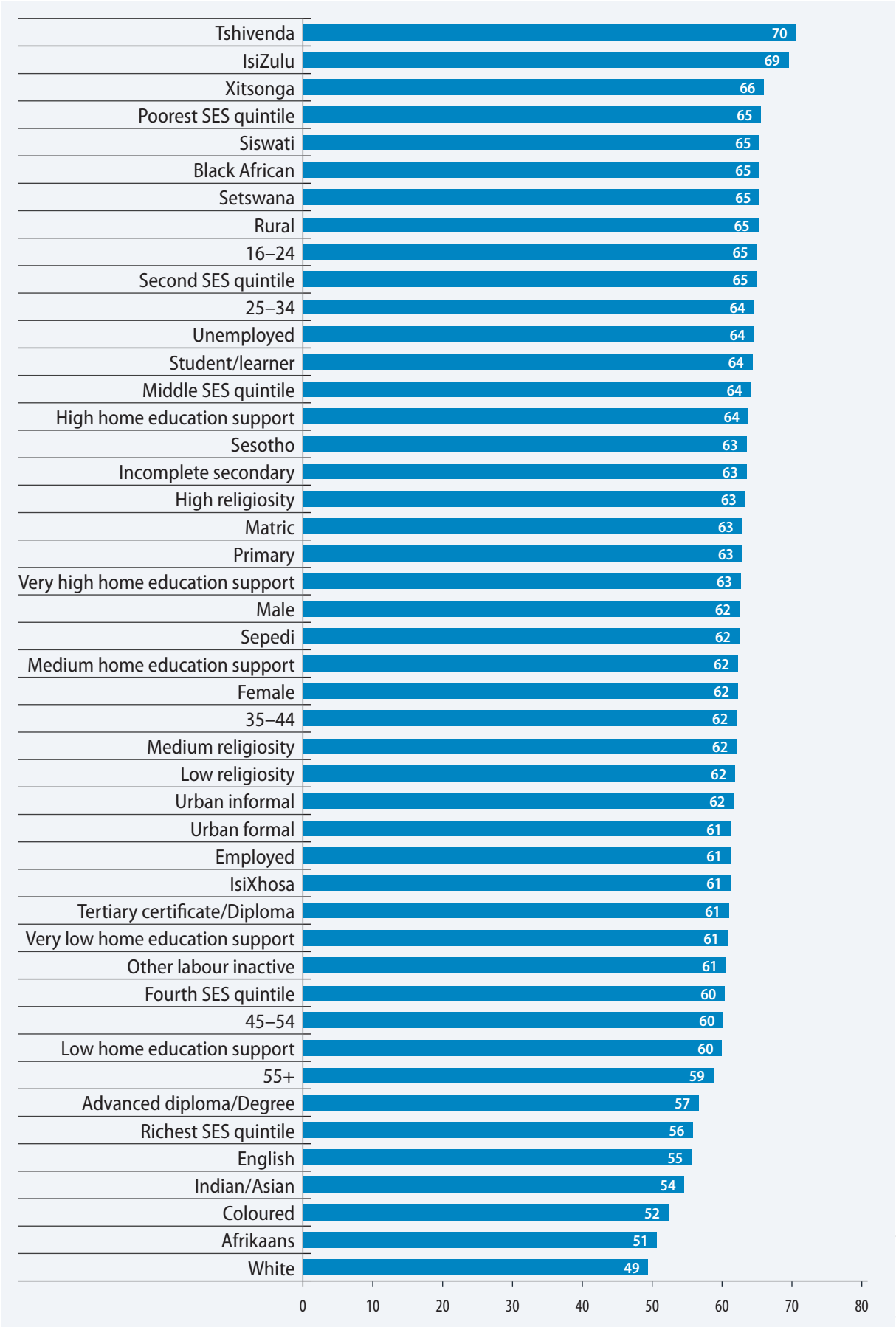
The scale scores were subsequently divided into five categories (very low, low, medium, high and very high) to present the distribution of promise attitudes (Table 21). On average, the public rated the promise of traditional S&T as moderate, with a mean index score of 62. Close to half of the public acknowledged the high promise of traditional S&T (47%), while a third expressed moderate promise, and one-fifth little promise.

TABLE 21: Promise of traditional S&T (percentage)

VERY LOW (0–33)	LOW (34–49)	MEDIUM (50–65)	HIGH (66–80)	VERY HIGH (81–100)	TOTAL	MEAN INDEX SCORE
8	12	33	28	19	100	62.3

In Figure 18, the differences in average promise of traditional S&T scores are presented across different personal characteristics, ranked from highest to lowest promise level. The mean scores for all the observed traits ranged from a low of 49 to a high of 70, illustrating the diversity of views. The highest promise of traditional S&T scores were recorded among those speaking Tshivenda, isiZulu, Xitsonga, Siswati and Setswana as a home language, those living in rural areas, as well as those in the poorer SES quintile, Black African adults and those aged 16 to 24 years. Conversely, the lowest promise scores were found among White, Coloured and Indian/Asian adults, and Afrikaans and English home language speakers, in addition to those in the richest SES quintile, and those with a tertiary-level education.

FIGURE 18: Differences in attitudes towards the promise of traditional science and technology by select socio-demographic attributes (ranked)



With respect to the significance of the mean differences in promise scores across personal characteristics, One-way ANOVA testing found all attributes apart from sex to be statistically significant, while differences based on religiosity were relatively weak. In Table 22, the significant differences are summarised, indicating which sub-groups tended to display higher and lower promise of traditional S&T scores on average.

TABLE 22: Personal characteristics associated with views of promise of traditional S&T

SIGNIFICANTLY HIGHER PROMISE	SIGNIFICANTLY LOWER PROMISE	F	SIG.	RANGE
16–24, 25–34	35–44, 45–54, 55+	24.5	***	59–65
Black African adults	White, Coloured, Indian/Asian adults	203.0	***	49–65
Matric or lower education levels	Advanced diploma/degree	10.9	***	57–63
Unemployed, students/learners	Other labour inactive, employed	16.9	***	61–64
High or very high home education support	Low home education support	6.3	***	60–64
Poorest quintile, second quintile, middle quintile	Richest quintile, fourth quintile	54.8	***	56–66
Rural	Urban formal, urban informal	25.9	***	61–65
Tshivenda, isiZulu, Xitsonga	Afrikaans, English, isiXhosa	73.5	***	51–70

Note: The F-statistic is a measure used to determine whether the mean scores between groups are significantly different from one another. Higher F-statistic values suggest that there may be significant differences between group mean scores. Statistical significance is denoted as * $p<0.05$ (95% level), ** $p<0.01$ (99% level), *** $p<0.001$ (99.9% level). The range of values reflects the minimum and maximum index values on the index for the specific personal attribute.

To further identify the groups who were more and less likely to report higher levels of promise towards traditional S&T when considering all personal characteristics simultaneously, we computed a series of multivariate models using a linear regression approach. Promise towards traditional S&T was the outcome variable of interest. All models contained the standard socio-demographic controls (see Table 3). Table 23 presents data on which factors remained significant when they were considered jointly.

In Model I, we explored how socio-demographic characteristics shaped the promise attitudes towards traditional S&T. Population group identity had a strong association with the promise of traditional S&T index. Black African adults were more likely to report significantly higher promise of traditional S&T than Coloured, Indian/Asian and White adults. In line with the descriptive statistics presented earlier, those with more years of education and higher SES were less likely to report higher levels of promise towards traditional S&T, but these associations were small. Model I explained just 17% of the variance, meaning that the unexplained portion of the variation was large. This indicates that factors not included in Model I play a much stronger role in shaping attitudes of promise towards traditional S&T.

In line with our conceptual framework, in Models II, III and IV, we extended our base Model I to test the role of additional predictor variables in shaping attitudes of promise towards traditional S&T. Model II includes knowledge of and interest in scientific areas, Model III incorporates level of self-identified traditionalism, and Model IV contains knowledge of and interest in traditional S&T, as a predictor variable (Table 23).

In Model II, knowledge of, and interest in, priority S&T areas increased the model fit from 0.17 to 0.22, while in Model III, the level of traditionalness of the respondents similarly increased the model fit to 0.22. In Model IV, the inclusion of knowledge of and interest in traditional S&T almost doubled the proportion of variance explained from 0.17 to 0.30. In Model II, III and IV, with the additional predictors, population group identity continued to have a strong association with the promise of traditional S&T, while SES and educational attainment continued to be less likely to influence views of promise towards traditional S&T.

Interest in both modern (β = 0.243) and traditional (β = 0.272) S&T, knowledge of traditional S&T (β = 0.153), as well as level of traditionalness (β = 0.247) were all significantly and strongly associated with traditional S&T promise, above and beyond the demographic characteristics included.

TABLE 23: Attitudes of promise towards traditional S&T: Summary of OLS models

Full model, including all controls, showing only significant associations and their direction and Beta coefficients:
green = positive; red = negative

	OLS REGRESSIONS			
	Model I	**Model II**	**Model III**	**Model IV**
OUTCOMES	**Promise of traditional S&T**	**Promise of traditional S&T** *(with knowledge of and interest in scientific areas)*	**Promise of traditional S&T** *(with self-identified traditionalism)*	**Promise of traditional S&T** *(with knowledge of and interest in traditional S&T)*
PREDICTORS				
Age (years)				
Female				
Population group (Ref: Black African)				
Coloured	**–0.113*** **	**–0.104******	**–0.070*** **	**–0.085*** **
Indian/Asian	**–0.125*** **	**–0.124*** **	**–0.115*** **	**–0.099*** **
White	**–0.183*** **	**–0.162*** **	**–0.133*** **	**–0.122*** **
Years of education	**–0.060** **	**–0.094*** **	**–0.045***	**–0.094*** **
Home education support	**0.052***		**0.043***	
Employment status (Ref: employed)				
Unemployed				
Student/learner		**–0.046***		
Labour inactive				
Geographic type (Ref: urban formal)				
Urban Informal				
Rural				
Religiosity scale (low to high)				
Socioeconomic status (low to high)	**–0.072** **	**–0.112*** **		**–0.069** **
Knowledge in priority science areas	…		…	…
Interest in priority science areas	…	0.243***	…	…
Level of traditionalness	…	…	0.247***	…
Knowledge of traditional S&T	…	…	…	0.153***
Interest in traditional S&T	…	…	…	0.272***
R-squared	0.17	0.22	0.22	0.30
N	5 792	5 775	5 715	5 673

Notes: *** p<.001; ** p<.01; * p<.05. The symbol '…' indicates the variable was not included in the model. Analyses were weighted. Province of residence was included in all models as a control variable. The regression coefficients displayed in the models are standardised Betas.

Trends in attitudes of promise and reservation towards traditional S&T

We compared the responses to two traditional S&T items using SASAS 2009 and SAPRS 2022 data. Although the items were not phrased identically in both rounds of surveying, the comparison does provide an insight into trends in these attitudes.

The views of the promise of small-scale farming (*traditional small-scale farming provides healthy food for South Africans*) decreased by a statistically significant seven percentage points between 2009 and 2022. Although this is a somewhat small decrease, it is a concern given the role of small-scale farming in providing healthy food for South Africans. It is pleasing to note that the reservation towards traditional science decreased significantly by 18 percentage points over the same period, with more of the public in 2022 trusting in *both modern science and traditional and cultural practices* (Table 24).

TABLE 24: Trends in promise (P) and reservation (R) towards traditional S&T (percentage)

2009 ITEM	2022 ITEM	2009	2022	CHANGE 2009 TO 2022	ONE-WAY ANOVA
Traditional agriculture plays an important role in providing livelihoods for a significant proportion of South Africans (P)	Traditional small-scale farming provides healthy food for South Africans (P)	71	64	–7 percentage points	***
We trust too much in science and not enough in cultural beliefs and practices (R)	I trust more in modern science than in traditional and cultural practices (R)	71	53	–18 percentage points	***

Notes: *** p<.001; ** p<.01; * p<.05.

Key results: Attitudes of promise and reservation towards S&T

This chapter, firstly, reported the levels of promise and reservation attitudes towards modern as well as traditional S&T. Secondly, we identified the sub-group characteristics of those who were more likely to have higher promise and reservation towards modern as well as traditional S&T. Thirdly, we explored the role of knowledge of, and interest in, S&T in shaping promise and reservation attitudes, as well as knowledge of and interest in modern and traditional S&T in shaping promise towards traditional S&T.

LEVELS OF PROMISE AND RESERVATION TOWARDS MODERN AND TRADITIONAL S&T

- The South African public acknowledged the benefits of S&T, as well as the risks that it poses to society. On average, there were high and similar levels of promise and reservation towards modern science, with the mean index scores of 68 and 69 (out of 100), respectively.
- The comparison of the responses to promise items between 2013 and 2022 was mixed. Promise was higher in 2022 for the items "benefits of S&T outweigh the risks" and "S&T will make work more interesting". At the same time, promise was lower for the item "S&T would create opportunities for future generations".
- Overall, the public were moderately positive about the promise of traditional science, with a mean index score of 62 out of 100. Two in ten adults reported they were "very" knowledgeable, while three in ten were "very" interested, in traditional S&T. Five in ten adults acknowledged the high promise of traditional S&T.
- The reservation towards traditional S&T decreased significantly over the 2009 to 2022 period, with more of the 2022 public trusting in both modern science and traditional and cultural practices.

CHARACTERISTICS OF THOSE WHO WERE MORE LIKELY TO HAVE HIGHER PROMISE AND RESERVATION TOWARDS MODERN AND TRADITIONAL S&T

- The average levels of promise and reservation varied within a relatively narrow score range between 62 to 72 and 64 to 76, respectively, across the different characteristics examined: South Africans tended to adopt a favourable but not uncritical view of S&T, irrespective of their diverse backgrounds.
- The socio-demographic characteristics of adults who were more likely to have higher promise and reservation towards modern S&T were those who experienced higher levels of educational attainment and higher home education support, students and learners, those living in urban formal areas, and Black African, Indian and White adults. Socioeconomic status and being a male were also significant factors, but with less notable effects.
- On the other hand, there was higher variation in the views of the promise of traditional S&T, with scores for all observed traits ranging from a low of 49 to a high of 70, reflecting the diversity of views in South African society. South Africans from the poorer SES quintile homes, those with lower education attainment, as well as younger adults were more likely to exhibit higher promise of traditional S&T scores.
- There was a strong association between population group identity and attitudes towards the promise of traditional S&T: Black African adults were significantly more likely to report higher levels of promise towards traditional S&T than Coloured, Indian/Asian and Whites adults. The language spoken at home is also strongly associated with the promise of traditional S&T, with those who spoke Tshivenda, isiZulu and Xitsonga reporting the highest levels of promise of traditional S&T. On the other hand, those who spoke Afrikaans, English and isiXhosa reported lower levels of promise towards traditional S&T.

ROLE OF KNOWLEDGE OF, AND INTEREST IN, S&T IN SHAPING PROMISE AND RESERVATION ATTITUDES

- The socio-demographic factors alone explained less than 10% of the variation of promise and reservation for modern S&T. The addition of interest in, and knowledge of, modern S&T as predictors increased the explanatory power of the promise and reservation models to 16% and 17%, respectively. Interest in the priority science areas was strongly associated with attitudes of promise and reservation towards modern S&T, while knowledge of S&T was only associated with promise of S&T, but its effects were smaller.
- The socio-demographic factors explained a slightly higher 17% of the promise for traditional S&T. The explanatory power of the promise of traditional S&T models was increased by the addition of interest in and knowledge of modern and traditional S&T as predictors. Interest in the priority science areas as well as interest in traditional S&T was strongly associated with attitudes of promise towards traditional S&T, while those that were more knowledgeable of traditional S&T were more likely to see the promise of traditional S&T.

CHAPTER 5

Trust in Science and Confidence in Science Institutions

Science and scientists provide information, evidence, and advice, which informs decisions about how to solve societal problems. For the advice to be heard, the public must be willing and able to trust science, as well as the scientists, and they must have confidence in the institutions that produce such knowledge. Trust means that one can expect science and scientists to provide reliable knowledge and evidence, even if one's own understanding of science is limited.

We use the term *trust* when referring to individuals (scientists), and the term *confidence* when referring to institutions, including science institutions. This chapter explores the trust relationship between science and the public by reporting on the following:

- Trust in scientists and the promise attitudes towards the work of scientists, as well as the characteristics of adults who were more likely to provide positive assessments of the work of scientists,
- Confidence in science and technology (S&T) information received from institutions, as well as the characteristics of those who were inclined to trust information from universities and research organisations,
- Confidence in the way government makes decisions based on evidence, as well as the characteristics of adults who were predisposed towards trusting government evidence-based decision-making, and
- Confidence in the transformation of cultures within science organisations, as well as the characteristics of those who tended to report positive changes in science organisational culture.

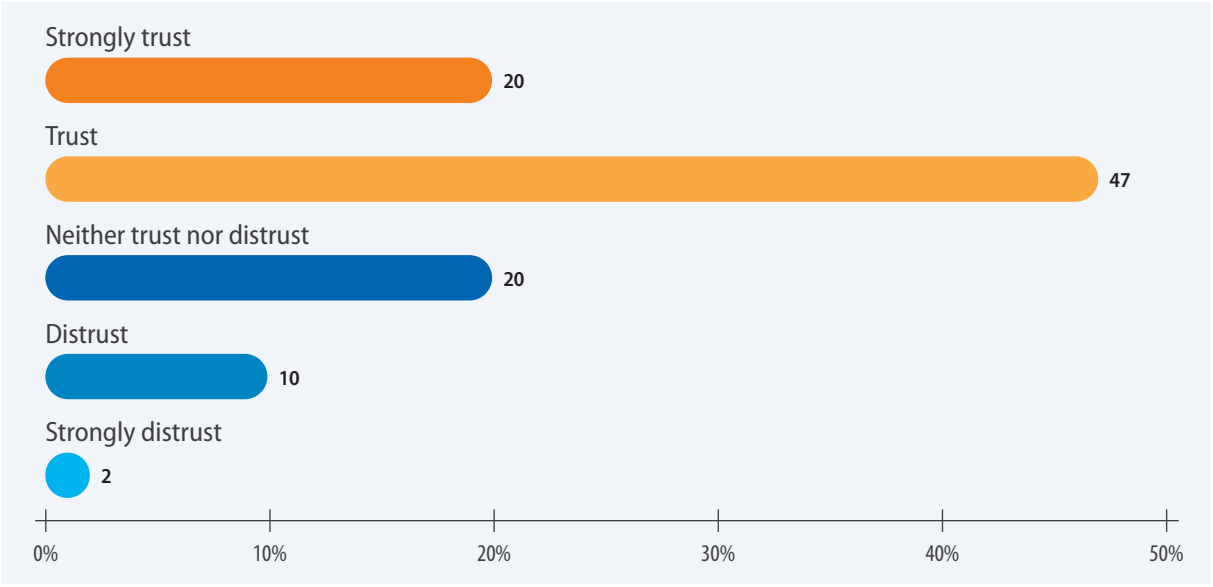
Trust in scientists: promise and reservation attitudes towards the work of scientists

Trust in science and scientists is likely to be associated with greater acceptance of scientific information (Wintterlin et al., 2022). The South African public rated their level of trust or distrust in the work of scientists (Figure 19). Results show that the public had a relatively high level of trust in scientists, with two-thirds (67%) reporting that they "trusted" the work of scientists, and only slightly more than one-tenth (12%) stating that they did not.

To interpret the meaning of the trust statistics described above, we compared public trust in scientists in South Africa with that of other countries. While we do not have a direct comparison measure with other countries, a Pew Research Center survey conducted in 20 countries between October 2019 and March 2020 provides an approximation measure. The survey respondents selected a single response to the item "trust in scientists to do what is right for the survey public" based on a 4-point scale (a lot, some, not much, not at all) (Pew Research Centre, 2019). The percentage of the public who responded "a lot" in select other countries differed appreciably. India reported the highest level of trust (59%), followed by Germany (43%), UK (42%), USA (38%), Malaysia (25%), Brazil (23%), Japan (23%) and South Korea, which had the lowest level of trust (17%) (Funk et al., 2020). Equating the "strongly trust" response in the SAPRS survey to "a lot" in the Pew Research Center survey, it seems that the South African level of

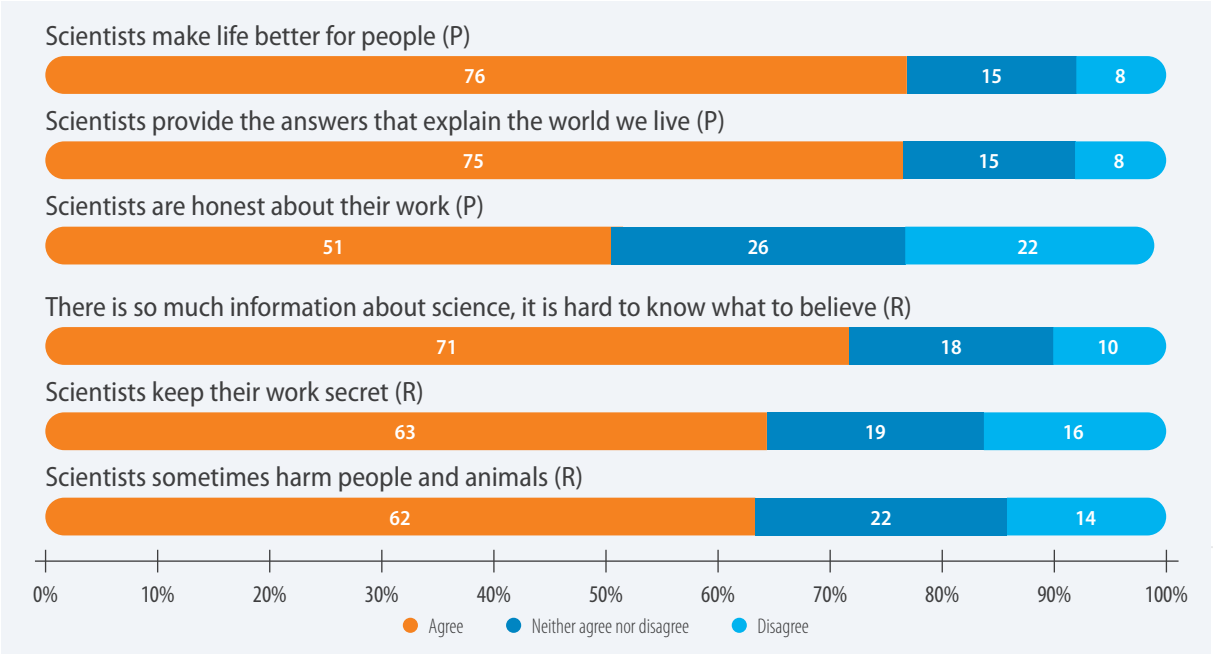
trust in scientists (20% of the public "strongly trusted") falls at the lower end of the 20-country ranking and is closest to the level of trust found in Taiwan, Japan and Brazil.

FIGURE 19: Trust in the work of scientists



Building on the previous chapter, our analysis also explored public views related to the promise and reservations about the work of scientists (Figure 20). Three-quarters of the public recognised the promise of the work of scientists, reporting that it makes life better for people (76%), and generates knowledge that explains the world we live in (75%). However, there were also reservations about the integrity of scientists, with only half of the public (51%) perceiving that scientists are honest about their work, and almost two-thirds being concerned that scientists keep their work secret (63%) and sometimes harm people and animals (62%). More concerning is the finding that seven in 10 of the public (71%) felt overwhelmed as there is "so much information about science, it is hard to know what to believe".

FIGURE 20: Promise (P) and Reservation (R) statements about the work of scientists



Who was more likely to report higher promise of the work of scientists?

We followed two steps to identify which sub-groups expressed higher promise attitudes towards the work of scientists. We first created a *Promise of the work of scientists Index* (Cronbach $\alpha = 0.632$) by averaging out the constituent items and then transforming them into a 0–100 scale, with larger scores representing higher promise.[23]

The scale scores were subsequently divided into five categories (very low, low, medium, high and very high) to report the distribution of promise of the work of scientists (Table 25). The mean index score of the promise of the work of scientists was 69 out of 100, which falls within the high trust category. In line with the high mean index score, two-thirds of the public (66%) rated the promise of the work of scientists as "high" or "very high", while just over one-tenth (11%) rated the promise of their work as "low" or "very low".

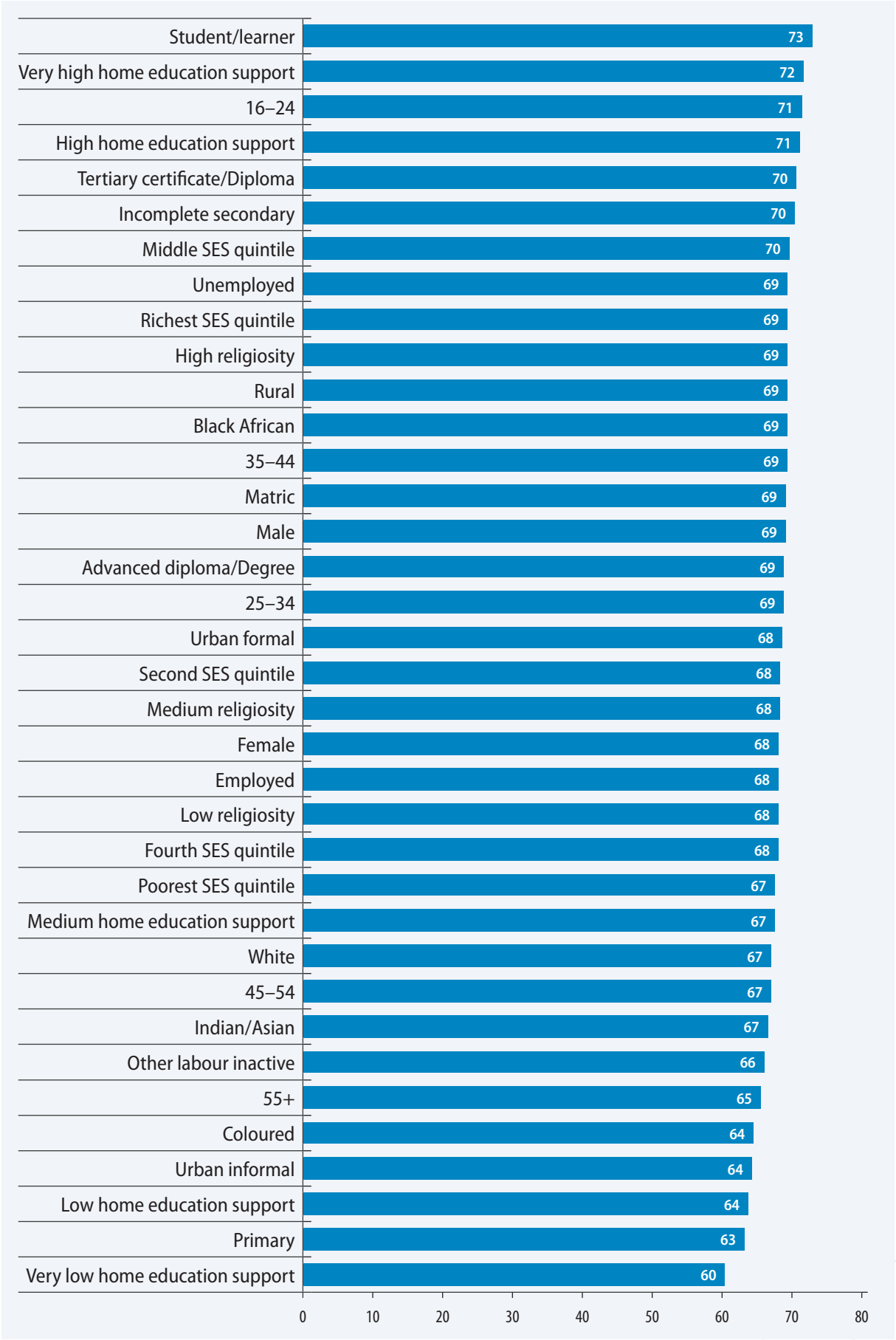
TABLE 25: Promise of the work of scientists (percentage)

VERY LOW (0–33)	LOW (34–49)	MEDIUM (50–65)	HIGH (66–80)	VERY HIGH 81–100)	TOTAL	MEAN INDEX SCORE
6	5	23	40	26	100	68.5

In Figure 21, the mean scores of the promise of the work of scientists' index are presented for various social and demographic sub-groups. The bar chart is ranked from highest to lowest based on a score of 0–100 on the composite index. The mean scores for the promise of the work of scientists' index varied within a range of 60 and 73 across the different sub-groups examined. Trust was high, but within a narrow band. The highest scores on the promise of the work of scientist index were evident among students and learners, those who reported high levels of home education support, those with tertiary certificate/diploma, and those aged 16 to 24 years. Conversely, lower scores were found among those with limited home education support, those with primary or no formal schooling, as well as Coloured adults, those aged 55 years or older, and those living in urban informal areas.

23 We did not create an *Index of reservation toward the work of scientists* as the Cronbach alpha for the reservation items was 0.493, and this low reliability value signified that the items would not load well together to create a reservation scale score.

FIGURE 21: Promise of the work of scientists by select socio-demographic attributes (ranked)



To test whether the group differences in the promise of the work of scientists presented in Figure 21 were significant, One-way ANOVA tests were conducted. Significant differences in the average level of the promise of the work of scientists were found based on all characteristics, except sex, religiosity and socioeconomic status (SES). In Table 26, a summary of significant sub-group differences in the average levels of promise in the work of scientists is presented.

TABLE 26: Personal characteristics associated with the promise of the work of scientists (One-way ANOVA comparison of mean scores)

SIGNIFICANTLY MORE LIKELY	SIGNIFICANTLY LESS LIKELY	F	SIG.	RANGE
16–24	45–54, 55+	17.5	***	65–71
Black African	Coloured and Indian/Asian adults	12.8	***	64–69
Advanced diploma/degree, tertiary certificate/diploma, matric, incomplete secondary	Primary schooling	25.0	***	63–70
Students/learners, unemployed	Employed, other labour inactive	26.6	***	66–73
Very high, high and medium home education support	Very low or very low home education support	57.9	***	60–72
Urban formal and rural	Urban informal	10.9	***	64–69

Note: The F-statistic is a measure used to determine whether the mean scores between groups are significantly different from one another. Higher F-statistic values suggest that there may be significant differences between group mean scores. Statistical significance is denoted as * p<0.05 (95% level), ** p<0.01 (99% level), *** p<0.001 (99.9% level). The range of values reflects the minimum and maximum index values on the index for the specific personal attribute.

The third step was to run a series of multivariate models using a linear regression approach. In the three multivariate models, the *Index of promise of the work of scientists* was the outcome variable of interest. All models contained the standard socio-demographic controls. Table 27 presents data to explore which factors remained significant when they were considered simultaneously.

In Model I, we explored the role of socio-demographic characteristics in shaping beliefs about the promise of the work of scientists. Students and learners (relative to the employed), and those who experienced higher home education support, were more inclined to recognise the promise of the work of scientists. Indian/Asian adults (relative to Black Africans) and those living in urban informal areas (relative to urban formal areas) were less inclined to view the work of scientists positively. This model explained a very low 7% of the variance about the belief in the promise of the work of scientists. Given that the unexplained variance was large, we can conclude that other factors not included in Model I influence the variation in the promise of scientists' work.

In line with our conceptual framework, Model II extends Model I with the addition of the indices of knowledge of, and interest in, S&T as predictor variables to test its association with the belief about the promise of the work of scientists. Model III further extends Model II by including promise and reservation attitudes towards S&T, to test the role of knowledge of, and interest in, science areas, as well as promise and reservation attitudes in shaping the belief about the promise of the work of scientists (Table 27).

The addition of the indices of knowledge of, and interest in, science areas to the base model in Model II, and the further addition of attitudes towards the promise and reservation of S&T in Model III, increased the model fit to 0.18 for Model II and 0.30 for Model III.

In Model II, knowledge of, and interest in, science areas are strongly associated with belief about the promise of the work of scientists. In Model III, the three variables, knowledge of (β = 0.113) and interest

in (β = 0.136) science areas, as well as promise towards S&T (β = 0.361) had a strong association with positive attitudes towards the work of scientists. Reservation towards S&T (β = 0.054) also shaped views about the promise of the work of scientists, albeit to a smaller degree.

It is noteworthy that home education support remained strongly associated with the promise of the work of scientists, even after controlling for a range of other demographic and attitudinal variables: Home education support showed the importance of intergenerational curiosity and knowledge building. It is also noteworthy that Indian/Asian adults remained significantly less likely than Black African adults to recognise the promise of the work of scientists across all three models.

TABLE 27: Promise of the work of scientists: Summary of OLS models

Full model, including all controls, showing only significant associations, their direction and the beta coefficients: green = positive; red = negative

	OLS REGRESSIONS		
	MODEL I	MODEL II	MODEL III
OUTCOME	**Promise of the work of scientists**	**Promise of the work of scientists** *(with knowledge of and interest in scientific areas)*	**Promise of the work of scientists** *(with knowledge of, interest in, promise and reservation towards S&T)*
PREDICTORS			
Age (years)			
Female			
Population group (Ref: Black African)			
Coloured			
Indian/Asian	**–0.054*** **	**–0.055*** **	**–0.042*** **
White			
Years of education			
Home education support	**0.160*** **	**0.104*** **	**0.081*** **
Employment status (Ref: employed)			
Unemployed			
Student/learner	**0.046***	**0.043***	
Labour inactive			
Geographic type (Ref: Urban formal)			
Urban Informal	**–0.047***		
Rural			
Religiosity scale (low to high)			
Socioeconomic status (low to high)			
Knowledge of scientific areas	…	0.152***	**0.113*** **
Interest in scientific areas	…	0.247***	**0.136*** **
Promise towards S&T	…	…	**0.361*** **
Reservation towards S&T	…	…	**0.054****
R-squared	0.07	0.18	0.30
N	5 814	5 795	5 764

Notes: *** p<.001; ** p<.01; * p<.05. The symbol '…' indicates the variable was not included in the model. Analyses were weighted. Province of residence was included in all models as a control variable. The regression coefficients displayed in the models are standardised Betas.

One way to understand confidence in institutions is to rate the trust placed in the information that emerges from those institutions.

Confidence in S&T information from science institutions

One way to understand confidence in institutions is to rate the trust placed in the information that emerges from those institutions. To gauge this level of confidence, survey participants were asked the extent to which they trusted or distrusted S&T information from several different institutions, using a 5-point scale. We collapsed the responses to these questions into three distinct categories – trust, neither trust nor distrust, and distrust (Figure 22).

The most trusted institutions for S&T information were universities and research institutions, with 71% of the public reporting "trust" in information from these sources, and just 8% expressing "distrust". This is in line with the levels of public trust in scientists reported in Figure 19. The levels of trust dropped to below 50% in the case of all other institutions listed (which are not necessarily knowledge producers), with just 45% reporting trust in the S&T information emerging from the corporate world and 42% trusting religious leaders.

On average, around a quarter of the public were neutral regarding trust in S&T information from the institutions listed, that is they reported neither trusting nor distrusting them. The lowest reported level of trust in S&T information was from government institutions: national government (38% trusted); local government (33%); as well as traditional leaders (36%). Worryingly, "distrust" exceeded "trust" by 13 percentage points for S&T information from local government.

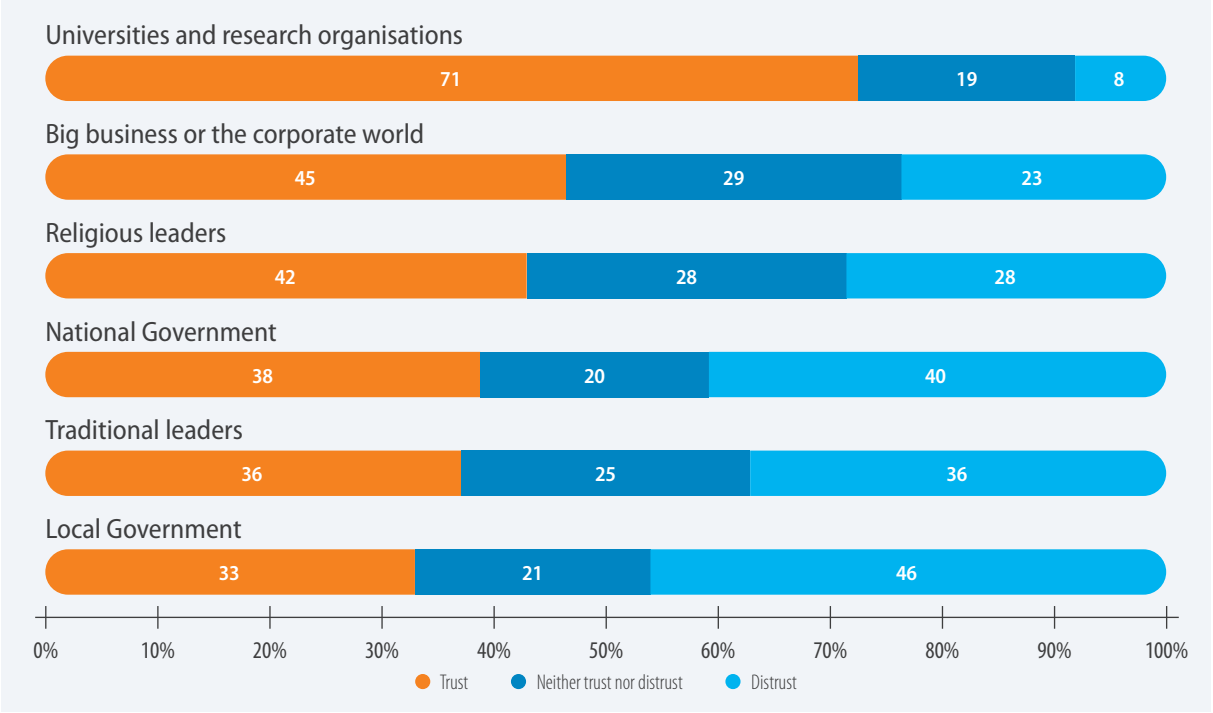
Previous research has shown that there was a decrease in public confidence in South African state institutions since the 2010s. At the time of writing, large segments of the public distrust governance institutions in South Africa. Consequently, it is not surprising that the public distrusts S&T information from such institutions (see Roberts et al., 2024).

Trust in government institutions globally has also declined. A cross-national survey on public governance and administration included an item on confidence in national government.[24] The comparative statistics for select countries who responded "Yes" were South Africa (51%), Germany (61%), Russia (46%), South Korea (43%), Brazil (40%), UK (40%) and USA (31%) (OECD 2023b). The low trust levels observed could be related to the governance challenges experienced during the COVID-19 pandemic. The survey was

24 The survey question was "In this country, do you have confidence in national government?" with options Yes/No/Don't know.

conducted in 2021, the second year of the coronavirus pandemic when the public began losing confidence in governments' response to the health crisis.

FIGURE 22: Confidence in S&T information from different institutions

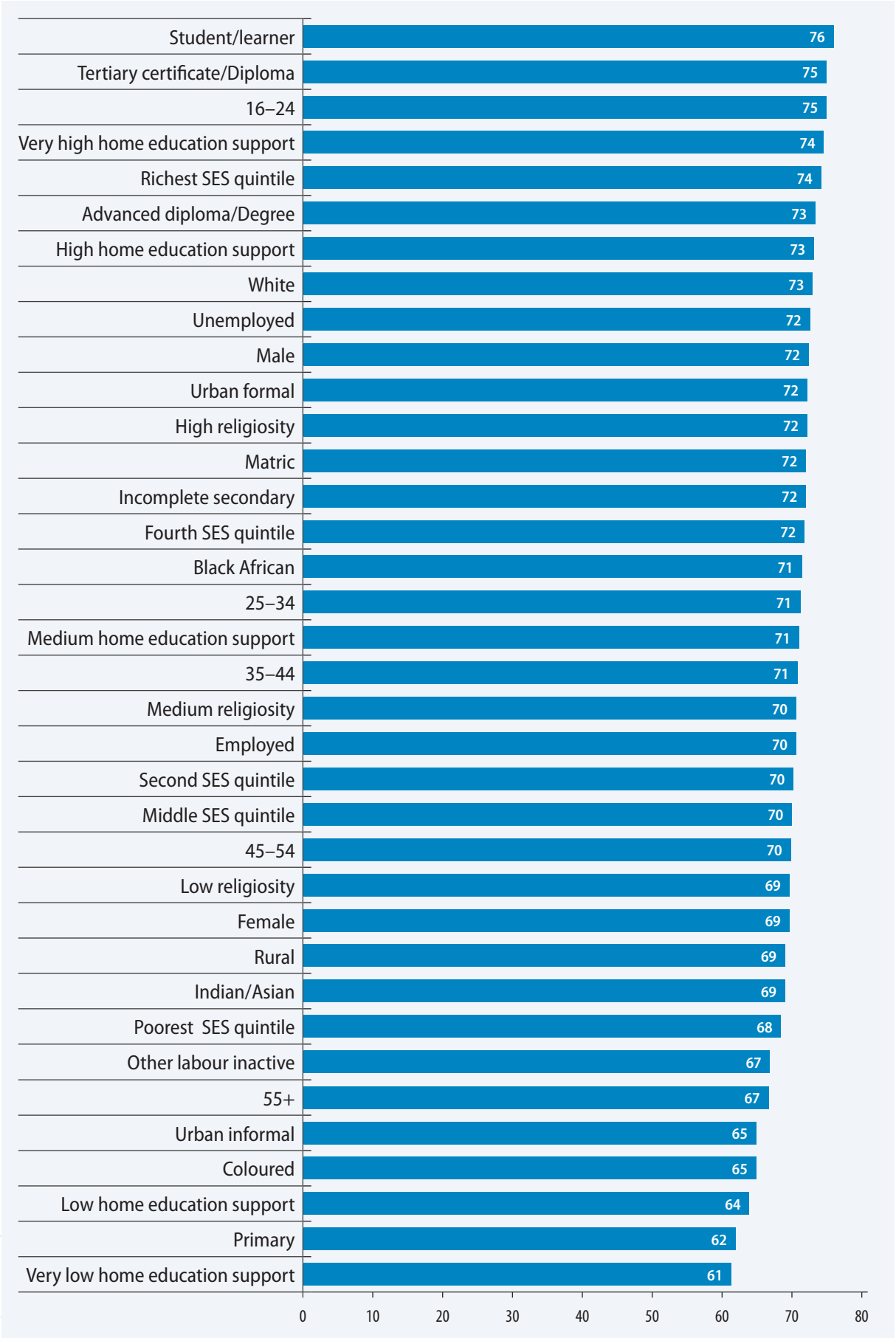


Who was more and less likely to trust S&T information from universities and research organisations?

While 71% of the public "trusted" S&T information from universities and research organisations, only 21% reported that they "strongly trusted" S&T information from these organisations. To identify the groups who were more and less likely to trust S&T information from universities and research organisations, the trust variable was cross-analysed against the socio-demographic variables. This descriptive analysis was based on a reversed version of the measure that was converted to a 0–100 scale for ease of interpretation, with 0 meaning strong distrust in information from universities and research organisations and 100 meaning strong trust in information from these sources.

In Figure 23, mean scores for trust in information from universities and research organisations are presented for various social and demographic sub-groups. The bar chart scores are ranked from highest to lowest on this single-item measure. The level of trust in information from universities and research organisations among the public varied within a narrow range of 61 and 76 across the different characteristics examined. The highest levels of trust in information from universities and research organisations were evident among students and learners, those who reported very high levels of home education support, those with a tertiary qualification, those aged 16 to 24 years and those in the richest socioeconomic quintile. Conversely, lower scores were found among those with limited home education support, those with primary schooling, Coloured adults, those aged 55 years or older, those living in urban informal areas, and those from the poorest SES homes.

FIGURE 23: Trust in information from universities and research organisations by select socio-demographic attributes (ranked)



To test whether the sub-group differences in the level of trust in information from universities and research organisations presented in Figure 23 were significant, One-way ANOVA tests were conducted. Significant differences in the average level of trust in information from universities and research organisations were found based on all characteristics. Table 28 presents a summary of significant sub-group differences in the average levels of trust in information from universities and research organisations.

TABLE 28: Personal characteristics associated with trust in information from universities and research organisations

SIGNIFICANTLY HIGHER TRUST	SIGNIFICANTLY LOWER TRUST	F	SIG.	RANGE
16–24	25–34, 35–44, 45–54, 55+	20.3	***	67–75
Male	Female	22.6	***	69–72
Black African, Indian/Asian and White adults	Coloured adults	15.6	***	65–73
Advanced diploma/degree, tertiary certificate/ diploma, matric, incomplete secondary	Primary or no formal schooling	43.9	***	62–75
Students/learners, unemployed, employed	Other labour inactive	33.0	***	67–76
Very high, high or medium home education support	Very low or low home education support	55.4	***	61–74
Richest and fourth asset quintile	Poorest, second and middle asset quintile	10.0	***	68–74
Urban formal and rural	Urban informal	24.7	***	65–72
High religiosity	Low religiosity	5.8	***	69–72

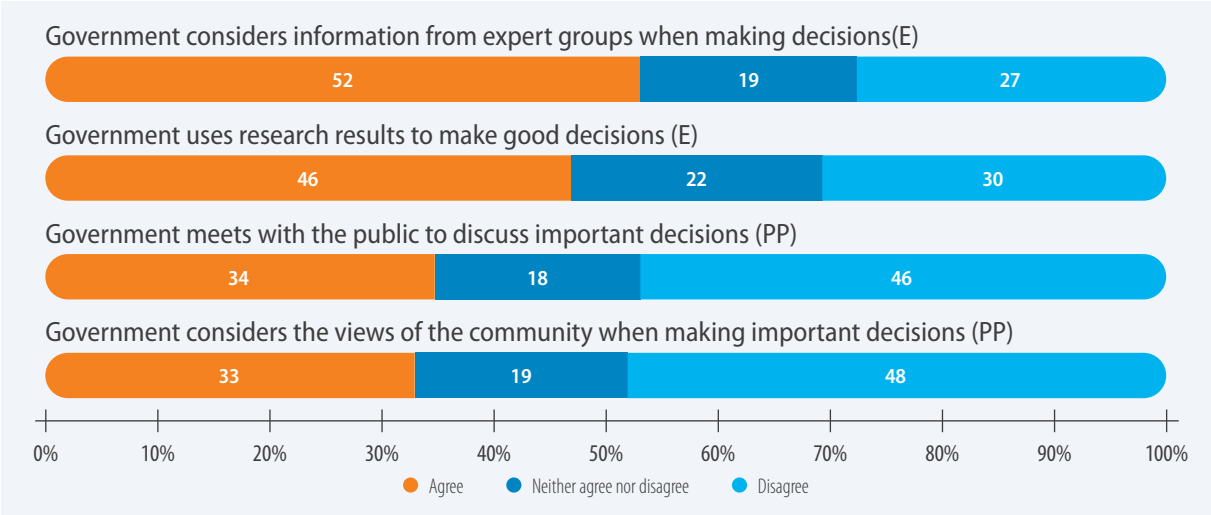
Note: The F-statistic is a measure used to determine whether the mean scores between groups are significantly different from one another. Higher F-statistic values suggest that there may be significant differences between group mean scores. Statistical significance is denoted as * p<0.05 (95% level), ** p<0.01 (99% level), *** p<0.001 (99.9% level). The range of values reflects the minimum and maximum index values on the index for the specific personal attribute.

Confidence in government's evidence-based decision-making processes

The South African government is committed to an evidence-based and public participation philosophy in its decision- and policymaking processes (DPME, 2019). To unpack the public trust in government's decision-making processes, we used two constructs: (i) evidence-based decision making, and (ii) public participation. Two items were used to measure public trust in evidence-based decision making (E), and another two items were used to assess public attitudes towards government's incorporation of public participation (PP) processes (Figure 24). The level of trust in these processes gives an indication of an analytical and evidence-based society.

The public were more positive about government's use of evidence in decision making than they were about government's public participation processes. On the one hand, close to 50% of the public agreed that government used an evidence-based approach to decision making (*considered information from expert groups (52%) and used research results (46%)*), while 30% disagreed. On the other hand, only one-third of the public agreed that there was public participation included in government's decision-making processes *(met with the public (34%), and considered community views (33%)*, while close to half disagreed with this.

FIGURE 24: Confidence in government's evidence-based and participatory decision-making processes



Who was more and less likely to trust government's evidence-based and participatory decision-making processes?

As in the preceding analyses, we wanted to understand whether there are identifiable characteristics distinguishing those who were more likely to trust how government makes decisions. We created a *Trust in government decision-making processes index* (Cronbach $\alpha = 0.793$) by averaging out the constituent items and then transforming them into a 0–100 scale, with larger scores representing greater trust.

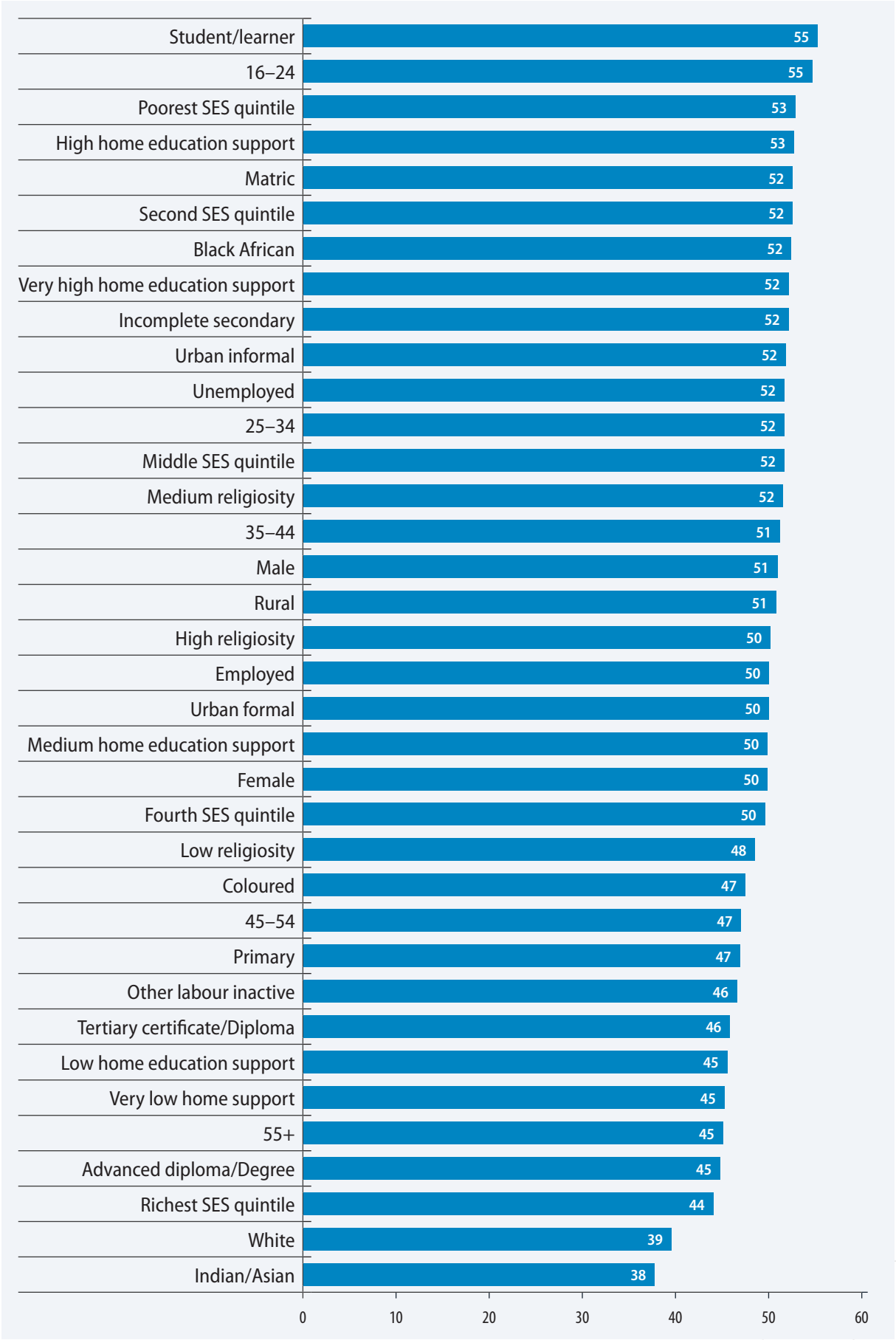
The scale scores were subsequently divided into five categories (very low, low, medium, high and very high) to present the distribution of trust in government decision-making processes (Table 29). On average, the level of trust in government decision-making processes in South Africa can be categorised as low to moderate in nature, with a mean index score of 50. One in three adults (29%) had high trust in government decision-making processes, one in three had medium trust (29%) and four in ten (43%) had low or very low trust in government decision-making processes (see also Figure 22).

TABLE 29: Trust in government's evidence-based and participatory decision-making process (percentage)

VERY LOW (0–33)	LOW (34–49)	MEDIUM (50–65)	HIGH (66–80)	VERY HIGH (81–100)	TOTAL	MEAN INDEX SCORE
27	16	29	19	10	100	50.2

In Figure 25, the mean scores of the trust in government decision-making processes are presented for various social and demographic sub-groups. The bar chart is ranked from highest to lowest, based on a score of 0–100. The average level of trust in government decision-making processes among the public varied within a range from 38 to 55 across the different sub-groups examined. The highest levels of trust in government decision-making processes were evident among students and learners, those aged 16 to 24 years, those from homes in the poorest SES quintile, those from homes with high educational support, and Black African adults. Conversely, lower scores were found among Indian/Asian and White adults, those from homes in the richest SES quintile, those with advanced levels of education, and those aged 55 years and above.

FIGURE 25: Trust in government decision making by select socio-demographic attributes (ranked)



To test whether the group-based differences in average levels of trust in government decision making presented in Figure 25 were significant, One-way ANOVA tests were conducted. Significant differences in the average level of trust in government decision making were found for all characteristics examined, except for sex and urban-rural location. In Table 30, a summary of significant sub-group differences in the average levels of trust in government decision making is presented.

TABLE 30: Personal characteristics associated with trust in government's decision making (One-way ANOVA comparison of mean scores)

SIGNIFICANTLY HIGHER TRUST	SIGNIFICANTLY LOWER TRUST	F	SIG.	RANGE
16–24, 25–34, 35–44	45–54, 55+	32.5	***	45–55
Black African and Coloured adults	Indian/Asian and White adults	74.2	***	38–52
Matric, incomplete secondary	Advanced diploma/degree, tertiary certificate/ diploma, primary or no formal schooling	24.6	***	45–52
Students/learners, unemployed, employed	Other labour inactive	27.6	***	46–55
Very high or high or medium home education support	Very low or low home education support	21.5	***	45–53
Poorest and second SES quintile	Richest and fourth SES quintile	29.4	***	44–53
Medium religiosity	Low religiosity	8.7	**	48–52

Note: The F-statistic is a measure used to determine whether the mean scores between groups are significantly different from one another. Higher F-statistic values suggest that there may be significant differences between group mean scores. Statistical significance is denoted as * $p<0.05$ (95% level), ** $p<0.01$ (99% level), *** $p<0.001$ (99.9% level). The range of values reflects the minimum and maximum index values on the index for the specific personal attribute.

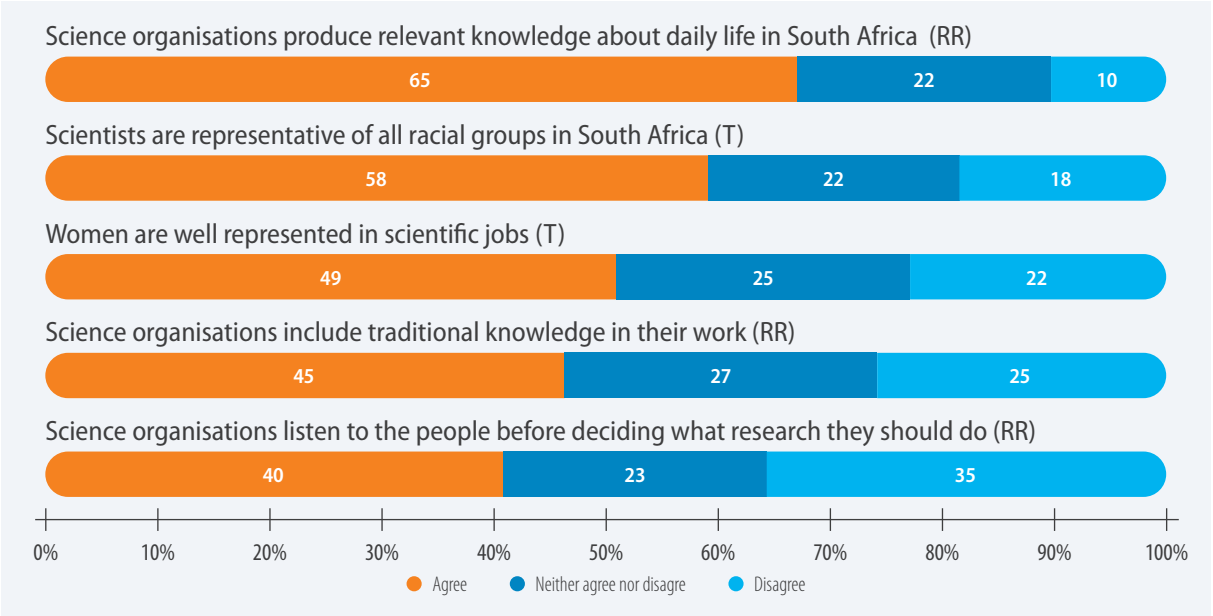
Confidence in the transformation of cultures within science organisations

Science institutions, like other organisations in the country, are required to: (i) make their work more relevant and responsive to the needs of the public (RR), and (ii) have workforces that are transformed and more representative of the population group and sex demographics of the country (T). Figure 26 reports the responses to a set of statements on the extent to which the public perceived these changes were happening in science organisations.

While two-thirds (65%) of the public agreed that science organisations produced relevant knowledge about daily life, less than half felt that the research agendas were informed by listening to the people (40%), or that traditional knowledge was being included in the work of these organisations (45%).

The public were generous in their assessments of transformation within science professions, with half of the public (49%) agreeing that gender transformation was evident, while slightly under six-tenths (58%) perceived that there was racial transformation. The higher education sector is made up of 53% male and 47% female academic staff, while the population group composition (South African citizens) is 37% White 33%, Black African, 9% Indian/Asian and 6% Coloured (DSI, 2024).

FIGURE 26: Public perceptions of transformation of cultures in science organisations (row percentages)



Who was more and less likely to agree that there was transformation of organisational cultures?

We wanted to identify the socio-demographic characteristics of adults who strongly agreed that there was transformation of cultures in science organisations in the country. We therefore created a *Transformation of cultures in science organisations index* (Cronbach $\alpha = 0.694$) by averaging outthe constituent items and then transforming them into a 0–100 scale, with larger scores representing more positive views of the changed culture.

The scale scores were subsequently divided into five categories (very low, low, medium, high and very high) to present the distribution of changes in science organisational cultures (Table 31). The mean index score for perceptions of transformation of cultures in science organisations was 59 – a moderate rating. Forty-four per cent of the public rated the transformational changes as high or very high, 32% as moderate and 23% as low or very low.

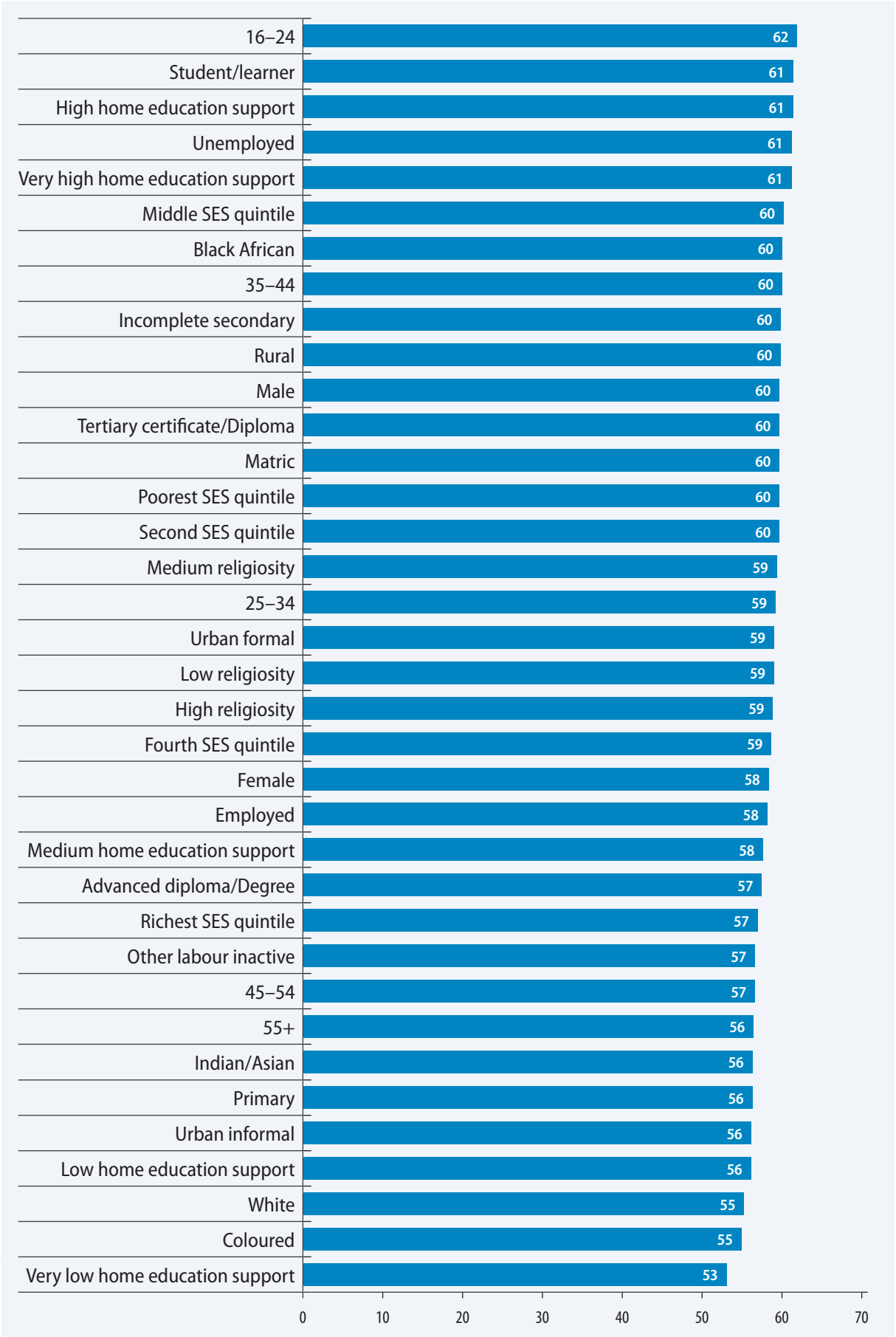
TABLE 31: Transformation of cultures in science organisations (percentage)

VERY LOW (0–33)	LOW (34–49)	MEDIUM (50–65)	HIGH (66–80)	VERY HIGH (81–100)	TOTAL	MEAN INDEX SCORE
6	17	32	37	7	100	59.0

In Figure 27, mean scores for the transformation of cultures in science organisations are presented for various social and demographic characteristics. The bar chart is ranked from highest to lowest, based on the mean scale score on the composite index. The level of agreement about transformation in science organisations among the public varied within a relatively narrow range between 53 and 62 across the different characteristics examined. This suggests that, on average, South Africans tend to adopt a broadly similar view of transformation of cultures in science organisations, irrespective of their diverse backgrounds.

The highest levels of agreement that changes in science organisations were evident were found among those aged 16 to 24 years, students or learners, Black African adults, those who reported high levels of home education support, and the unemployed. Conversely, lower scores were found among Coloured, White and Indian/Asian adults, those with primary or no formal education and those reporting very low levels of home education support, those aged over 55 years, and those living in urban informal areas.

FIGURE 27: Changes in science organisations by select socio-demographic attributes (ranked)



To test whether the group differences in the views of transformation in cultures in science organisations are presented in Figure 27 were significant, One-way ANOVA tests were conducted. Significant differences in the average level of views of transformation in the cultures in science organisations were found based on all characteristics, except religiosity. In Table 32, a summary of significant sub-group differences in the average levels of transformation in science organisation culture is presented.

TABLE 32: Personal characteristics associated with views on transformation in cultures in science organisation

SIGNIFICANTLY HIGHER AGREEMENT	SIGNIFICANTLY LOWER AGREEMENT	F	SIG.	RANGE
16–24, 25–34, 35–44	45–54, 55+	20.8	***	56–62
Male	Female	9.5	*	58–60
Black African adults	Indian/Asian, Coloured and White adults	27.2	***	55–60
Incomplete secondary, matric, tertiary certificate/diploma	Primary or no formal schooling	9.0	***	56–60
Students/learners, unemployed	Other labour inactive and employed	25.8	***	57–61
Very high or high home education support	Very low, low or medium home education support	35.6	***	53–61
Urban formal and rural	Urban informal	6.6	*	56–60
Poorest, second and middle asset quintile	Richest asset quintile	6.1	**	57–60

Note: The F-statistic is a measure used to determine whether the mean scores between groups are significantly different from one another. Higher F-statistic values suggest that there may be significant differences between group mean scores. Statistical significance is denoted as * $p<0.05$ (95% level), ** $p<0.01$ (99% level), *** $p<0.001$ (99.9% level). The range of values reflects the minimum and maximum index values on the index for the specific personal attribute.

Key results: Trust in science and science institutions

This chapter, firstly, reported the levels of trust in the work of scientists, confidence in S&T information from different organisations, confidence in government's evidence-based decision-making processes and the transformation of cultures within science organisations. Secondly, we identified the sub-group characteristics of those who were more and less likely to have higher trust in science and science organisations. Thirdly, we explored the role of knowledge of and interest in science areas, as well as attitudes of promise and reservation, in shaping the trust attitudes towards science.

LEVELS OF TRUST

- The South African public had a relatively high level of trust in scientists with two-thirds rating the promise of the work of scientists as "high" or "very high".
- The confidence in institutions to provide credible S&T information varied, with 71% of the public trusting S&T information from universities and research institutions. There was lower trust in the non-knowledge producing institutions, with 45% trusting business and the corporate world, 42% trusting religious leaders, and a third each trusting national government (38%), local government (33%) or traditional leaders (36%).
- Trust in government decision-making processes in South Africa can be categorised as low to moderate, with a mean index score of 50 out of 100. While close to half of the public agreed that government used an evidence-based approach to decision making, only one-third agreed that there was public participation in government decision-making processes.
- The average rating of transformation of cultures in science organisations was moderate with a mean index score of 59 out of 100.

CHARACTERISTICS OF THOSE WHO WERE MORE LIKELY TO HAVE HIGHER TRUST IN SCIENTISTS AND SCIENCE INSTITUTIONS

- Promise in the work of scientists and trust regarding S&T information received from universities and research organisations was high. In addition, the average levels were within a narrow range of 60 to 73 and 61 to 76 (out of 100), respectively, across the different socio-demographic characteristics examined.
- Those with higher educational attainment, who experienced higher home education support, students and learners, Black African, Indian/Asian and White adults were more inclined to see the promise of the work of scientists and trust in S&T information from universities and research organisations. Similar views were shared, albeit to a lesser extent, by males.
- The average level of trust in government decision-making processes among the public varied within a low and narrow range of 38 to 55 out of 100 across the different characteristics examined. The highest levels of trust in government decision-making processes were evident among Black African and Coloured adults, students and learners as well as the employed and unemployed, adults aged between 16 and 44 years, those from the poorer SES quintile homes and, to a lesser extent, those with an educational attainment of matriculation or lower.
- The level of agreement about transformation of cultures in science organisations among the public was moderate, with average mean scores varying within a relatively narrow range of between do we keep both words 53 and 62 out of 100 across the different subgroups examined. This suggests that, on average, South Africans tended to adopt a broadly similar view of transformation of cultures in science organisations, irrespective of their diverse backgrounds. Higher mean scores were evident among those who reported high home education support and, to a lesser extent, adults aged 16 to 44 years and Black African adults.

ROLE OF KNOWLEDGE AND INTEREST IN SCIENCE AREAS, AS WELL AS ATTITUDES OF PROMISE AND RESERVATION, IN SHAPING THE TRUST ATTITUDES TOWARDS S&T

- The socio-demographic variables explained less than 10% of variation in trust in scientists and confidence in scientific institutions. Factors other than the socio-demographics shape such patterns of trust and confidence. We tested the role of knowledge of, and interest in, S&T as well as promise and reservation attitudes in shaping attitudes of trust in S&T.
- The results confirm the key hypotheses regarding the relationships between these constructs as outlined in the conceptual model (see Chapter 1). Knowledge of and interest in science areas as well as promise towards S&T have a strong positive relationship towards/ with the work of scientists. The implications are that efforts to improve scientific knowledge and interest in society are likely to have a direct positive impact on trust in scientists and confidence in science institutions. They are also likely to have an indirect positive influence on trust and confidence levels through the greater recognition of the promise (as well as reservations) of science that are promoted.

SECTION C

Science Engagements: S&T Information, Activities, Behaviours and Views

4 Access to and Trust in S&T information

- Digital and internet access and usage
- S&T information exposure and consumption
- Trust in S&T news sources

5 Science Engagement Outcomes

5.1 Activities and behaviours

- Academic
- Event-based
- Community-based
- Use of online apps
- Information sharing

5.2 Pride, promise, and priorities in the NSI

- Pride in S&T achievements
- Promise of S&T skills for youth
- Support for R&D spending
- S&T research priorities
- Value of S&T in everyday life

CHAPTER 6

Access to, and Trust in, Science and Technology Information

The consistent recommendation for a healthy relationship between science and society relates to the importance of sharing science and technology (S&T) information and ensuring that the public can access and trust this information. This chapter reports on the level of public access to, and trust in, scientific information. In line with our conceptual model, we tested how such access and trust shape public attitudes towards S&T, as well as science engagement actions and behaviours. We use the South African Public Relationship with Science (SAPRS) 2022 data to report on access to, and trust in, S&T information on the following:

- Digital and internet access and usage, and the characteristics of those who were more and less likely to have higher internet usage;
- Patterns of internet usage, and frequency of the use of social media;
- The amount of S&T information the public received (i.e. exposure), and the characteristics of those who were more and less likely to have higher exposure;
- The amount of S&T information the public actively accessed (i.e. consumption), and the characteristics of those who were more and less likely to have higher consumption;
- Trust in S&T information, and the characteristics of those who were more and less likely to have higher trust in the news; and
- How access to, and trust in, S&T information shapes knowledge of, and interest, in S&T, promise and reservation attitudes, as well as trust in scientists and government evidence-based decision-making processes.

Digital and internet access and usage

The digital space is now the most popular source for access to, and the communication of, information. A description of the levels of access to this space, especially in low-income, unequal societies, provides a picture of one of the prerequisites for access to S&T information. In the SAPRS survey, access was measured in several ways. Table 33 reports on the availability of select personal assets that enable access to the digital space.

In 2022, most of the public reported having access to a cell phone (94%) and three-quarters had some form of internet access (76%). Access to smartphones (i.e. cell phones with internet access) was lower, with 61% of the public reporting having a smartphone. Close to a quarter of the public reported having a computer (27%) or internet connection (21%) at home.

TABLE 33: Availability of digital devices and internet access (percentage)

CELL PHONE	ANY FORM OF INTERNET ACCESS	SMARTPHONE	COMPUTER OR TABLET AT HOME	HOME INTERNET CONNECTION
94	76	61	27	21

In addition to the availability of these digital assets, we asked the public how often they accessed and spent time on the internet. We created a *frequency of internet usage measure,* to compute the amount of time the public spent online at the time of surveying, using three variables: (i) Do you have access to the internet?; (ii) How often do you access the internet?; and (iii) How much time do you spend on the internet each day?

The *frequency of internet usage index* was subsequently classified into six categories to describe the distribution of usage: no internet access; less than weekly; weekly; less than four hours on most days; between four and eight hours on most days; and more than eight hours on most days (Table 34).

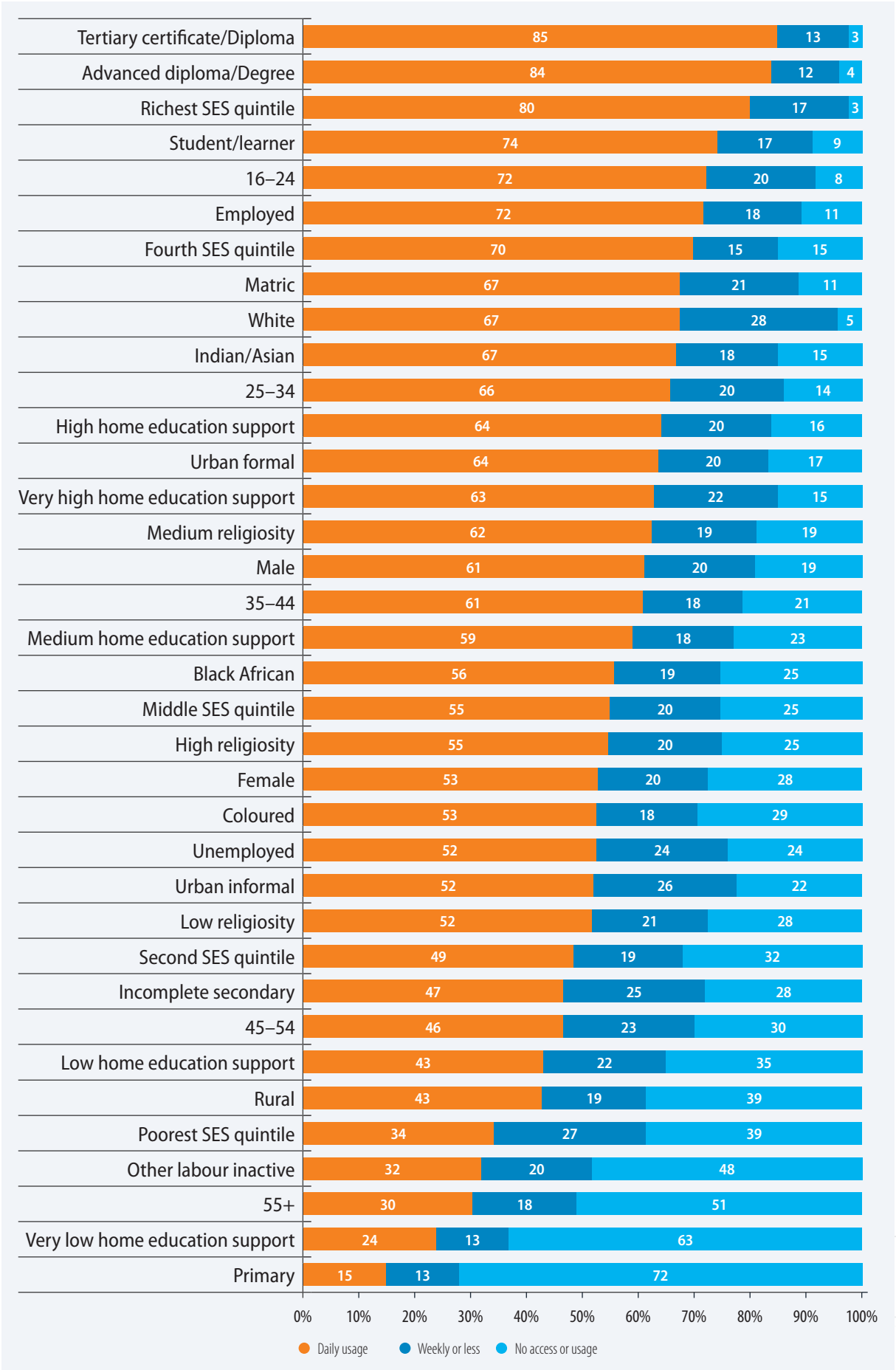
A quarter of the public had no internet access (24%), while a third reported using the internet for four hours or more on most days (31%). Fifteen per cent of the public were very frequent users of the internet, i.e. spending more than eight hours most days on the internet.

TABLE 34: Frequency of internet usage measure (row percentage)

NO INTERNET ACCESS	LESS THAN WEEKLY	WEEKLY	LESS THAN 4 HOURS ON MOST DAYS	BETWEEN 4 AND 8 HOURS ON MOST DAYS	MORE THAN 8 HOURS ON MOST DAYS	TOTAL
24	11	9	26	16	15	100

Figure 28 presents the distributions based on internet access and usage, categorised into daily usage, weekly or less than weekly usage, and no usage, by various social and demographic characteristics. The bar chart is ranked from highest to lowest, based on the usage category. The range of daily access to and use of the internet by sub-groups is wide – from a high of 85% to a low of 15% – reflective of the diverse and unequal nature of South African society. From the figure, we see that daily access to and use of the internet was highest among those with higher levels of education, those in the richest SES quintile, those aged 16 to 24 years, students or learners, and the employed. Conversely, the lowest access and use were observed among those with primary or no formal schooling, those with very low home education support, those aged 55 years and older, those from rural areas and the poorest SES quintile, and persons categorised as other labour inactive.

FIGURE 28: Frequency distribution of internet usage by select socio-demographic characteristics (percentage, ranked)



To test whether the sub-group differences in frequency of internet usage were significant, One-way ANOVA tests were conducted. For this analysis, we transformed the 0–5 scale into a 0–100 scale for ease of interpretation. According to this measure, 0 means no access and 100 means usage for eight or more hours a day on most days. Significant differences in the average level of internet usage were found based on all the characteristics examined. In Table 35, a summary of significant sub-group differences based on the mean score (0–100) is presented.

TABLE 35: Who is more and less likely to have higher internet usage

LIKELY TO HAVE HIGHER INTERNET USAGE	LIKELY TO HAVE LOWER INTERNET USAGE	F	SIG.	RANGE
16–24, 25–34	45–54, 55+	217.9	***	26–63
Male	Female	30.1	***	46–51
White and Indian/Asian adults	Black African and Coloured adults	16.2	***	44–57
Matric, tertiary certificate/diploma, advanced diploma/degree	Primary, incomplete secondary	426.2	***	13–69
Very high and high and medium home education support	Very low and low home education support	116.3	***	20–56
Employed, student/learner	Other labour inactive, unemployed	328.4	***	28–65
Fourth and richest SES quintile	Poorest, second and middle SES quintile	160.6	***	33–66
Medium and high religiosity	Low religiosity	19.8	***	45–52
Urban formal	Urban informal and rural residents	99.3	***	39–53

Note: The F-statistic is a measure used to determine whether the mean scores between groups are significantly different from one another. Higher F-statistic values suggest that there may be significant differences between group mean scores. Statistical significance is denoted as * $p<0.05$ (95% level), ** $p<0.01$ (99% level), *** $p<0.001$ (99.9% level). The range of values reflects the minimum and maximum index values on the index for the specific personal attribute.

Patterns of internet usage

The use of the internet is increasing for most people and is a popular way to access information. As part of the survey, those with access to the internet (76%) were read a list of different categories of online activities and asked which three they mostly used the internet for (Table 36). We report the usage of the internet for the adult population with access to the internet and also as a proportion of the total adult population.

By far the most popular use of the internet among the public was for communication via chat apps like WhatsApp (54%) and to access social media (47%). A lower usage rate was reported for accessing general information (25%) and entertainment (20%). Close to one in six members of the public used the internet for the more serious purposes of seeking information for work (16%), following the news (14%), or to access information for their studies (11%).

Of those with access to the internet, again most of the public used it for communication (71%) and social media activities (62%), while disappointingly small numbers used it to access news (19%). Students or learners comprised 13% of the sample and it seems that most of them account for the 15% that reported using the internet to access information for their studies.

TABLE 36: The main uses of the internet (percentage)

	Adult population with access to the internet	Total adult population
Communication (e.g. WhatsApp)	71	54
Social media (e.g. Facebook, Twitter)	62	47
General information	33	25
Entertainment (e.g. Netflix, playing games)	26	20
Work	21	16
News	19	14
Information for your studies	15	11

With the high shares of the public reporting that they used the internet for communication on chat apps like WhatsApp or Viber, and to access social media websites like Facebook, Twitter (now X) and Instagram, we further explored how much time the public spent on these activities (Table 37).

Of the adult population with access to the internet, half (51%) spent time on social media and seven in ten (69%) on chat apps, at least "often". For the survey public (i.e. including those who do not have access to the internet), 39% reported using social media and 53% online chat apps, at least "often". This relatively high access to the internet and social media points to a channel or mechanism that could be used to communicate S&T information.

TABLE 37: Frequency of online activity on chat apps and social media (percentage)

	ADULT POPULATION WITH ACCESS TO THE INTERNET		TOTAL ADULT POPULATION	
Frequency	Social media	Chat apps	Social media	Chat apps
Often/Very often	51	69	39	53
Sometimes	28	20	22	15
Never/Rarely	20	10	15	8
No internet	–	–	23	23

The amount of S&T information received (exposure) by the public

Information is key to participating in S&T debates and could subsequently influence actions and behaviours. We refer to the amount of information that the public received as exposure to information and report on: (i) the exposure to S&T information; and (ii) the socio-demographic characteristics of those with higher exposure to S&T information.

When the public rated their level of exposure to S&T information, just over a third (36%) claimed it to be the "right amount" of S&T information. One in ten people said they received "too much" information, while just over half reported that they either received "too little" information (41%) or "none" at all (11%) – the implication being that there is an unmet demand for S&T information by more than half of the public.

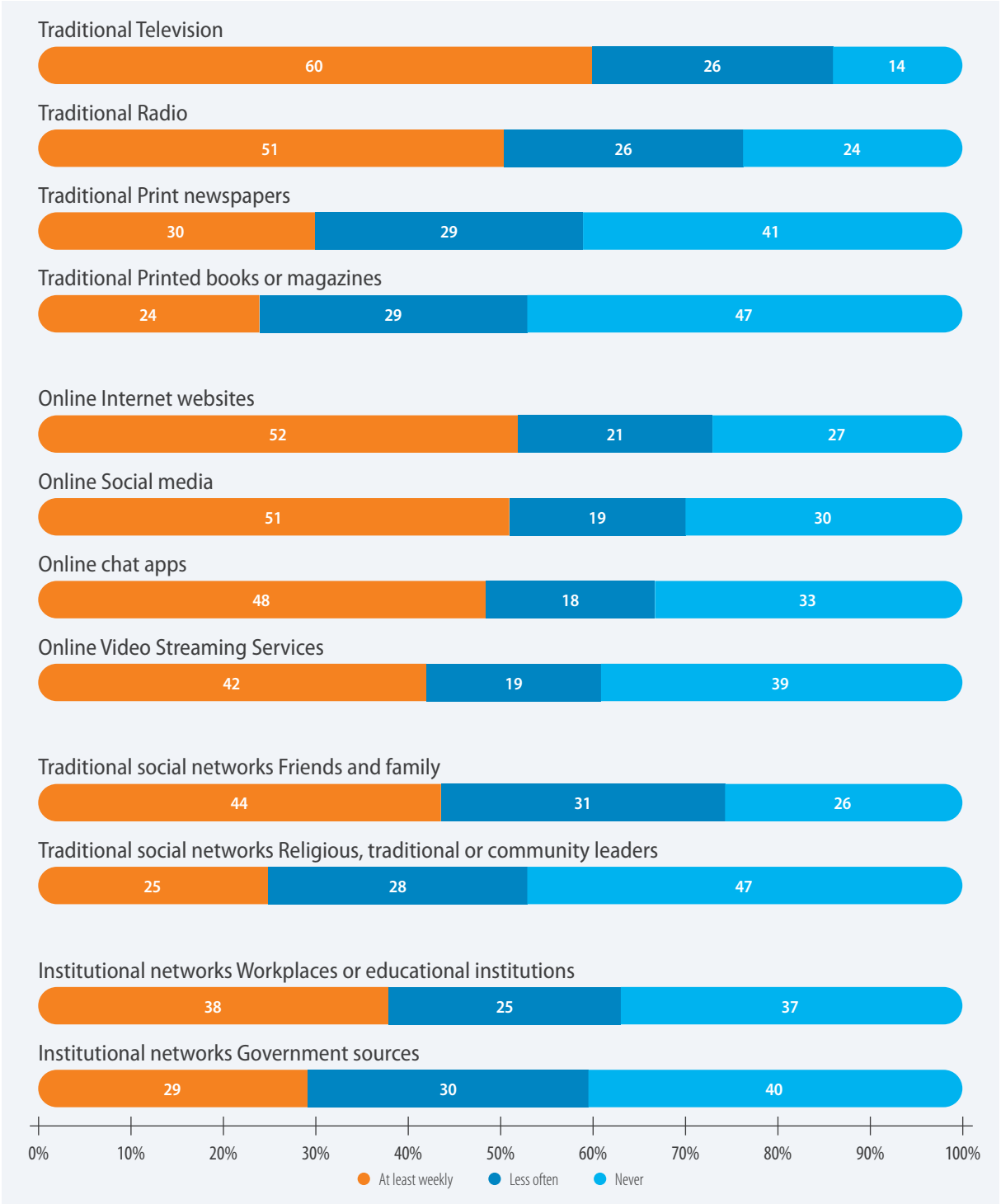
We next probed the frequency with which the public received S&T information from different sources. We categorised the news sources into four broad types: traditional media; online media; traditional social networks; and institutional networks (Figure 29).

The most popular sources through which the public reported receiving S&T information, at least weekly, were the two traditional media sources: namely television (60%) and radio (51%). Close to half of the public reported that they frequently (at least weekly) received S&T news from online media sources such as internet websites (52%), social media (51%) and online chat apps (48%).

Institutional and traditional social networks were less popular sources of S&T information than broadcast media or online media. We found that 44% of the public reported family and friends, and 38% reported workplaces or educational institutions, as their sources of S&T information on a weekly basis.

The public depended less on printed sources, such as books and newspapers, as well as government and community leaders, for S&T information, with only between 24% and 30% reporting obtaining information from these sources at least weekly.

FIGURE 29: Frequency of S&T information received from different sources



Who received higher levels of S&T information?

To identify the characteristics of the adults who received more S&T information, we used the 12 items described above to create an *Index of scientific news received from different sources (exposure)* and transformed it into a 0–100 scale, ranging from 0 for very low S&T information to 100 for very high S&T information. We produced correlations for all paired sets of variables as well as the Cronbach alpha statistic (α) for the scale formed from the full set of items. The results of this test ($\alpha = 0.901$) confirmed the validity of the index construction.

For the purpose of distributional analysis, the scale score was divided into five categories: very low, low, medium, high, and very high (Table 38). The mean index score of 42 places the overall assessment of information exposure in the low category.

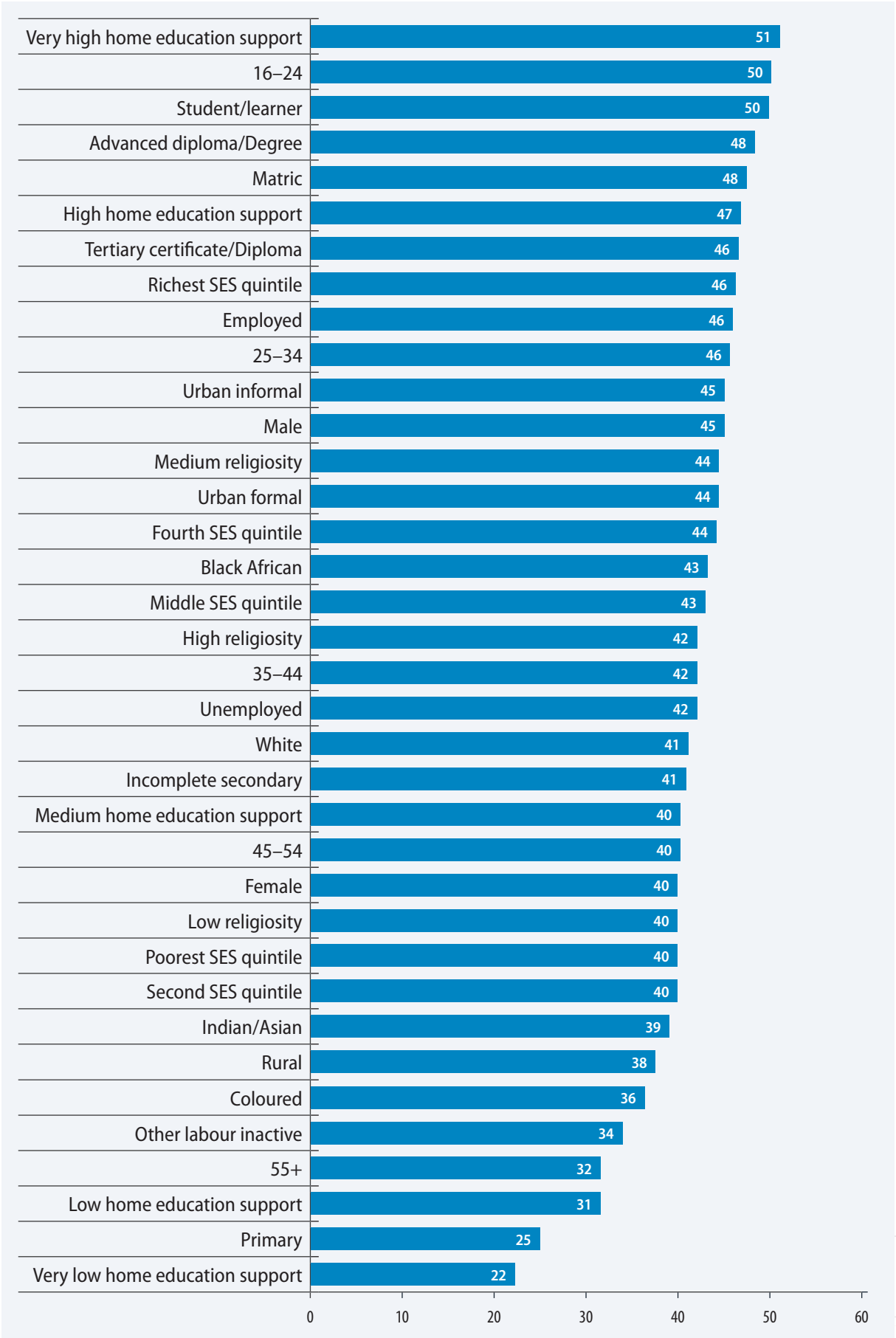
Close to six in ten members of the South African public reported receiving "low" or "very low" levels of S&T information (57%), two in ten received moderate levels of information (22%), and another two in ten reported higher exposure to information (21%). At the time of surveying, one in 20 (5%) reported receiving a very high level of S&T information from various sources.

TABLE 38: Level of scientific information received from different sources (percentage)

VERY LOW (0–33)	LOW (34–49)	MEDIUM (50–65)	HIGH (66–80)	VERY HIGH (81–100)	TOTAL	MEAN INDEX SCORE
41	16	22	16	5	100	42.4

In Figure 30, the mean scores of scientific information received from different sources are presented for various social and demographic characteristics. The bar chart is ranked from highest to lowest based on a score of 0–100 using the composite measure. Across the different characteristics examined, the mean scores varied within a wide range between 22 and 51. This is again reflective of the diverse socioeconomic conditions within the country. The highest levels were evident among those with very high home education support, those with higher levels of education, students and learners, those aged 16 to 24 years and those from the richest SES quintile. Conversely, lower scores were found among those who had very low levels of home education support, with primary or no formal education, those aged 55 years and above, and those categorised as other labour inactive.

FIGURE 30: Index of scientific news from different sources by select socio-demographic attributes (ranked)



To test whether the sub-group differences in scientific news exposure presented in Figure 30 were significant, One-way ANOVA tests were conducted. Significant differences in the average level of scientific news exposure were found for all characteristics examined. In Table 39, a summary of significant sub-group differences in the average levels of scientific news received from different sources is presented.

TABLE 39: Personal characteristics associated with scientific information received (exposure) from different sources

LIKELY TO HAVE HIGHER EXPOSURE TO S&T INFORMATION	LIKELY TO HAVE LOWER EXPOSURE TO S&T INFORMATION	F	SIG.	RANGE
16–24, 25–34,	35–44, 45–54, 55+	94.5	***	32–50
Male	Female	63.3	***	40–45
Black African and White adults	Coloured and Indian/Asian adults	13.8	***	36–43
Matric, tertiary certificate/diploma, advanced diploma/degree	Primary, incomplete secondary	157.4	***	25–48
Very high and high home education support	Very low and low and medium home education support	184.9	***	22–51
Student/learner	Other labour inactive, unemployed, employed	94.4	***	34–50
Richest and fourth SES asset quintile	Poorest, second and middle SES quintile	14.7	***	40–46
Medium and high religiosity	Low religiosity	16.6	***	40–44
Urban formal and urban informal	Rural residents	47.6	***	38–45

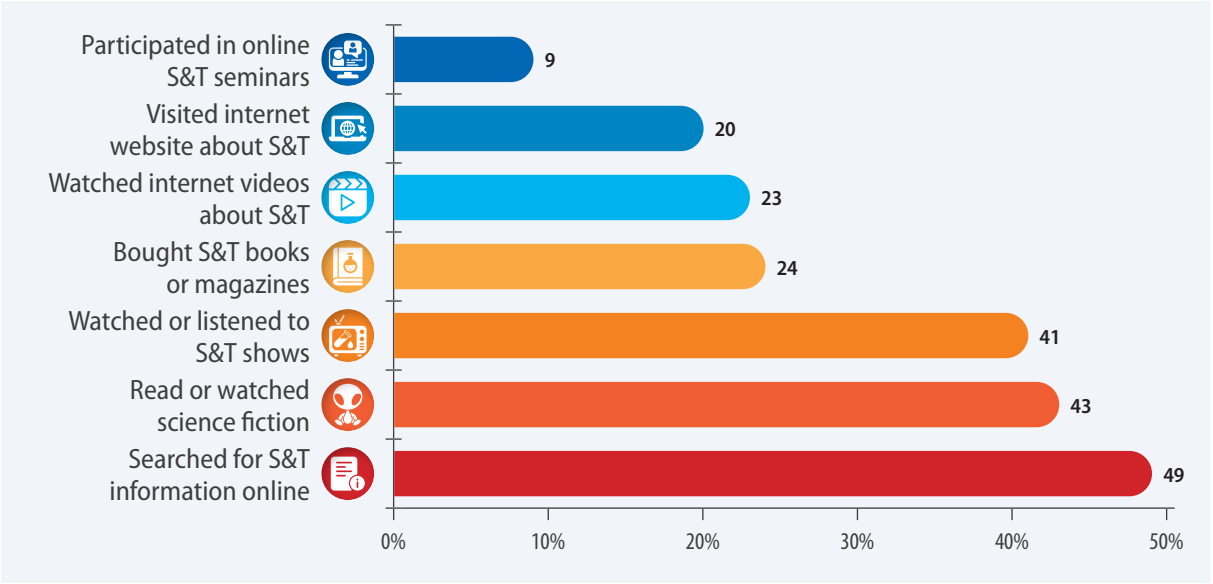
Note: The F-statistic is a measure used to determine whether the mean scores between groups are significantly different from one another. Higher F-statistic values suggest that there may be significant differences between group mean scores. Statistical significance is denoted as * $p<0.05$ (95% level), ** $p<0.01$ (99% level), *** $p<0.001$ (99.9% level). The range of values reflects the minimum and maximum index values on the index for the specific personal attribute.

The amount of S&T news actively accessed or consumed by the public

By consumption of S&T news, we mean respondents actively accessed S&T information either by reading, watching or listening to the news. Just over a third of the public (36%) reported that they read, watched or listened to (i.e. consumed) S&T information at least "a few times a week", while around a half (47%) consumed news less frequently and just under one-fifth (17%) never consumed S&T information.

Figure 31 reports the different forms of S&T information that the public reported consuming in the year prior to the survey. Between 40% and 50% of the public, had at least "sometimes" searched for S&T information online (49%), read or watched science fiction (43%) and listened to or watched S&T shows (41%). Slightly less than a quarter reported buying S&T books or magazines (24%), viewing internet videos about S&T (23%) or accessing websites about S&T (23%). A relatively small share (9%) participated in online S&T seminars.

FIGURE 31: Consumption of S&T information, at least sometimes



Notes: We combined the responses often and sometimes for items 132 to 135 (the first four items in the figure) and included the Yes response for items 143 to 145 (the last three items) in the survey instrument (see Appendix 2).

Who consumed S&T information frequently?

To identify the characteristics of the adults who consumed more S&T information, we used the seven items outlined above to create an *Index of scientific news actively accessed (consumption)* and transformed it into a 0–100 scale, ranging from 0 "never" consuming S&T information to 100 "very high" consumption of S&T information. We produced correlations for all pairs of variables as well as the Cronbach alpha statistic (α) for the scale formed. The results of this test (α = 0.799) confirmed the validity of the index construction. The scale scores were then divided into six categories: never, very low, low, medium, high, and very high (Table 40).

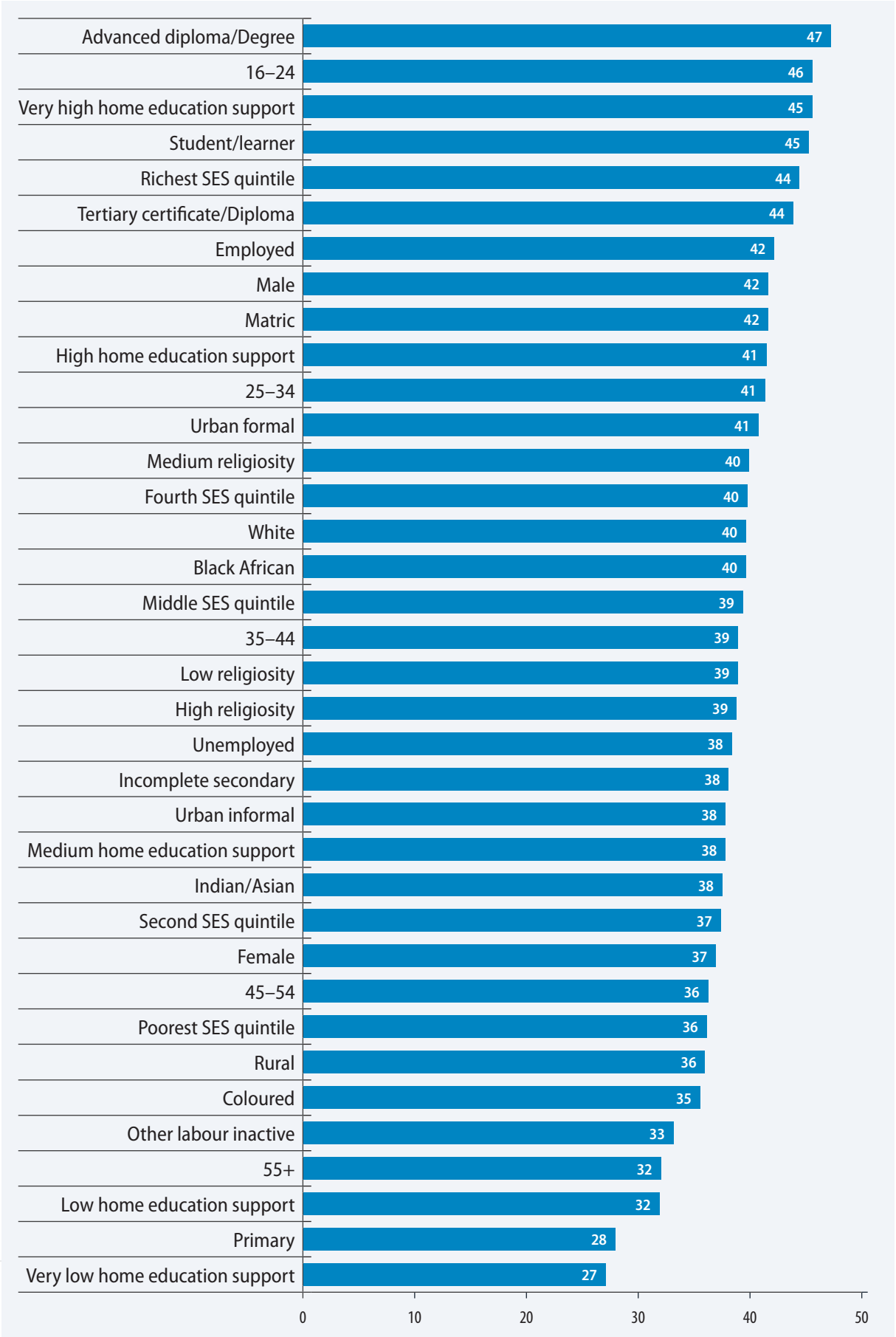
The mean index scale score for consumption of S&T information was a low 39 out of a total of 100 – indicating that, on average, there is very little consumption of S&T information by the South African public. Close to three-quarters (73%) of the public reported accessing little S&T information, slightly over one-fifth (22%) accessed moderate amounts, and only one-twentieth (5%) accessed high amounts of S&T information.

TABLE 40: Consumption of S&T information index (percentage)

VERY LOW (0–33)	LOW (34–49)	MEDIUM (50–65)	HIGH (66–80)	VERY HIGH (81–100)	TOTAL	MEAN SCORE
40	33	22	4	1	100	39.2

In Figure 32, the mean scores are presented for various social and demographic sub-groups based on the consumption of S&T information index. The bar chart is ranked from highest to lowest based on a score of 0–100. The average levels among the public varied within a range of 27 to 47 across the different sub-groups. The highest levels were evident among those who had an advanced diploma/bachelor's degree, those aged 16–24 years, students and learners, those who reported high home education support, and those from the richest SES quintile. Conversely, lower scores were found among those with low levels of home support, those with primary or no formal schooling, those aged 55 years and above, Coloured adults, and those classified as other labour inactive.

FIGURE 32: Consumption of S&T information by select socio-demographic attributes (ranked)



To identify the characteristics of the sub-groups who were more and less likely to report higher consumption of S&T information, the *Index of scientific news actively accessed (consumption)* was analysed across a set of demographic sub-groups, using One-way ANOVA tests. Significant differences in the average consumption of S&T information were found for all characteristics examined, except religiosity. The significant results are presented in Table 41.

TABLE 41: Personal characteristics associated with consumption of S&T information

LIKELY TO REPORT HIGHER CONSUMPTION OF S&T INFORMATION	LIKELY TO REPORT LOWER CONSUMPTION OF S&T INFORMATION	F	SIG.	RANGE
16–24, 25–34, 35–44, 45–54	55+	117.5	***	32–46
Male	Female	114.2	***	37–42
Black African and White adults	Coloured adults	10.7	***	35–40
Matric, tertiary certificate/diploma, advanced diploma/degree	Primary, incomplete secondary	162.1	***	30–47
Medium, high and very high home support	Very low and low home support	173.3	***	27–45
Employed and student/learners	Unemployed and other labour inactive	128.6	***	33–45
Middle, fourth and richest SES quintile	Poorest and second SES quintile	41.3	***	36–44
Urban formal residents	Urban informal and rural residents	51.4	***	36–41

Note: The F-statistic is a measure used to determine whether the mean scores between groups are significantly different from one another. Higher F-statistic values suggest that there may be significant differences between group mean scores. Statistical significance is denoted as * p<0.05 (95% level), ** p<0.01 (99% level), *** p<0.001 (99.9% level). The range of values reflects the minimum and maximum index values on the index for the specific personal attribute.

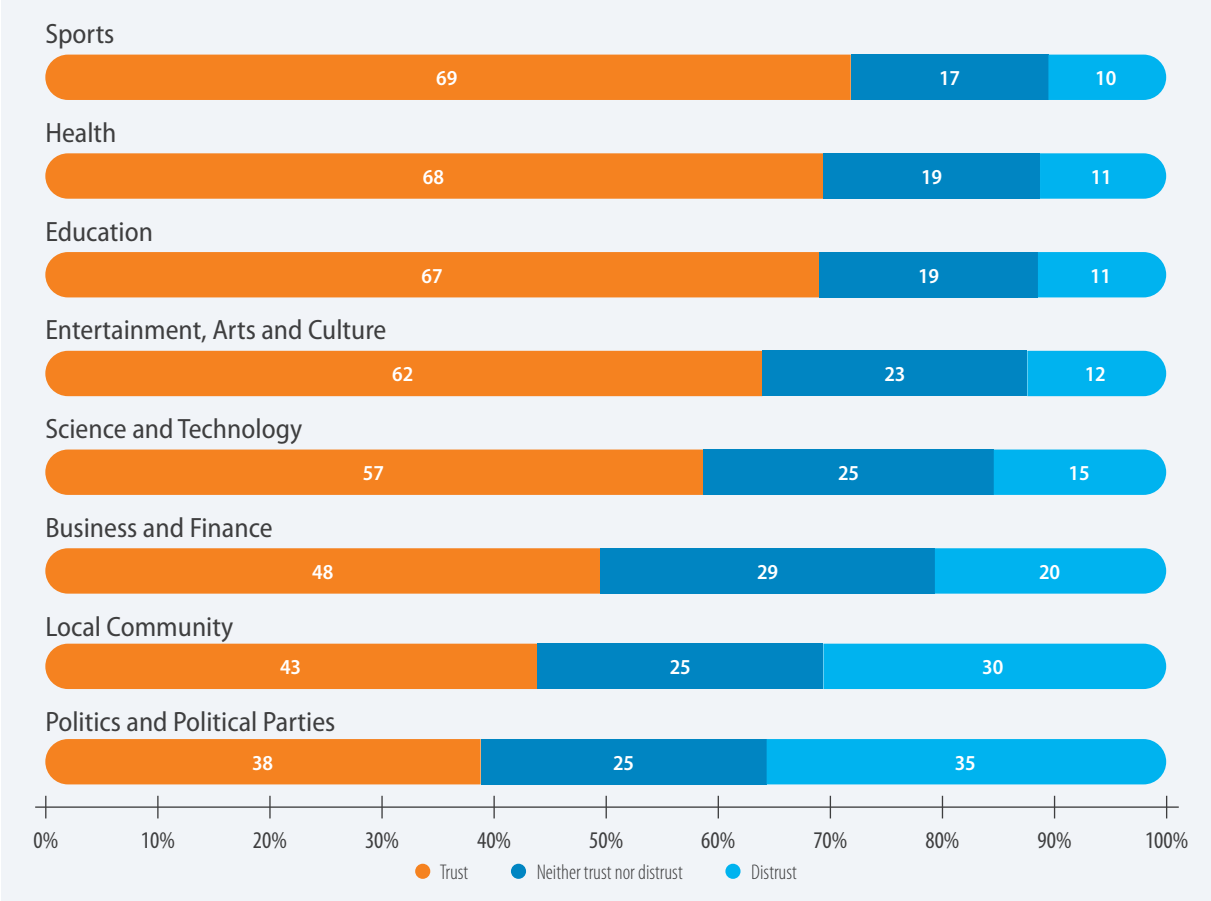
Trust in S&T information

Six in ten adult South Africans (60%) stated that they were satisfied with the way the media reported S&T news. In this section, we drill down further and report on (i) public trust in the content areas examined, (ii) public trust in S&T news sources, and (iii) the characteristics of adults who had higher trust in S&T news.

Trust in specific news content

Our analyses explored levels of trust in specific news content areas, including S&T. Figure 33 reports that the highest levels of trust were in areas related to sports (69%), health (68%) and education (67%). Trust in S&T news was lower at 57%. Fewer adults trusted news about local communities (43%), and about politics and political parties (38%). Interestingly, levels of trust and distrust in news about politics and political parties were roughly similar, at 38% and 35%, respectively – this corroborates the earlier findings regarding confidence in S&T information from national and local government (see Figure 22).

FIGURE 33: Trust in specific news content



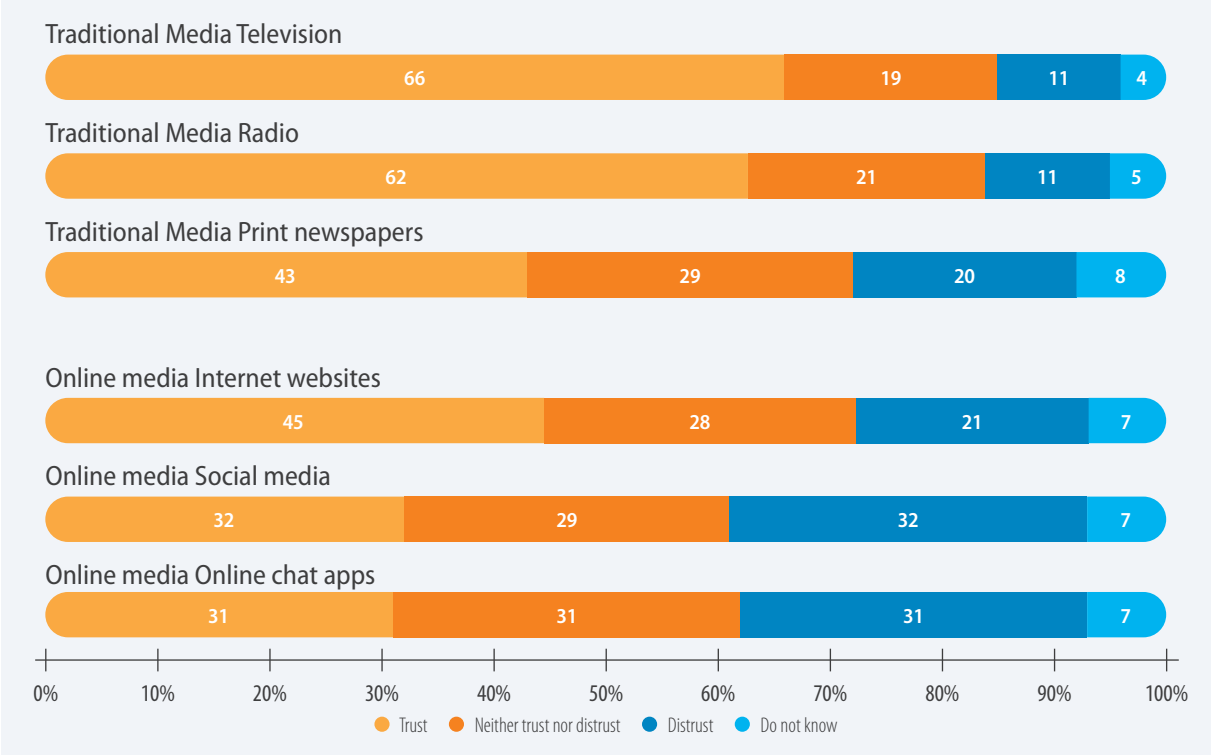
Trust in S&T news sources

The public receive S&T news from a variety of media sources. We therefore asked the public to rate their level of *trust* or *distrust* in the S&T news they received from the three traditional media sources and three online media sources (Figure 34).

Close to two-thirds of the public trusted S&T information from television (66%) and radio broadcast media (62%). The inter-item correlation between trust in the S&T content provided by radio and television was strong ($r = 0.67$), indicating that those who expressed confidence in S&T information from the radio were also likely to state that they trusted S&T news broadcast on television. This suggests a clear belief in the reliability of information from both traditional media sources.

There were lower, but similar, levels of trust in S&T news from internet websites (45%) and print media (43%). The public were cautious in their trust of S&T news shared on online chat apps and social media, with similar levels of trust and distrust reported for these channels. Around a third of the public said they trusted S&T news from online chat apps (31%) or social media (32%), another third were neutral, with the final third being distrustful of S&T news from these sources. It is encouraging that the public are more discerning about trusting the online sources, as they are often uncorroborated and can be used to spread fake news or disinformation.

FIGURE 34: Trust in S&T information sources



Who had higher trust in S&T news?

To identify the characteristics of adults who were more and less likely to trust S&T news, we used the six items described above to create an *Index of trust in scientific news from different sources* and transformed it to a 0–100 scale, with higher scores representing a greater degree of trust. We computed inter-item correlations for all pairs of variables, as well as the Cronbach alpha statistics for the scale formed from them. The results of this test ($\alpha = 0.799$) confirmed the validity of the index construction.

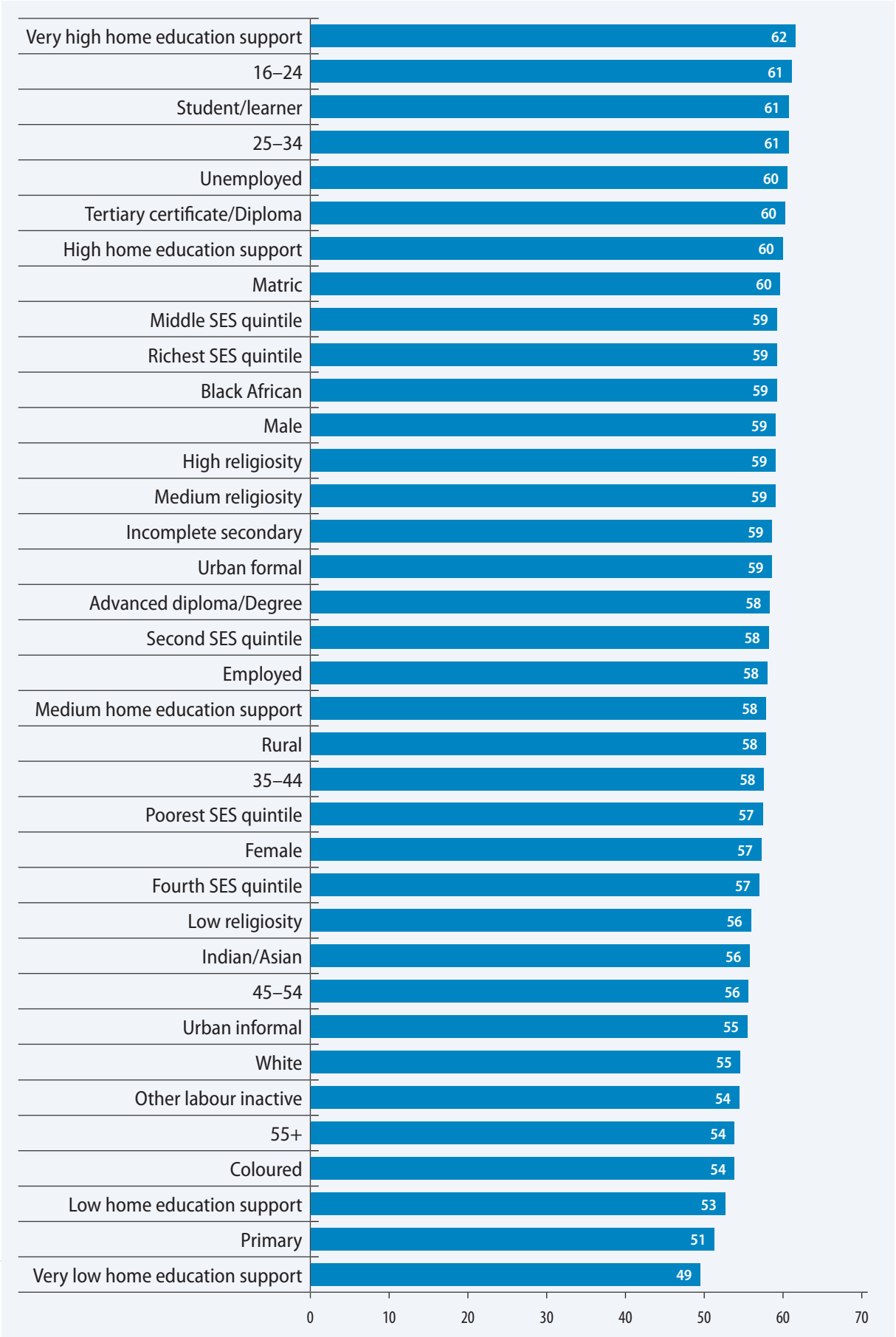
A categorical variable was then created by taking the scores on the 0–100 scale, and classifying them into five categories: very low, low, medium, high, and very high (Table 42). The mean index score of 58 (out of 100) indicates that, on average, public trust in S&T news was moderate. On this scale, 38% of the public reported "high" or "very high" trust in S&T news, 36% had moderate trust, and 25% low trust.

TABLE 42: Trust in S&T news (row percentage)

VERY LOW (0–33)	LOW (34–49)	MEDIUM (50–65)	HIGH (66–80)	VERY HIGH (81–100)	TOTAL	MEAN INDEX SCORE
11	14	36	30	8	100	58.1

In Figure 35, the mean scores for the public trust in scientific news are presented for various social and demographic characteristics. The bar chart is ranked from highest to lowest based on a score of 0–100 using the composite item index. The average level of trust among the public varied within a range of 49 and 62 across the different characteristics examined. The highest levels of trust in scientific news were evident among those with very high home education support, those aged 16 to 34 years, students and learners, and the unemployed. Conversely, lower scores were found among those with limited home education support, those with primary or no formal schooling, as well as Coloured adults and those aged 55 years or older.

FIGURE 35: Public trust in scientific news by select socio-demographic attributes (ranked)



To test whether the sub-group differences in public trust in scientific news presented in Figure 35 were significant, One-way ANOVA tests were conducted. Significant differences in the average level of trust in S&T news were found based on all characteristics apart from SES. In Table 43, a summary of significant sub-group differences in the average levels of trust in S&T news is presented.

TABLE 43: Who was more and less likely to have trust in S&T news?

LIKELY TO HAVE HIGHER TRUST IN S&T NEWS	LIKELY TO HAVE LOWER TRUST IN S&T NEWS	F	SIG.	RANGE
16–24, 25–34	35–44, 45–54, 55+	34.7	***	54–61
Male	Female	13.7	***	57–59
Black African adults	Coloured, Indian/Asian, and White adults	22.5	***	54–59
Incomplete secondary, matric, tertiary certificate/diploma, advanced diploma/degree	Primary education	35.6	***	51–60
Very high, high and medium home education support	Very low and low home education support	58.3	***	49–62
Unemployed, student/learner	Other labour inactive, employed	34.9	***	54–61
High and medium religiosity	Low religiosity	16.9	***	56–59
Urban formal	Urban informal	5.0	**	55–59

Note: The F-statistic is a measure used to determine whether the mean scores between groups are significantly different from one another. Higher F-statistic values suggest that there may be significant differences between group mean scores. Statistical significance is denoted as * $p<0.05$ (95% level), ** $p<0.01$ (99% level), *** $p<0.001$ (99.9% level). The range of values reflects the minimum and maximum index values on the index for the specific personal attribute.

How does access to, and trust in, information shape attitudes towards S&T?

Earlier, in this chapter, we described the levels of internet access and usage, as well as exposure to, consumption of, and trust in, S&T information. In our conceptual model, we hypothesised that the level of internet usage, exposure to S&T information, consumption of S&T information and trust in S&T news would influence the level of science knowledge and interest, promise and reservation attitudes towards S&T, the perceived promise of traditional science, trust in scientists and government evidence-based decision-making processes.

We tested the relationships described above by running a series of different multivariate models using a linear regression approach. Each model contained the standard socio-demographic background controls (see Table 3), as well as the three predictor variables: (i) trust in S&T news, (ii) exposure to S&T news, and (iii) frequency of internet access and usage.

Seven models were generated with each specified model having a different outcome of interest variable (Table 44). The outcome variables of interest are the following:

- knowledge of S&T;
- interest in S&T;
- promise attitudes towards modern S&T;
- reservation attitudes towards modern S&T;
- promise attitudes towards traditional S&T;
- trust in scientists; and
- trust in government evidence-based decision-making processes.

The influence of the socio-demographic variables in each of the models is discussed in the earlier chapters (Table 11, Table 17, Table 23, Table 27). The model fits (R-squared, a measure of the proportion of variance accounted for) are also included in Table 44. The addition of the three predictor variables (i.e. trust in S&T news, exposure to S&T news and frequency of internet access and usage) over and above the baseline model increased the explanatory power of each of the models to varying degrees. This finding indicates that these factors contribute to explaining the variance of the attitudinal outcome variables.

Associations were stronger between exposure to S&T news and knowledge – those who receive more S&T information, know more about it. This relationship makes sense but also shows the potential route for informing those with lower exposure rates as a way to increase knowledge. The positive associations with interest, trust in government decision making and promise of traditional science are also encouraging and highlight the value of receiving high-quality, reliable and accurate S&T news for the public. The negative association with reservations is very small but also makes sense: those with greater exposure, who glean higher levels of knowledge, interest and trust, are less likely to have reservations about the promise of S&T since they understand more about it.

The role of trust in S&T news is also important here – it has a strong, positive relationship with each of the seven outcome variables. Over and above simple exposure, these results highlight the importance of reliable and accurate S&T information reaching the public.

The results for the frequency of internet access and usage were surprising in that there was a positive association with knowledge of S&T and a negative association with trust in scientists and trust in government decision-making processes. However, associations were small or non-existent when controlling for other variables including trust in S&T news and frequency of news received.

These results all speak to the adage of "knowledge as power". Even when social and background characteristics were taken into account, people who were more exposed to and trusting of S&T news showed enhanced knowledge, interest in and understanding of both the potentials and pitfalls that science can offer.

TABLE 44: Access to and trust in S&T information and attitudes: Summary of OLS models

Full model, including all controls, showing only significant associations and their direction and beta coefficients: green = positive; red = negative

OLS REGRESSIONS							
	Model I	Model II	Model III	Model IV	Model V	Model VI	Model VII
OUTCOME VARIABLE	**Knowledge of S&T**	**Interest in S&T**	**Promise of S&T**	**Reservation towards S&T**	**Promise of traditional S&T**	**Trust in scientists**	**Trust in government evidence-based decision making**
PREDICTOR VARIABLES							
Age (years)							
Female							
Population group (Ref: Black African)							
Coloured			–0.044*	–0.04*	–0.107***		
Indian/Asian	0.032*			0.048***	–0.116***	–0.040***	–0.062***
White		–0.049*		–0.065**	–0.165***		–0.071**
Years of education	0.095***	0.094***			–.077***		
Home education support	0.073***	0.052**	0.052*	0.049*		0.103***	0.049*
Employment status (Ref: Employed)							
Unemployed							
Student/learner					–0.045*	0.057**	
Other Labour inactive	–0.090***	–0.056*					
Geographic type (Ref: Urban formal)							
Urban Informal			–0.074***	–0.049*			
Rural	0.068**		–0.052*	–0.065*			
Religiosity scale (low to high)							
Socioeconomic status (low to high)	0.111***	0.147***			–0.082**		–0.100***
Exposure to S&T news	0.207***	0.121**		–0.07***	0.081***		0.110***
Trust in S&T News	0.142***	0.236***	0.329***	0.259***	0.136***	0.353***	0.274***
Internet access and usage (0–100 scale)	0.064**					–0.050*	–0.048*
R-squared	0.26	0.26	0.17	0.15	0.20	0.18	0.17
R-squared for demographics only	0.19	0.18	0.07	0.10	0.17	0.07	0.08
N	5 630	5 632	5 630	5 628	5 624	5 638	5 638

Notes: *** p<.001; ** p<.01; * p<.05. The symbol '. . .' indicates the variable was not included in the model. Analyses were weighted. Province of residence was included in all models as a control variable. The regression coefficients displayed in the models are standardised Betas.

Key Results: Access to and trust in S&T information

This chapter, firstly, reported on the levels of digital and internet access, patterns of internet usage, exposure to and consumption of S&T news, as well as the levels of trust in S&T news. Secondly, we identified the sub-group characteristics of those who were more likely to report higher internet usage, exposure to and consumption of S&T information, as well as trust S&T news. Thirdly, we explored how the predictor measures of internet access and usage, exposure to S&T news and trust in S&T information influenced the following outcome measures: knowledge of, and interest in, S&T; promise and reservation attitudes; as well as trust in scientists and trust in government's evidence-based decision-making processes.

LEVELS OF INTERNET ACCESS AND USAGE, EXPOSURE TO AND CONSUMPTION OF S&T INFORMATION, AND TRUST IN S&T NEWS

- There was a relatively high digital access among the South African public, with 94% having access to a cell phone, 76% having some form of internet access and 61% having a phone with internet access. A third of the public (31%) were on the internet for more than four hours a day on most days.
- Close to half of the adult population used the internet for communication through apps like WhatsApp (54%), or to access social media (47%), around a quarter used it to access general information (25%) or for entertainment (20%), while only one-tenth (11%) searched for information for their studies.
- There was low exposure to and low consumption of S&T information, with a mean index score of 42 and 39 out of 100, respectively. Over three-quarters (73%) reported accessing little S&T information while just under three-quarters this should be three-fifths, not three quarters (57%) had low exposure to the information. Two in ten (21%) adults reported high exposure to S&T information while only 5% actively accessed high amounts of S&T information.
- Television, radio, internet website and social media were the most popular sources, with between 51% and 60% of the adult public reporting that they received S&T news at least weekly through each of these modalities.
- Overall, trust in S&T information from different news sources was rated as moderate, with 38% reporting high trust, 36% moderate trust and 25% low trust. The highest trust in S&T news sources was for television (66%) and radio (62%), while the public were cautious about news shared online, with only three in ten trusting chat apps (31%) and social media (32%).
- The public had the highest trust in news related to sports (69%), followed by health (68%) and education (67%). The lowest trust was in news about local communities (43%) and politics and political parties (38%). S&T news was trusted by 57% of the public.

CHARACTERISTICS OF ADULTS WHO WERE MORE LIKELY TO HAVE HIGHER INTERNET ACCESS, HIGHER EXPOSURE TO AND CONSUMPTION OF S&T INFORMATION, AND HIGHER TRUST IN S&T INFORMATION

- There was a wide variation in access to S&T information by the different sub-groups. Daily usage of the internet ranged from a low of 15% to a high of 85%, while the exposure to (receiving news) S&T news ranged from a low of 22% to a high of 51% and the consumption of (actively seeking) S&T news ranged from 27% to 47% for the different sub-groups. This is reflective of the diverse socio-demographic conditions in South Africa.
- In general, access to, and use of, the internet was highest among those with higher educational attainment, higher home education support, those from the richer SES quintiles, those who are younger, students, learners or the employed, those living in urban formal areas, and White and Indian/Asian adults. Males, and those who reported higher religiosity, have significant but smaller variations.
- The sub-groups who reported higher exposure to, and consumption of, S&T news were those with matric or higher education attainment, those from homes with higher educational support, students or learners and those who were younger. Black African and White adults, those living in urban formal areas, those from the richer SES asset quintile homes and males reported significantly higher exposure to and consumption of S&T news, but with less notable effects.
- The average level of trust in S&T news among the public varied within a moderate range of 49 and 62 out of 100 across the different sub-groups examined. The higher levels of trust in S&T news were evident among those with at least some secondary education, with higher home education support, those who were younger, students and learners.

ROLE OF INTERNET USAGE, EXPOSURE TO S&T NEWS AND TRUST IN S&T INFORMATION IN SHAPING ATTITUDES TOWARDS S&T

- In our conceptual model, we hypothesised that access to, and trust in, scientific information was associated with the key S&T attitudinal outcomes – viz., knowledge of and interest in S&T, promise and reservation attitudes, the promise of traditional S&T, as well as trust in scientists and government's evidence-based decision making.
- Trust in S&T information had a strong, significantly positive relationship with each of the seven listed outcome variables. It has the strongest relationship with trust in scientists and promise attitudes towards S&T, followed by trust in government evidence-based decision-making processes, reservations towards S&T, interest in, and knowledge of, S&T and the perceived promise of traditional S&T.
- Exposure to S&T news was also significantly associated with five attitudinal outcomes. It was positively associated with knowledge of S&T, interest in S&T, trust in government's evidence-based decision making and the promise of traditional S&T. There was a small, negative association with reservations towards S&T, possibly because higher news exposure increases awareness and knowledge of S&T.

CHAPTER 7

Science Engagements: Activities and Behaviours

This chapter reports on the measures of science engagement activities and behaviours of the public. Participation in science and technology (S&T) activities or events serves as an expression of these science engagement behaviours. We further identify the personal characteristics of those who demonstrated higher participation in science engagement activities. Thirdly, we report on how access to S&T information, as well as knowledge of, and interest in, S&T areas, is associated with higher science engagement activities.

To provide a measure of science engagements, survey participants were asked several questions about whether they had participated in various S&T-related activities or events. The activities or events were categorised into five broad types of engagement:

Academic engagement: Exposure to formal STEM knowledge

In Chapter 3, we measured science knowledge using data gathered from a short quiz that was given to respondents as well as from self-reported knowledge of priority S&T topics. A further measure of academic engagement with S&T is the level of formal STEM education received in senior secondary school.[25] In addition to presenting findings based on this measure, this section also provides the comparative statistic for social science and humanities (SSH) education.

25 The school system is divided into a General Education (Grade R to 9) phase, where all learners take the same subjects, and a Further Education and Training or senior secondary phase (Grade 10 to 12), where learners choose different subject streams.

Eight out of every ten adults (82%) reported remaining in school after Grade 9. This corroborates the results of Census 2022, which shows that half the population aged 20 and above had completed secondary education, while almost one-third (32%) had some secondary education (StatsSA, 2023a). Error: Reference source not found Table 45 reports the extent to which the surveyed public were exposed to secondary school science, technology, engineering and mathematics (STEM) and social science and humanities (SSH) education, meaning that they chose to continue with these subjects after Grade 9.

Two-thirds of the public (68%) reported continuing with either mathematics or mathematics literacy[26] post Grade 9, while half (52%) continued with biological or life sciences, and over one-third (39%) continued with physical sciences. In comparison, the exposure to secondary school SSH education was 48% for geography and 41% for history.

We created a secondary school *(i) STEM and (ii) SSH exposure index* by aggregating the number of subjects in each area that respondents were exposed to.[27] A quarter of the public (25%) had no exposure to any STEM subjects after Grade 9, meaning that three-quarters had at least some exposure to secondary school STEM subjects. This suggests that most of the adult public should have basic mathematics and science knowledge. Close to a third of the public had high exposure, taking the three STEM subjects (31%). By contrast, 44% had no exposure to either SSH subject, while 32% were exposed to both subjects.

TABLE 45: Exposure to school STEM and SSH subjects post grade 9 (percentage)

SUBJECT EXPOSURE					
STEM Exposure			SSH Exposure		
Mathematics/Math Literacy	Biology/Life Sciences	Physical Sciences	Geography	History	
68	52	39	48	41	
SUBJECT EXPOSURE INDEX					
STEM Exposure Index				SSH Exposure	
No exposure	Low (1 subject)	Medium (2 subjects)	High (3 subject)	No exposure	Low (1 subject)	High (2 SSH subjects)
25	23	21	31	44	24	32

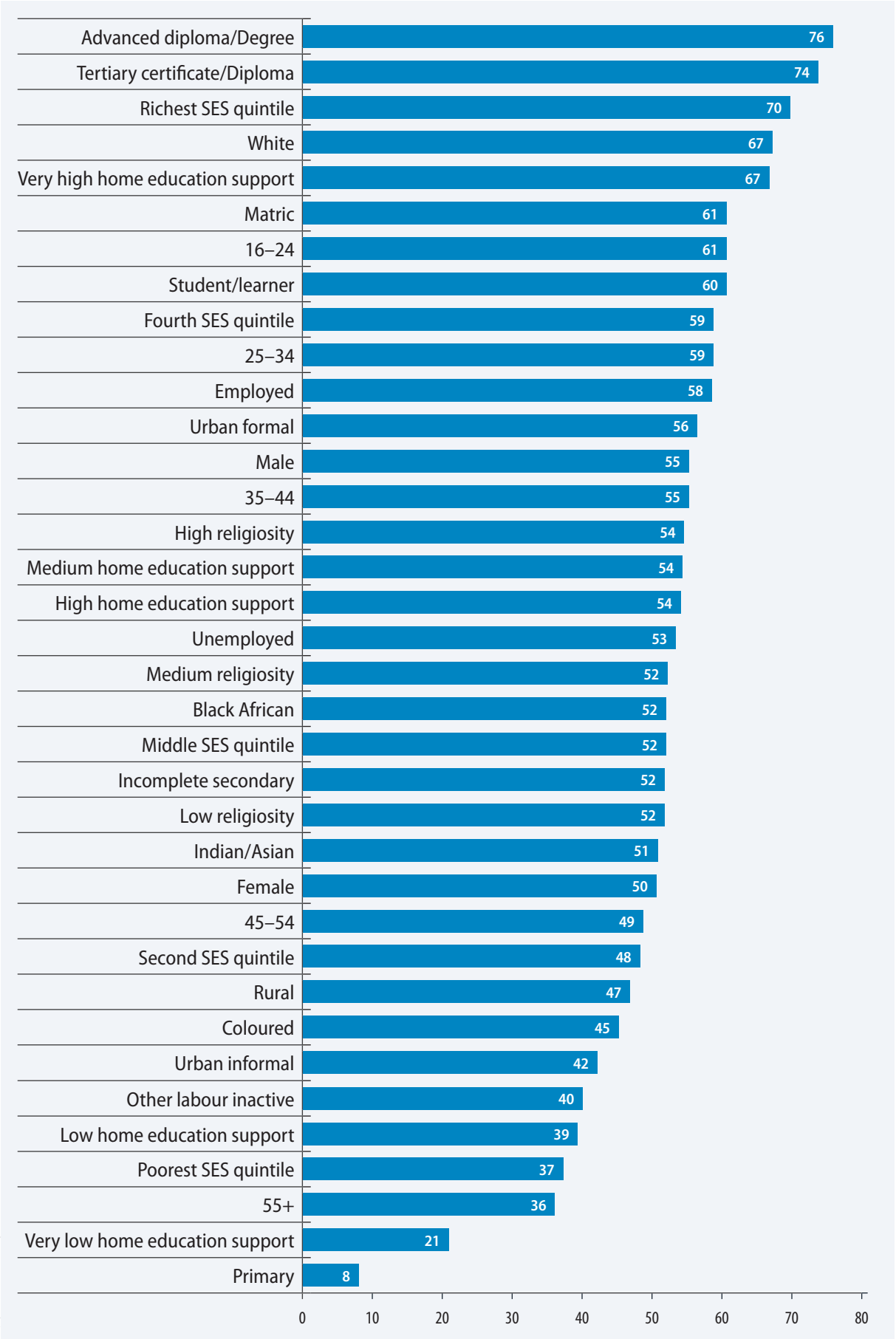
The STEM exposure index was converted into a 0–100 score, with 0 continuing to represent no exposure to STEM subjects post grade 9 and 100 representing exposure to all three STEM subjects post-Grade 9.

In Figure 36 , the mean STEM exposure index scores are presented across various social and demographic sub-groups. The bar chart is ranked from highest to lowest, based on the 0–100 score values. The level of senior secondary school STEM exposure among the public varied appreciably, with the mean scores ranging between 8 and 76 across the different sub-groups examined. The highest levels were evident among those with higher levels of education, those in the richest SES quintile, and White adults. Conversely, lower scores were found among those with primary or no formal schooling, as well as adults with limited home education support, and those aged 55 years and above.

26 Since 2006, all learners in the senior secondary school phase were required to study mathematics by selecting either mathematics or mathematical literacy as a subject.

27 In 2023, 38% of Grade 12 learners wrote mathematics and 62% wrote mathematics literacy in the NSC examination. The shares of learners writing the following subjects were: physical science (29%), life sciences (54%), geography (52%) and history (34%).

FIGURE 36: STEM exposure by select socio-demographic attributes (mean scores based on 0–100 scale, ranked)



To test whether the observed sub-group differences in STEM exposure at secondary school were significant, One-way ANOVA tests were conducted. In Table 46 significant differences in the average STEM exposure index were found based on all characteristics examined, apart from religiosity.

TABLE 46: Personal characteristics associated with STEM exposure

LIKELY TO HAVE HIGHER SECONDARY SCHOOL STEM EXPOSURE	LIKELY TO HAVE LOWER SECONDARY SCHOOL EXPOSURE	F	SIG.	RANGE
16–24	35–44, 45–54, 55+	79.9	***	36–61
Males	Females	22.6	***	50–55
White adults	Indian/Asian, Black African, Coloured adults	33.1	***	45–67
Advanced diploma/degree, tertiary certificate/diploma, matric	Incomplete secondary, primary or less	530.3	***	8–76
Very high home, high and medium education support	Very low and low home education support	154.1	***	21–67
Employed, student/learners	Other labour inactive, unemployed	81.0	***	40–60
Second, middle, fourth and richest SES quintile	Poorest SES quintile	118.3	***	37–70
Urban formal	Urban informal and rural residents	51.1	***	42–56

Note: The F-statistic is a measure used to determine whether the mean scores between groups are significantly different from one another. Higher F-statistic values suggest that there may be significant differences between group mean scores. Statistical significance is denoted as * p<0.05 (95% level), ** p<0.01 (99% level), *** p<0.001 (99.9% level). The range of values reflects the minimum and maximum index values on the index for the specific personal attribute from 0 to 100, where higher scores reflect greater interest in South African S&T.

Attraction-based engagement

Science events and activities, occurring in fixed spaces or through outreach programmes, are one way to establish a link between science and society. Slightly more than half (53%) of the public reported that they were "somewhat" or "very" interested in attending S&T activities and events, whereas the other less than half (46%) were "hardly" or "not" interested in attending. This suggests that there is a need to promote more interest in S&T among the South African public.

Availability of S&T sites offering activities and events

Events or attraction-based engagements are dependent on these activities being conducted close to where one resides. We therefore asked survey respondents whether the following sites or activities were available close to their residence (at the time of the survey), and whether they had attended any of these S&T sites or activities. We then identified the characteristics of those who reported higher attendance at S&T sites or activities.

Table 47 reports the availability of public sites that could potentially offer S&T activities and events. There was generally a low availability of these sites or activities, with slightly more than half (55%) of the public reporting that there was a public library close to their residence. Close to one in ten reported that community science activities (14%), museums (12%), botanical gardens, nature or game reserves (10%) or S&T centres (7%) were available near their homes.

TABLE 47: Availability of and attendance at S&T sites and activities (percentage)

S&T SITES AND ACTIVITIES	AVAILABLE IN AREA	ATTENDED
Public library	55	30
Public science activities e.g. community clean up, nature walk	14	18
Museum	12	23
Botanical garden, nature or game reserve, zoo, aquarium	10	26
Science and technology centre or exhibition	7	16

We then created an additive *Index of the number of S&T sites or activities available* close to the publics' homes, ranging from no sites to all five (Table 48). The mean number of sites or activities was a low 0.97 out of a total of five. Thirty-seven per cent of the public reported no sites or activities close to where they stayed, and only 3% had either four or five sites or activities near their homes. Our analysis, however, was unable to determine whether this finding reflects limited spaces available for S&T activities and events, or a lack of public knowledge about these spaces.

TABLE 48: Number of S&T sites available close to where you stay (row percentage)

0 SITES	1 SITE	2 SITES	3 SITES	4 SITES	ALL 5 SITES	TOTAL	MEAN SCORE
37	41	12	6	2	1	100	0.97

Attendance at S&T sites and activities

Given the low availability of S&T sites and activities reported above, it was unsurprising to find that attendance was also low. Less than a third (30%) of the public reported attending S&T events or activities at a library, around a quarter visiting a museum (23%) or botanical garden etc. (26%), and just under one-fifth (18%) were involved in community science activities (Table 47). It is noteworthy that public libraries were the only site where availability exceeded usage, suggesting these facilities are being underutilised by the public.

Using these five items, we created an *Index of attendance at S&T sites and activities* (Cronbach $\alpha = 0.807$) on a 0 to 100 scale, with 0 denoting no attendance and 100 signifying very high attendance. The scale was divided into the following categories: no attendance, very low, low, medium, high and very high attendance (Table 49).

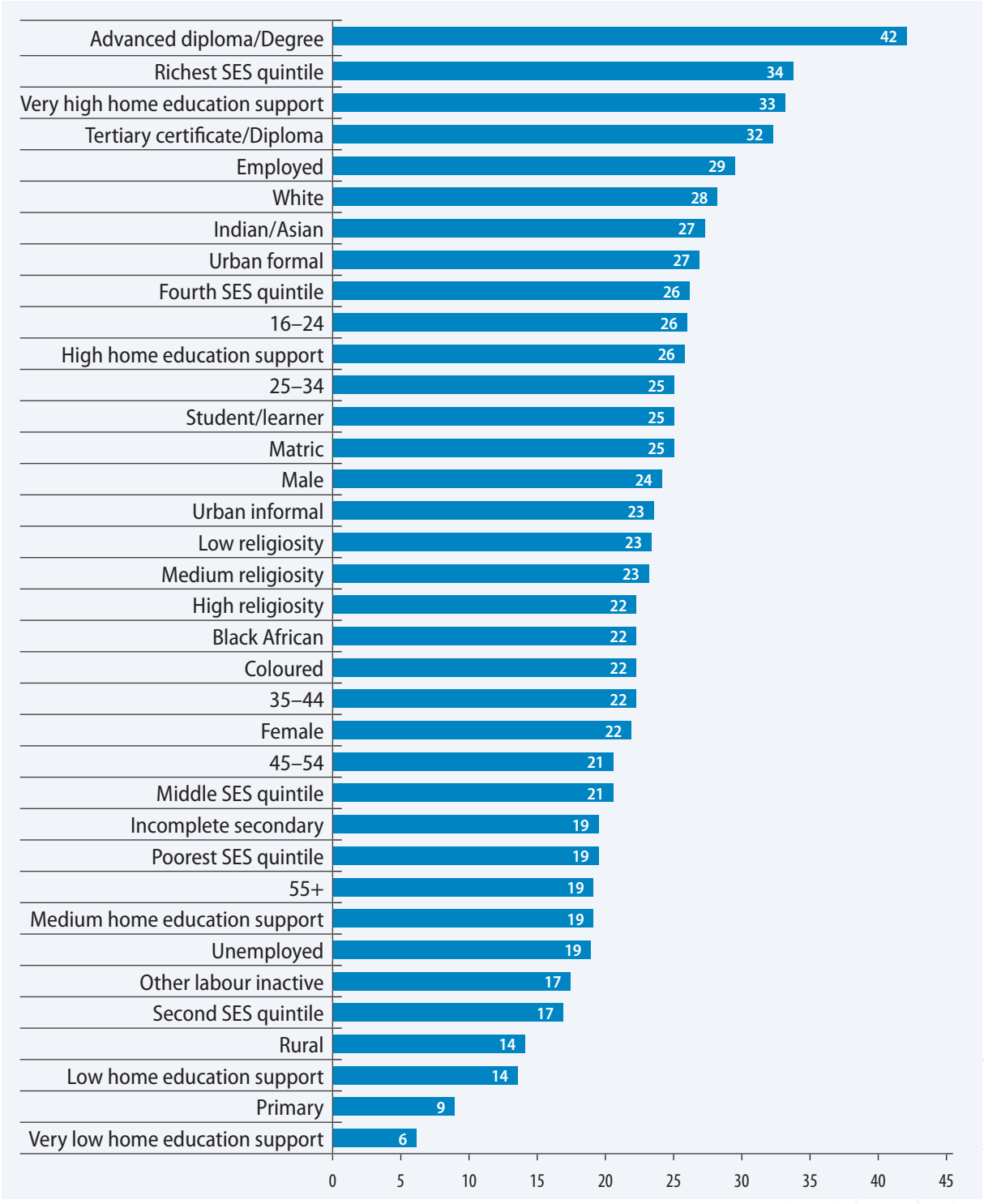
The mean index score was low at 23 out of 100: More than half the public (55%) had never attended any S&T sites or activities, whereas just over one-tenth (12%) of the public had attended a high number of sites or activities.

TABLE 49: Index of attendance at S&T events and activities (row percentage)

NO ATTENDANCE (0)	VERY LOW (1–33)	LOW (34–49)	MEDIUM (50–65)	HIGH (66–80)	VERY HIGH (81–100)	MEAN INDEX SCORE
55	15	10	8	5	7	22.9

In Figure 37, the mean scores based on the index of attendance of S&T sites and activities are presented for various social and demographic sub-groups. The bar chart is ranked from highest to lowest, based on a score of 0–100 using the composite item index. The level of attendance at S&T sites and activities among the public generally tended to be low or very low in nature, even though the scores ranged widely between 6 and 42 across the different sub-groups examined. The highest attendance levels were evident among those with higher levels of education, persons with high home education support, those in the richest SES quintile, as well as among employed people and White adults. Conversely, lower scores were found among those with limited home education support, persons with primary or no formal schooling, those in low SES households, as well as rural residents.

FIGURE 37: Attendance at S&T sites and activities by select socio-demographic attributes (ranked)



To test whether the sub-group differences in attendance of S&T sites and activities were significant, One-way ANOVA tests were conducted. In Table 50, significant differences in the average attendance at S&T sites and activities were found based on all characteristics, except for religiosity.

TABLE 50: Personal characteristics associated with attendance of S&T events and activities (One-Way ANOVA)

LIKELY TO REPORT HIGH ATTENDANCE OF S&T SITES AND ACTIVITIES	LIKELY TO REPORT LOW ATTENDANCE OF S&T SITES AND ACTIVITIES	F	SIG.	RANGE
16–24, 25–34	45–54, 55+	9.8	***	19–26
Male	Female	7.9	**	22–24
White and Indian/Asian adults	Black African and Coloured adults	6.7	**	22–28
Matric, tertiary certificate/diploma, advanced diploma/degree	Primary, incomplete secondary	101.5	***	9–42
Medium, high and very high home support	Very low and low home support	99.2	***	6–33
Employed and students/learners	Unemployed and other labour inactive	55.9	***	17–29
Urban formal and urban informal residents	Rural residents	102.2	***	14–27
Fourth and richest SES quintile	Poorest, second and middle SES quintile	54.9	***	17–34

Note: The F-statistic is a measure used to determine whether the mean scores between groups are significantly different from one another. Higher F-statistic values suggest that there may be significant differences between group mean scores. Statistical significance is denoted as * p<0.05 (95% level), ** p<0.01 (99% level), *** p<0.001 (99.9% level). The range of values reflects the minimum and maximum index values on the index for the specific personal attribute.

What were the predictors of higher attendance at S&T sites and activities?

We showed earlier that there were very few S&T sites and activities near where most of the public lived. In this section, we identify the factors that predicted the attendance at S&T sites and activities. We therefore ran a series of different multivariate models, using linear regression analysis, to identify which factors were associated with attendance when considered together. All models contained the standard socio-demographic background controls (see Table 3).

Model I contained only the standard socio-demographic background controls. We introduced the availability of S&T sites or activities in Model II, to test the role that these had in driving attendance. In line with our conceptual framework outlined in Figure 4. Models III and IV tested the role of S&T news exposure to and consumption of S&T information, respectively on attendance. These results are presented in Table 51.

Model I identified the personal characteristics of those who were more and less likely to report high attendance at S&T sites and activities. In this model, as well as in the other three models, educational attainment and home education support were both strongly positively associated with attendance at S&T sites or activities. In addition, being employed (relative to the unemployed and labour inactive), as well as living in urban formal areas (relative to those in rural areas) made an adult more likely to attend S&T sites and activities.

The socio-demographic variables (Model I) explained only 13% of the variance in levels of attendance at S&T sites and activities. The unexplained variance was therefore large, and this finding suggests that other factors not included in Model I were associated with attendance.

As expected, when we included *public S&T sites or activities available close by* as a predictor (Model II), the explanatory power of the model increased from 0.13 to 0.21. There was a strong positive association

between the availability of S&T sites or activities, and attendance (β = 0.310). This finding shows that those who had these sites or activities available close by to where they lived were more likely to attend.

The addition of the predictors of *frequency of exposure to S&T news* (Model III) and *frequency of consumption of S&T information* (Model IV) to the base model increased the model fit from 0.13 to 0.17 and 0.22, respectively. The frequency of S&T news exposure (β = 0.222) and the frequency of consumption of S&T information (β = 0.335) were therefore strongly associated with attendance at S&T sites and activities. This shows that those with higher exposure to, and consumption of, S&T information were more likely to report higher attendance. It is noteworthy that those who actively consumed S&T news were more likely to attend S&T activities than those who were only exposed to (i.e. received) the news.

TABLE 51: Attendance at S&T sites or activities: Summary of OLS models

Full model, including all controls, showing only significant associations, their direction and beta coefficients: green = positive; red = negative

	OLS REGRESSIONS			
	Model I	Model II	Model III	Model IV
OUTCOME	ATTENDANCE AT S&T ACTIVITIES AND EVENTS			
PREDICTORS	Socio-demographic model	Availability of S&T spaces	Exposure to S&T news	Consumption of S&T information
PREDICTOR VARIABLES				
Age (years)				0.072**
Female				0.050*
Population group (Ref: Black African)				
Coloured				
Indian/Asian				
White	–0.060*	–0.060*		
Years of schooling	0.132***	0.109***	0.112***	0.091***
Home support for schooling	0.155***	0.137***	0.103***	0.092***
Employment status (Ref: employed)				
Unemployed	–0.090***	–0.089***	–0.079***	–0.067***
Student/learner				
Labour inactive	–0.073**	–0.079**	–0.064**	–0.058*
Geographic type (Ref: Urban formal)				
Urban informal				
Rural	–0.055**		–0.052**	–0.048*
Religiosity scale (low to high)			–0.042*	
Socioeconomic status (low to high)				
Availability of S&T spaces	…	0.310***	…	…
Frequency of S&T news exposure	…	…	0.222***	…
Frequency of consumption of S&T information	…	…	…	0.335***
R-squared	0.13	0.21	0.17	0.22
N	5 814	5 814	5 814	5 814

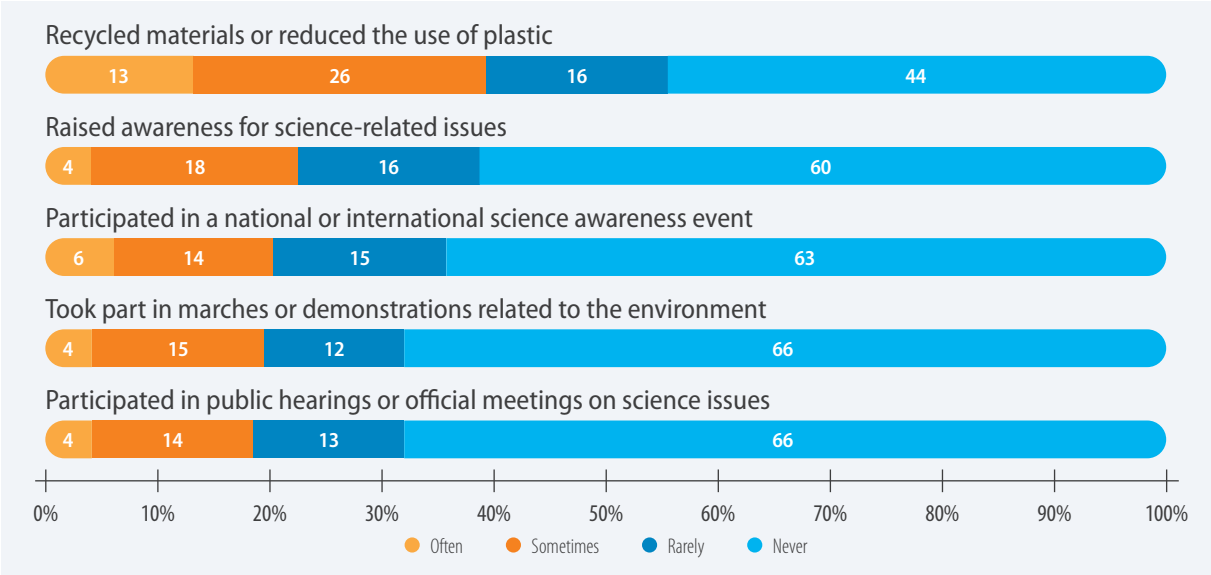
Notes: *** p<.001; ** p<.01; * p<.05.; The symbol '…' indicates the variable was not included in the model. Analyses were weighted. Province of residence was included in all models as a control variable. The regression coefficients displayed in the models are standardised Betas.

Community-based engagement: participation in community science activities

In Table 47, we saw that 14% of the adult population reported there were public science activities such as community clean-ups and nature walks available in their area, and 18% claimed that they attended such activities. Figure 38 reports public participation in science-related activities and events for the improvement of communities.

The most common form of participation reported was recycling, with 39% adults reporting that they recycled materials "often" or "sometimes", while 44% said they never recycled. Engagement across other areas of community participation was lower than engaging in recycling: around two in ten (18% to 22% range) participated "often" or "sometimes" in science-related public hearings, marches or awareness activities, or they themselves raised awareness for science-related issues.

FIGURE 38: Public participation in community-based science engagement activities



To identify the characteristics of the individuals who reported frequently participating in community-based science engagement activities, we created an *Index of community-based science engagement* ($\alpha = 0.824$) by reversing and averaging out the responses to the five survey questions and then transforming it to a 0 to 100 scale, ranging from 0 as "no participation" to 100 as "high participation".

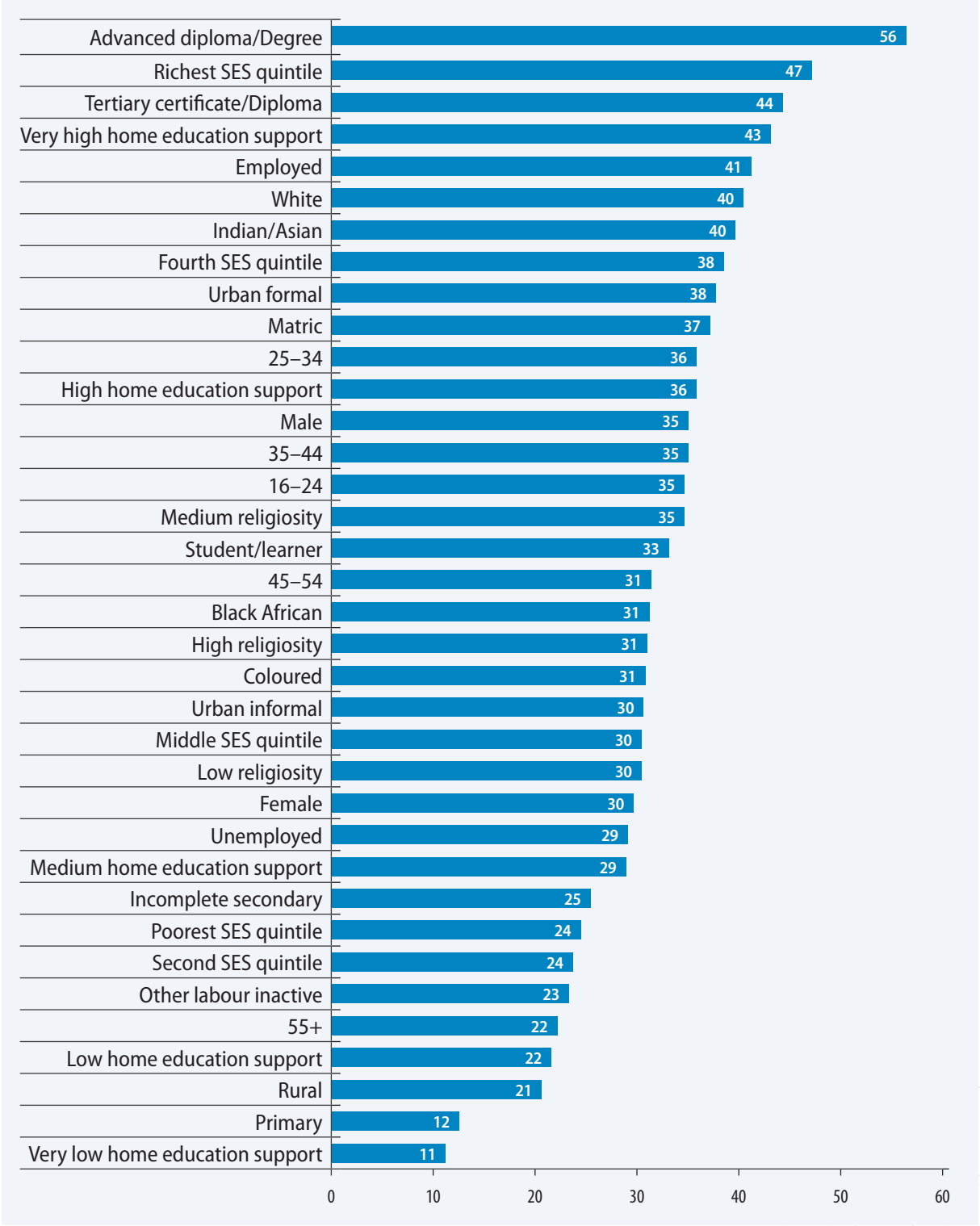
To provide a sense of the distribution of this index measure among the South African public, we divided the scale into the following categories: none, very low, low, medium, high and very high. There was a low level of community-based science engagement, with a mean score of 23 out of 100 – this is in line with the low level of attendance at public science activities reported in Table 47. A third of the public (34%) reported no participation and almost half (49%) indicated low participation in community-based science engagements. A further 7% reported moderate levels of community-based engagement while 10% reported a high level of engagement (Table 52). This highlights the need for the promotion of more community-based science engagements among the public.

TABLE 52: Community-based science engagement (row percentage)

NONE	VERY LOW (1–33)	LOW (34–49)	MEDIUM (50–65)	HIGH (66–80)	VERY HIGH (81–100)	MEAN SCORE
34	40	9	7	8	2	22.8

In Figure 39, the mean community-based science engagement index scores are presented for various social and demographic sub-groups. The bar chart is ranked from highest to lowest, based on the mean 0–100 index scores. The average levels of engagement among the public varied within a moderate range of 8 to 33 across the different characteristics. The highest levels were evident among those who had an advanced diploma/bachelors, urban informal residents, those who reported high levels of home education support, employed adults, and those aged 16–24 years. Conversely, lower scores were found among those with low levels of home support, persons with primary or no formal schooling, Indian/Asian adults, rural residents, and those aged 55 years and older.

FIGURE 39: Community-based science engagement by select socio-demographic attributes (ranked)



To test whether the observed sub-group differences in community-based science engagement were significant, One-way ANOVA tests were conducted. Significant differences in the average level of community-based science engagement were found for all the characteristics examined, except for SES. The significant results are presented in Table 53.

TABLE 53: Personal characteristics associated with community-based science engagement

LIKELY TO REPORT HIGH LEVELS OF COMMUNITY-BASED SCIENCE ENGAGEMENT	LIKELY TO REPORT LOW LEVELS OF COMMUNITY-BASED SCIENCE ENGAGEMENT	F	SIG.	RANGE
16–24, 25–34, 35–44	55+	20.6	***	17–26
Male	Female	26.9	***	21–25
Black African, Coloured and White adults	Indian/Asian adults	5.2	**	16–24
Matric or equivalent, advanced diploma/ bachelors	Primary or no formal schooling, incomplete secondary, tertiary certificate/diploma	62.0	***	13–33
Low, medium, high and very high home support	Very low home support	101.3	***	8–29
Employed and students/learners	Unemployed and other labour inactive	47.8	***	18–28
Medium religiosity	Low and high religiosity	8.0	**	22–24
Urban formal and urban informal residents	Rural residents	77.6	***	17–31

Note: The F-statistic is a measure used to determine whether the mean scores between groups are significantly different from one another. Higher F-statistic values suggest that there may be significant differences between group mean scores. Statistical significance is denoted as * $p<0.05$ (95% level), ** $p<0.01$ (99% level), *** $p<0.001$ (99.9% level). The range of values reflects the minimum and maximum index values on the index for the specific personal attribute.

Sharing S&T information

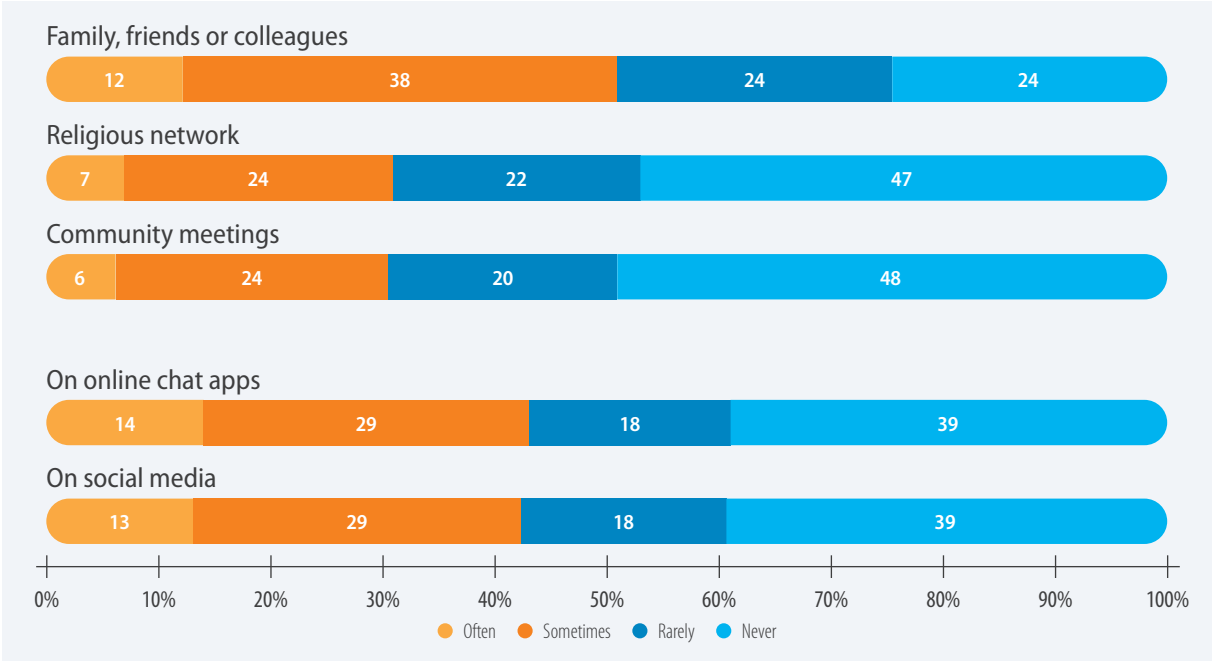
In addition to receiving S&T information, the public also reported how they shared S&T information. We report on who the public shared information with, and the socio-demographic characteristics of high information sharers.

How the public shared S&T information

The sharing of information through social networks is a mechanism to communicate and disseminate S&T information. Figure 40 reports the frequency with which the public shared information through their traditional social groups and social media.

Half of the public reported that they "often" or "sometimes" shared S&T information with those who were in closest proximity to them (i.e. traditional social groupings of family, friends, or colleagues). Furthermore, slightly less than a third of the public shared information at religious (31%) or community (30%) meetings. Four in ten adults shared information through online modalities, using chat apps (43%) and social media (42%).

FIGURE 40: Who and how the public shared information



Who were the frequent sharers of S&T information?

To identify the characteristics of the individuals who frequently shared S&T information, we created a *Sharing of S&T information index* (Cronbach $\alpha = 0.828$), which reversed and averaged responses to the survey questions together and then transformed them to a 0–100 scale, ranging from 0 "never" share S&T information to 100 "very high" sharing of S&T information. Table 54 shows the distribution of scores over six categories: never, very low, low, medium, high and very high.

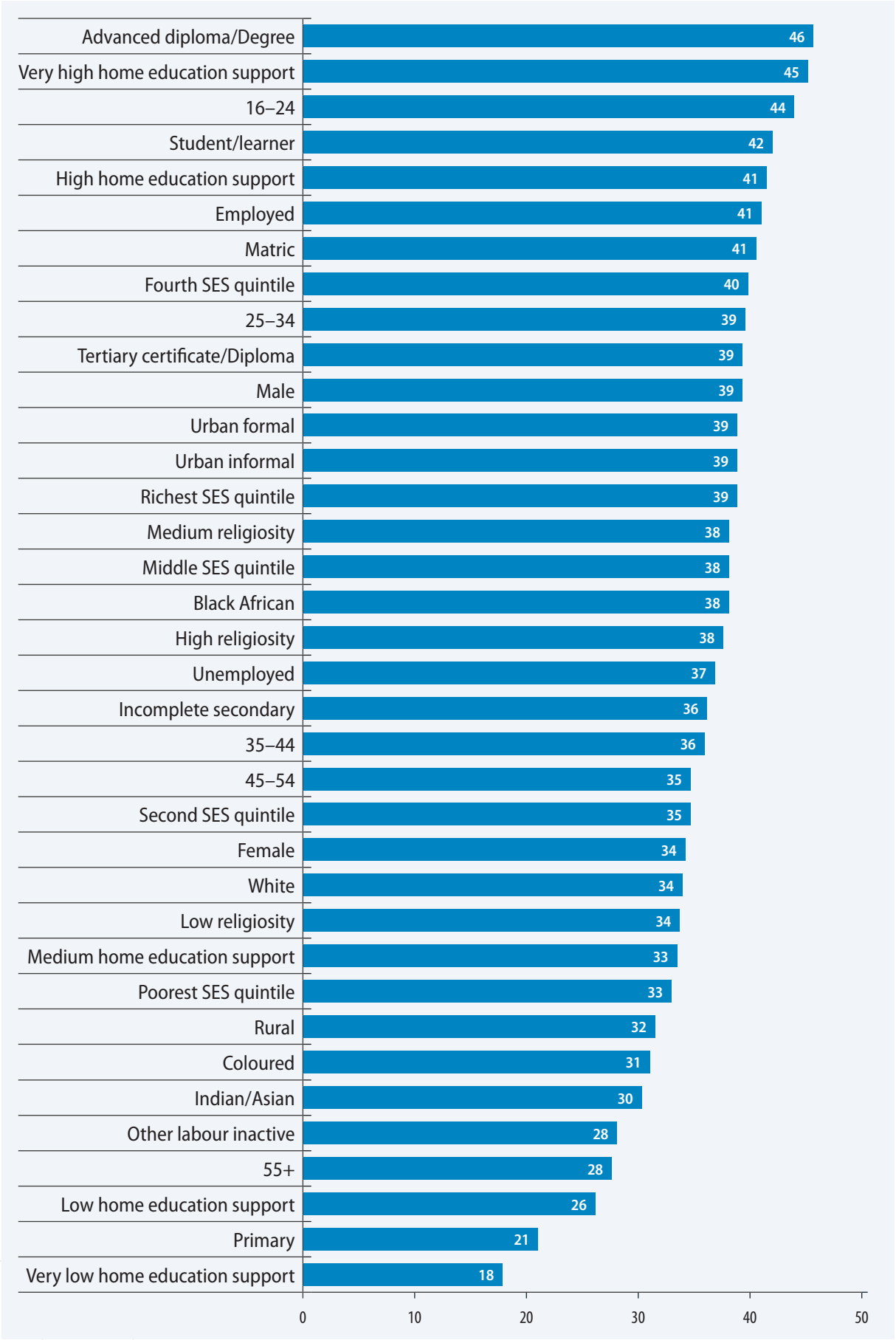
There was a low level of S&T information sharing among the public, with a mean index score of 37 (out of 100). While a fifth of the public (18%) were "high" or "very high" S&T information sharers, almost two-thirds of the public (64%) reported either "never" sharing S&T information (16%) or sharing little information (48%).

TABLE 54: Sharing of S&T information (row percentage)

NEVER (0)	VERY LOW (1 TO 33)	LOW (34–49)	MEDIUM (50–65)	HIGH (66–80)	VERY HIGH (81–100)	MEAN INDEX SCORE
16	33	15	17	15	3	36.7

In Figure 41, the mean scores based on the *Sharing of S&T information index* are shown for various social and demographic sub-groups. The bar chart is ranked from highest to lowest, based on the mean 0–100 score values of the composite item index. The sharing of S&T information among the public varied within a range of 18 and 46 across the different sub-groups examined. The highest levels were evident among those with an advanced diploma or bachelor's degree, those with very high home education support, those aged between 16 and 24 years, students and learners, as well as employed adults. Conversely, lower scores were found among those with limited home education support, persons with primary or no formal schooling, Indian/Asian adults, and those aged 55 years and over.

FIGURE 41: Sharing of S&T information by select socio-demographic attributes (ranked)



To test whether the sub-group differences in sharing of S&T information were significant, One-way ANOVA tests were conducted. The significant results are presented in Table 55. Significant differences in the sharing of S&T information were found on all the characteristics examined.

TABLE 55: Personal characteristics associated with sharers of S&T information (One-way ANOVA)

LIKELY TO BE HIGH SHARERS OF S&T INFORMATION	LIKELY TO BE LOW SHARERS OF S&T INFORMATION	F	SIG.	RANGE
16–24, 25–34	35–44, 45–54, 55+	63.3	***	28–44
Male	Female	55.4	***	34–39
Black African adults	Coloured, Indian/Asian, White adults	17.6	***	30–38
Incomplete secondary, matric, tertiary certificate/diploma, advanced diploma/ degree	Primary schooling	109.1	***	21–46
Medium, high and very high home support	Low and very low home support	155.9	***	18–45
Employed, student/labour	Other labour inactive, unemployed	83.0	***	28–42
Middle, fourth and richest SES quintile	Poorest and second SES quintile	14.6	***	33–40
Medium and high religiosity	Low religiosity	14.9	***	34–38
Urban formal and urban informal residents	Rural residents	48.5	***	32–39

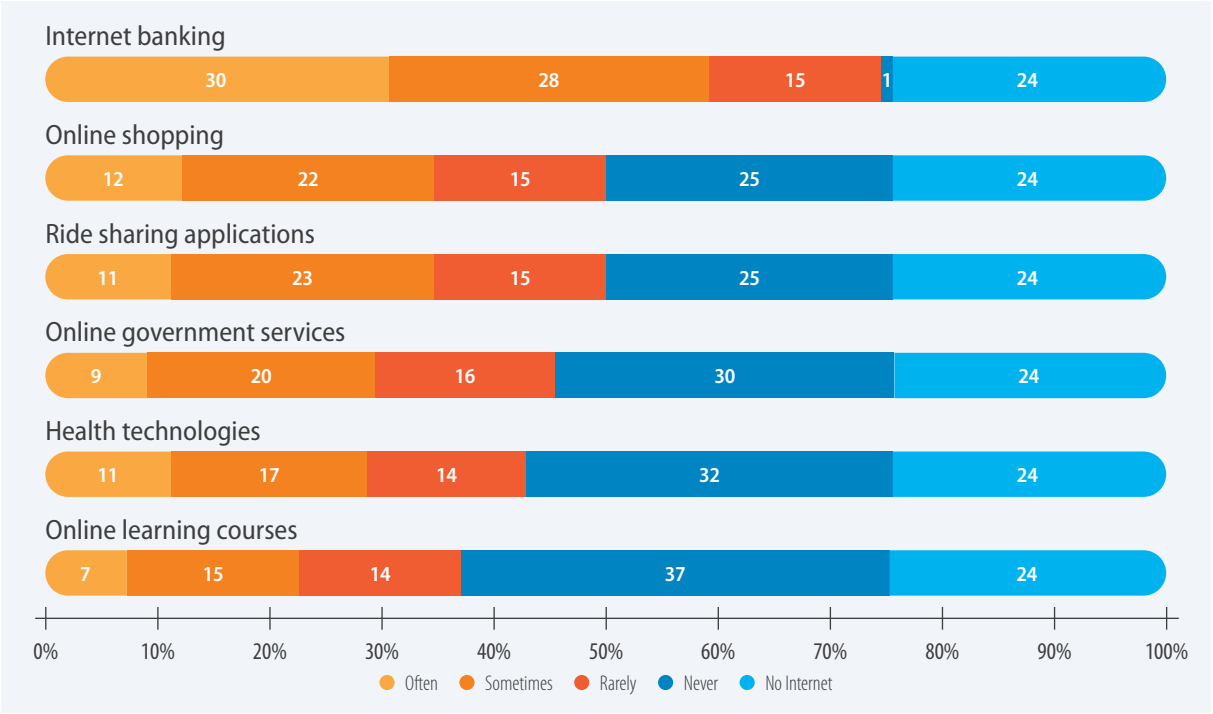
Note: The F-statistic is a measure used to determine whether the mean scores between groups are significantly different from one another. Higher F-statistic values suggest that there may be significant differences between group mean scores. Statistical significance is denoted as * $p<0.05$ (95% level), ** $p<0.01$ (99% level), *** $p<0.001$ (99.9% level). The range of values reflects the minimum and maximum index values on the index for the specific personal attribute.

Personal engagements: Experiences with online apps

In Chapter 6, we reported that three-quarters of the public (76%) had access to the internet, and over half (57%) accessed the internet daily. In the survey, we also asked a set of questions on the usage of select online apps (Figure 42).

The most frequently used online app by the adult population was internet banking (58% used it "often" or "sometimes"). The other listed apps were less frequently used – a third reported using online shopping (34%) and ride sharing (34%) applications at least "sometimes", almost a third (29%) reported using online government services (e.g. Home Affairs, SARS e-filing), while just over a quarter (28%) used health technologies such as a health monitor on their cell phone, and a fifth (22%) indicated using the internet to study online courses.

FIGURE 42: Use of select online apps



Who had the highest use of online apps?

In line with the preceding analysis, we created a *Use of online app index* (Cronbach $\alpha = 0.810$) to explore the characteristics of frequent users and transformed it into a 0–100 scale, where higher scores indicate greater usage. The scale was then divided into the following categories: never, very low, low, medium, high, and very high.

The use of this set of online apps was relatively low, with a mean index score of 32 (out of 100). Almost six in ten adults (59%) reported either never using these technologies or very low usage (Table 56). Only 15% of the public reported high or very high use of these online technologies, while 15% reported moderate use.[28]

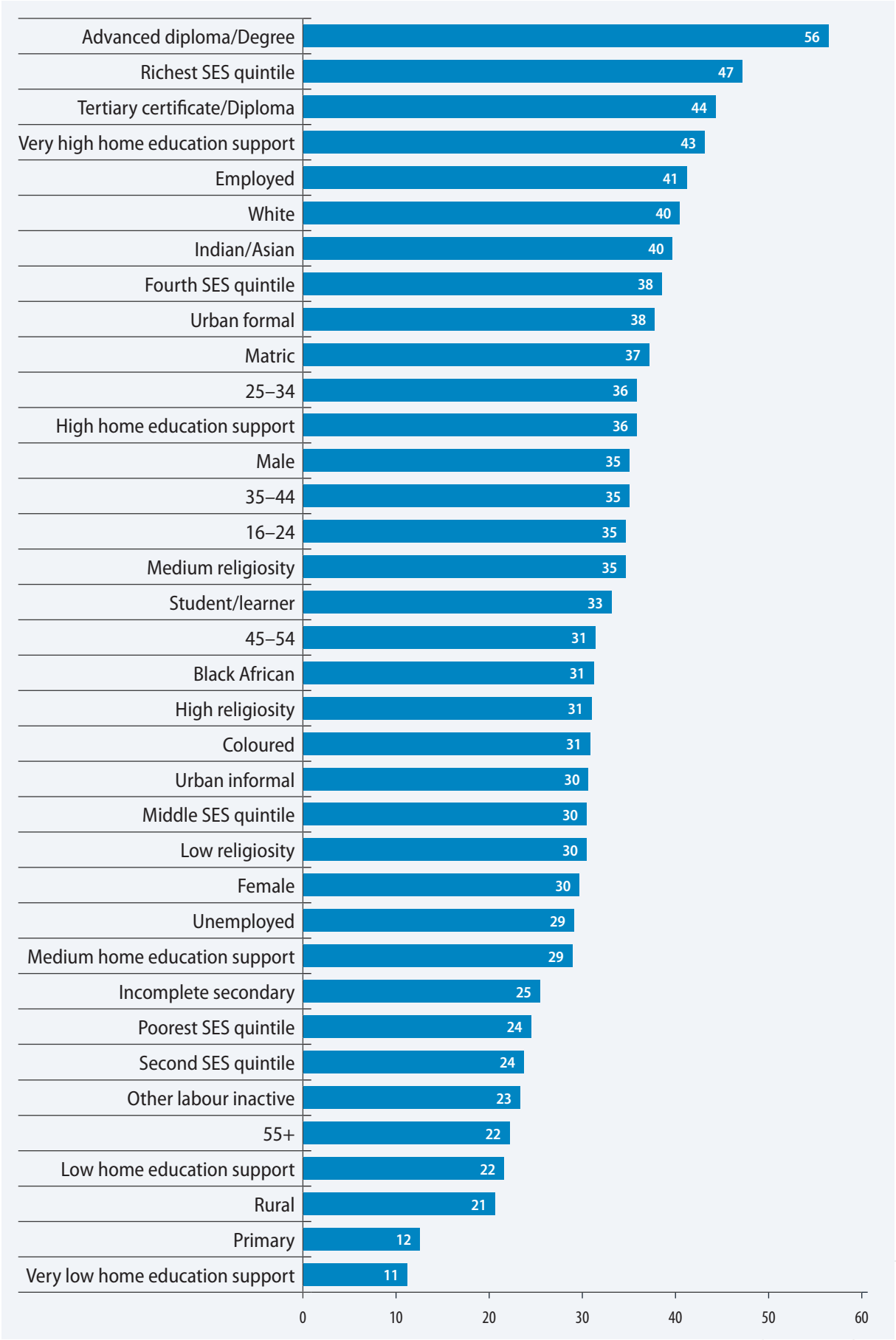
TABLE 56: Use of online apps (row percentage)

NEVER (0)	VERY LOW (1–33)	LOW (33 –49)	MEDIUM (50–65)	HIGH (66–80)	VERY HIGH (81–100)	MEAN INDEX SCORE
18	41	12	15	10	5	32.2

In Figure 43, the mean use of online app index scores is presented for various social and demographic sub-groups. The bar chart is ranked from highest to lowest, based on mean 0–100 index scores. The average levels of online app usage among the public ranged between 11 and 56 across the different sub-groups examined. The highest levels were evident among those who had an advanced diploma/degree or tertiary certificate/diploma, persons from the richest SES quintile, those who reported very high home support, the employed, and White adults. Conversely, lower scores were found among those with low home education support, those with primary or no formal schooling, rural residents, and those aged 55 years and older.

28 We recognise that the apps listed have higher currency for adults from higher SES homes and for young people.

FIGURE 43: Use of online apps by select socio-demographic attributes (mean scores 0–100, ranked)



To test whether the sub-group differences were significant, One-way ANOVA tests were conducted. Significant differences in the average level of use of online apps were found for all characteristics examined. The significant results are presented in Table 57.

TABLE 57: Personal characteristics associated with use of online apps

LIKELY TO REPORT HIGHER USE OF ONLINE APPS	LIKELY TO REPORT LOWER USE OF ONLINE APPS	F	SIG.	RANGE
16–24, 25–34, 35–44, 45–54	55+	55.6	***	22–36
Male	Female	63.6	***	30–35
Indian/Asian and White adults	Black African and Coloured adults	25.2	***	31–40
Matric, tertiary certificate/diploma, advanced diploma/bachelors	Primary and incomplete secondary	334.5	***	12–56
Medium, high and very high home support	Low and very low home support	195.3	***	11–43
Employed and student/learners	Other labour inactive and unemployed	151.5	***	29–41
Urban formal and urban informal residents	Rural	279.8	***	21–38
Medium religiosity	Low and high religiosity	16.2	***	30–35
Middle, fourth and richest SES quintile	Poorest and second SES quintile	185.9	***	24–47

Note: The F-statistic is a measure used to determine whether the mean scores between groups are significantly different from one another. Higher F-statistic values suggest that there may be significant differences between group mean scores. Statistical significance is denoted as * p<0.05 (95% level), ** p<0.01 (99% level), *** p<0.001 (99.9% level). The range of values reflects the minimum and maximum index values on the index for the specific personal attribute.

Who uses online apps more?

In the sections above, we described the use of online apps among the public. We extended the analysis to identify the characteristics of the groups that were more and less likely to report higher usage of online apps. We ran three multivariate models with each containing use of online apps as the outcome variable of interest. All models included the standard demographic variables as controls. In line with our conceptual framework (Figure 4), in addition to the demographic variables, we included the *exposure to S&T news* as well as *knowledge of and interest in priority S&T areas* as predictor variables to test which factors remained significant when they were considered simultaneously (Table 58).

In Model I, we examined the role of socio-demographic variables in explaining the variance of the use of online apps. Higher educational attainment, higher home education support and higher SES were strongly associated with the use of online apps. Younger adults, the employed, those living in urban formal areas (relative to rural areas), as well as Black African adults (relative to White adults), were also more likely to report slightly higher use of online apps. These characteristics continued to remain significant even when additional predictor variables were added.

In Model I, the socio-demographic variables explained a high 33% of the variance of the use of online apps. There was still a sizeable degree of unexplained variance, suggesting that other factors that were not included in the model had an influence on the outcome variables.

To account for the unexplained variance in the outcome variables, we tested the role of exposure to scientific news in Model II. Exposure to scientific news was strongly (and positively) associated with the usage of online apps (β = 0.319), and increased the model fit from 0.33 in Model I to 0.40 in Model II.

Knowledge of S&T priority areas was also positively associated with the use of online apps (β = 0.130). The addition of knowledge of, and interest in, S&T to the base model increased the model fit for use of online apps negligibly from 0.33 in Model I to 0.34 in Model III.

TABLE 58: Use of online apps: Summary of OLS models

Full model, including all controls, showing only significant associations and their direction and beta coefficients: green = positive; red = negative

	OLS REGRESSIONS		
	Model I	**Model II**	**Model III**
OUTCOME VARIABLE	**Use of online apps**	**Use of online apps** *(with exposure to news as predictor)*	**Use of online apps** *(with knowledge of and interest in S&T as a predictor)*
PREDICTOR VARIABLES			
Age (years)	–0.091***	–0.050*	–0.087***
Female			
Population group (Ref: Black African)			
Coloured			
Indian/Asian			
White	–0.077**	–0.060**	–0.07**
Years of education	0.190***	0.160***	0.170***
Home support for schooling	0.174***	0.100***	0.153***
Employment status (Ref: employed)			
Unemployed	–0.091***	–0.075***	–0.092***
Student/learner	–0.100***	–0.095***	–0.103***
Other Labour inactive	–0.091***	–0.079***	–0.076***
Geographic type (Ref: urban formal)			
Urban Informal			
Rural	–0.071***	–0.067***	–0.080***
Religiosity scale (low to high)		–0.038*	
Socioeconomic status (low to high)	0.165***	0.169***	0.146***
Frequency of exposure to scientific news	…	0.319***	…
Knowledge of S&T priority areas	…	…	0.130***
Interest in S&T priority areas	…	…	0.316***
R-squared	0.33	0.40	0.34
N	5 814	5 814	5 795

Notes: *** p<.001; ** p<.01; * p<.05. The symbol '…' indicates the variable was not included in the model. Analyses were weighted. Province of residence was included in all models as a control variable. The regression coefficients displayed in the models are standardised Betas.

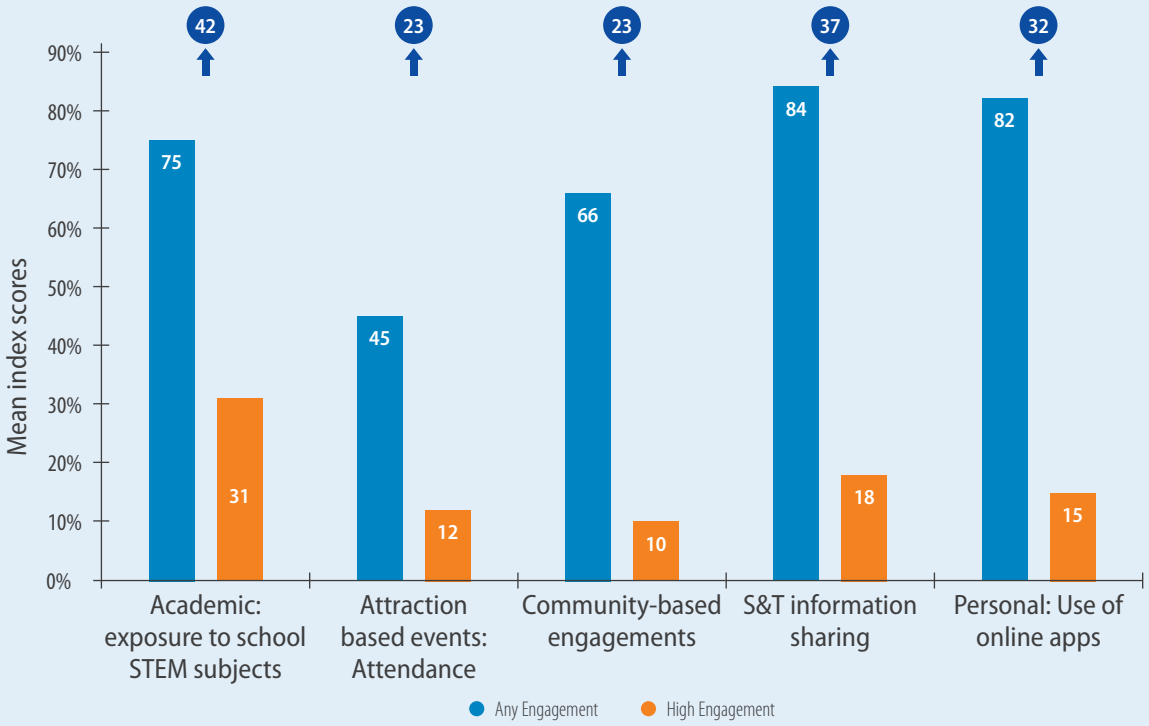
Key Results: S&T engagements: activities and behaviours

This chapter, firstly, reported the levels of science engagements on five broad types of activities: academic, event and attraction-based, community-based, information sharing, and use of online apps. Secondly, we identified the sub-group characteristics of those who were more likely to report higher science engagement levels. Thirdly, in line with our conceptual framework, we explored how the availability of spaces, as well as exposure and consumption of S&T information, influenced attendance at events and attraction-based activities. In addition, we tested the role of knowledge of, and interest in, S&T, as well as exposure to S&T information, in influencing the use of online apps.

LEVELS OF SCIENCE ENGAGEMENT

- The graph below presents the levels of each of the five broad types of engagements. We present the extent of *any* and *high* levels of engagement, as well as the mean index score (out of 100) for each engagement type.
- The extent of any engagement for each of the five science engagements (i.e. activities and behaviours) ranged from 45% (for attendance to attraction-based events) to 84% (for S&T information sharing). While most of the public participated in some science engagement activities, the overall levels of participation were low, with the mean index scores ranging from 23 for attraction-based attendance to 37 for S&T information sharing.

Levels of science engagement (percentage)



CHARACTERISTICS OF THOSE WHO WERE MORE LIKELY TO HAVE HIGHER PARTICIPATION IN SCIENCE ENGAGEMENT ACTIVITIES

- In addition to the generally low levels of engagement, there was a wide variation in the levels of science engagements across the different socio-demographic characteristics examined, reflective of the diverse and unequal socioeconomic conditions, as well as the age distribution within the country.
- STEM exposure was highest for those with educational attainment of matriculation or higher, those from homes with higher home education support and higher SES, White adults, those between 16 to 24 years of age, students, learners and the employed and those living in urban formal areas.
- Attendance at attraction-based events was highest for those with tertiary education, from homes providing higher support for education, living in urban formal and urban informal areas, the employed, students and learners, those aged 16 to 34 years and those from homes in the higher SES quintiles. White and Indian/Asian adults had significantly higher attendance than Black African and Coloured adults although their effects were less notable.
- Those who were more likely to have higher participation in community-based engagements were those with tertiary education attainment, persons with higher home education support, urban formal and informal residents, the employed, students and learners, Black African, Coloured and White adults, and those between 16 and 44 years of age.
- Those who were high information sharers were between 16 to 34 years of age, Black African adults, those who had more than primary school attainment, reported higher home education support, and were more inclined to be employed or students or learners.
- Those more likely to report higher use of online apps had educational attainment of matric or higher, higher home education support, were employed or students and learners, lived in urban formal areas or informal settlements, were aged below 55 years, Indian/Asian and White adults and from higher SES homes.

ROLE OF ACCESS TO S&T INFORMATION IN SHAPING ATTENDANCE AT S&T SITES AND USE OF ONLINE APPS

- The socio-demographic variables explained between 13% and 19% of the variance for all reported science engagement measures. The only exception was for the use of online apps, where these background attributes explained 33% of variance.
- As expected, the availability of S&T sites for attraction-based events near where one lives was strongly associated with attendance at these S&T sites and activities. In addition, those who experienced higher exposure to S&T news, as well as higher consumption of S&T information, were more likely to report more frequent attendance at attraction-based events.
- The frequency of exposure to S&T news and knowledge of the S&T areas was strongly associated with the use of online apps.

CHAPTER 8

Views of Pride, Promise and Priorities in the National System of Innovation

In this last analytical chapter, we return to the policy intent of the state, which is to achieve a science-literate and science-aware society (DST 2019b). A science aware society is underpinned by values which embrace and support science and technology (S&T). To obtain measures of how South Africans value and support S&T as well as the National System of Innovation (NSI), we surveyed their pride in, and promise and priorities of S&T. We report on:

1. Pride in South African S&T achievements, and the characteristics of those who had higher pride;
2. Promise of S&T skills for youth, and the characteristics of those who recognised the value of S&T skills for youth;
3. Public support for Research and Development (R&D) spending on S&T;
4. S&T research priorities for South Africa; and
5. The perceived value of S&T experiences in daily life.

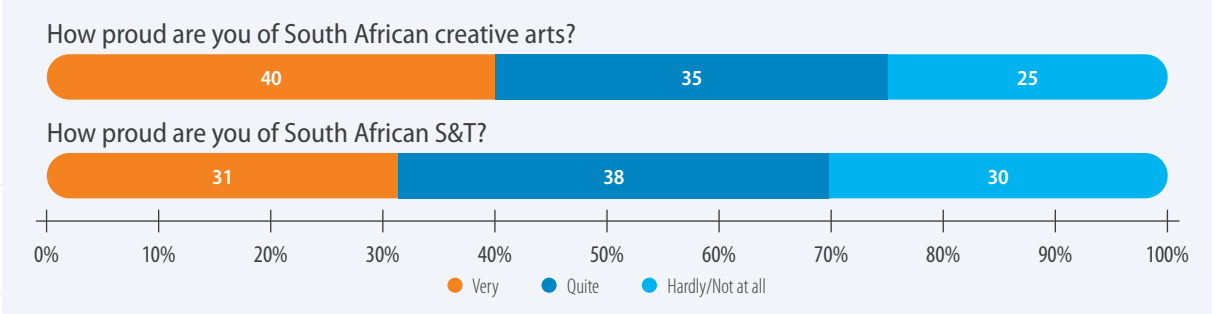
Pride in South African S&T achievements

Pride denotes a feeling of admiration the public has towards achievements in their country. This feeling of national pride towards S&T achievements can promote further S&T actions and attitudes (Wang et al. 2023). The public reported their level of pride in South African S&T achievements and, as a comparison, creative arts achievements (Figure 44).

In general, South Africans were proud of the country's S&T achievements. Seven in ten (69%) of the public reported that they were "very" or "quite" proud of South African S&T achievements. Similarly, a clear majority of the public (75%) was also proud of the nation's achievements in the creative arts.

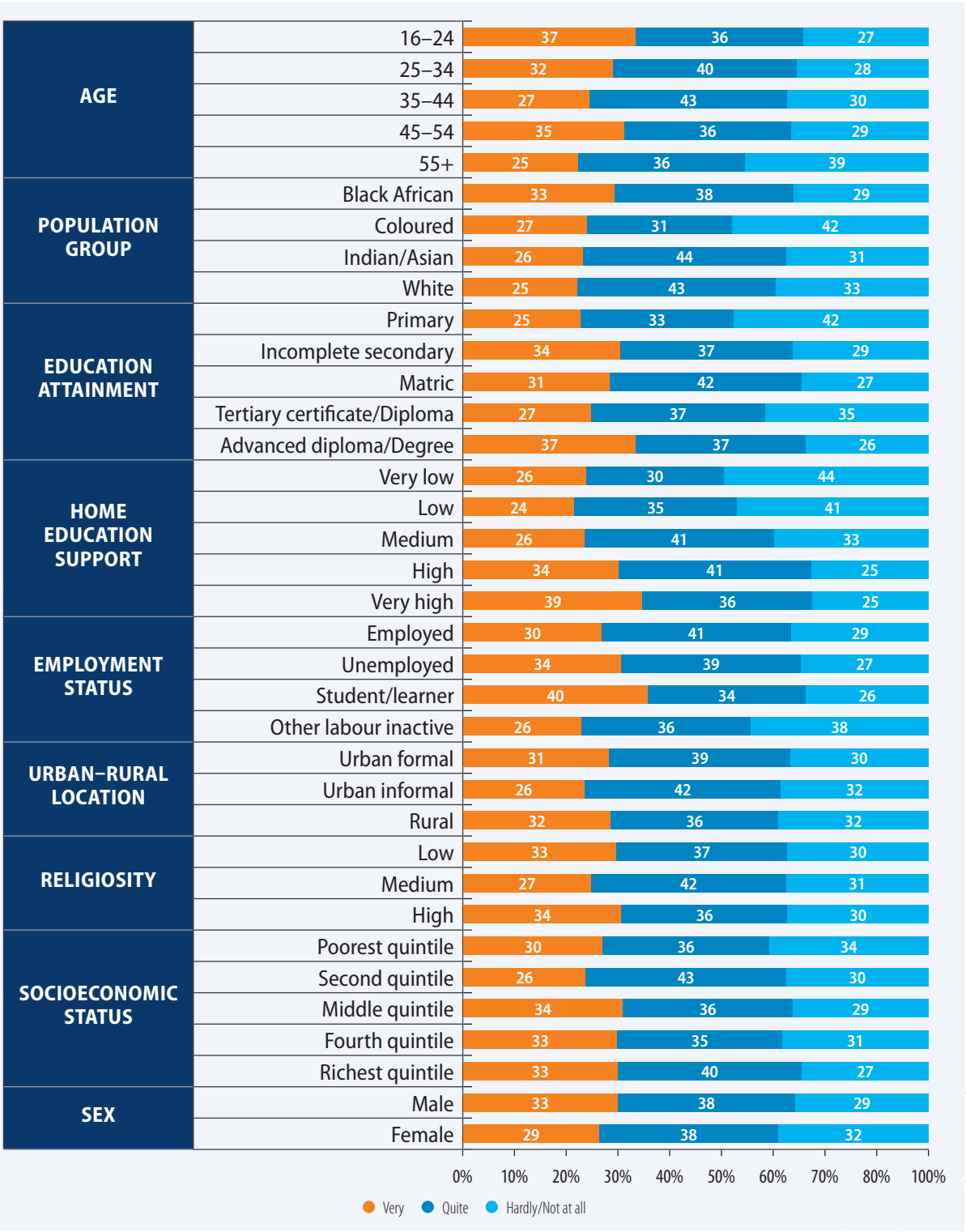
There was a moderate positive correlation between pride in S&T and pride in the creative arts (r = 0.45): Just over half the public (58%) who expressed pride in S&T achievements also expressed pride in the arts. A further 15% consistently reported being "hardly" or "not at all" proud of either. In contrast, about a quarter of the adult population provided different responses to the two measures. This indicates that close to three-quarters of the public responded in the same way to pride in S&T and pride in creative arts.

FIGURE 44: Pride in S&T and creative arts achievements



In Figure 45, the average level of pride in S&T by South Africans is presented for various social and demographic characteristics. The extent of those with "high" pride in S&T among the public varied within the score range between 24% and 40% – a moderate variation – across the different characteristics examined. The highest levels of pride were evident among students and learners, those who reported very high home education support, those with an advanced educational qualification, as well as those aged between 16 and 24 years. Conversely, pride was lowest among those with limited home educational support, those with primary or no formal schooling, those aged 55 years and older, as well as White and Indian/Asian adults.

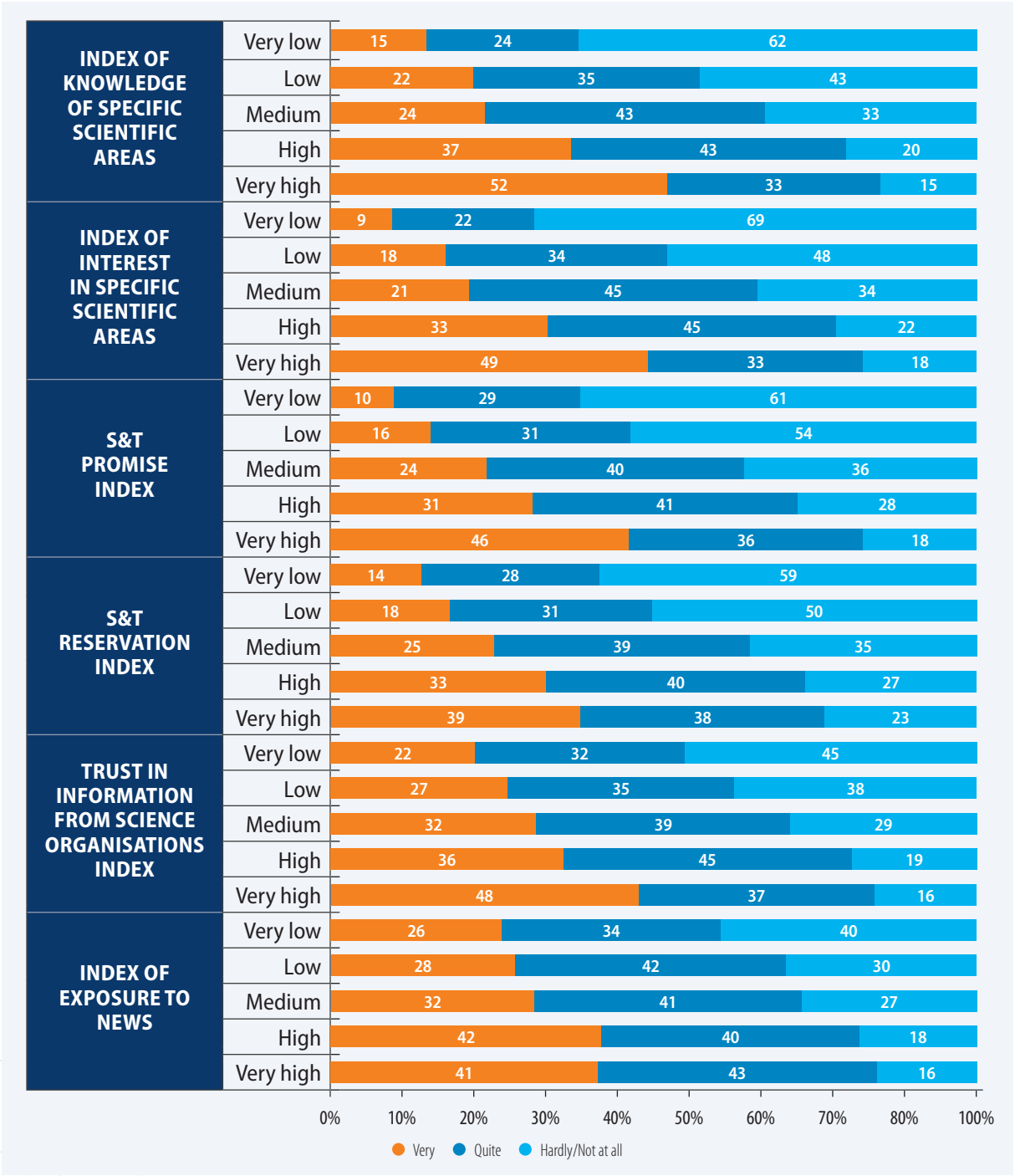
FIGURE 45: Pride in S&T by select socio-demographic attributes (percentages)



We extended the analysis to examine the relationship between the average level of pride in S&T in South Africa and the indices we created, results shown in Figure 46. These indices relate to knowledge of, and interest in S&T, attitudes of promise and reservation, trust in information from science organisations, as well as exposure to S&T information received. The level of pride in S&T varied widely, ranging from 9 to 52 percent indicating that they were "very proud" across the different indices examined.

The highest level of pride was evident among with those with high levels of knowledge, interest, and promise, in addition to trust in information from science organisations and exposure to S&T information. Conversely, pride was lowest among those with little interest and knowledge, as well as those with a low sense of S&T promise and reservation.

FIGURE 46: Variation in pride in S&T by select S&T indices (percentages)



To identify the characteristics of the sub-groups who were more and less likely to report a high degree of pride in South African S&T achievements, this pride variable was cross-analysed with a set of demographic variables, using One-way ANOVA tests. A 0–1 score was constructed based on those who had high pride and those who did not. This was then converted into a 0–100 scale for ease of interpretation. Table 59 shows that the results were significant for all characteristics, except the type of location where the public resided.

TABLE 59: Characteristics associated with a high degree of pride in South African S&T achievements (One-way ANOVA)

LIKELY TO HAVE HIGH PRIDE	LIKELY TO HAVE LOW PRIDE	F	SIG.	RANGE
Demographics				
16–24, 25–34, 45–54	35–44, 55+	16.1	***	23–37
Male	Female	12.1	**	29–33
Black African adults	Coloured, Indian/Asian and White adults	7.9	***	24–32
Incomplete secondary, matric, advanced diploma/degree	Primary schooling	8.2	***	24–37
Very high and high home education support	Very low and low home education support	22.4	***	23–38
Student/learners, unemployed, employed	Other labour inactive	20.8	***	24–39
Middle, fourth and richest SES quintile	Second SES quintile	6.3	**	26–34
High religiosity	Medium religiosity	11.1	***	27–33
Indices				
High and very high interest in scientific areas	Very low, low and medium interest in scientific areas	153.4	***	9–59
High and very high knowledge in scientific areas	Very low, low and medium knowledge in scientific areas	111.6	***	14–70
High and very high promise	Very low, low and medium promise	76.4	***	10–46
High and very high reservation	Very low, low and medium reservation	34.0	***	14–38
Very high, high and medium trust in information from science organisations	Very low and low trust in information from science organisations	29.1	***	22–43
High and very high news exposure	Very low, low and medium news exposure	30.2	***	23–41

Note: The F-statistic is a measure used to determine whether the mean scores between groups are significantly different from one another. Higher F-statistic values suggest that there may be significant differences between group mean scores. Statistical significance is denoted as * $p<0.05$ (95% level), ** $p<0.01$ (99% level), *** $p<0.001$ (99.9% level). The range of values reflects the minimum and maximum index values on the index for the specific personal attribute.

The results in the table indicate that while both socio-demographics as well as S&T measures appear to matter for levels of pride in South African S&T, it is evident that the latter (i.e. the S&T indices) appear to exert a greater bearing on pride. This is especially true of interest in, and knowledge of, S&T. In these instances, the difference in the share of the population feeling proud in South African S&T achievements between those with very low and very high interest and very low and very high knowledge, is close to 40 percentage points.

How did South African S&T achievements compare to other regions of the world?

The public also rated how they felt about South African S&T achievements compared with other regions of the world (Table 60). Two-thirds of the public (67%) rated South Africa as better than other parts of Africa in terms of its S&T achievements, while a quarter (25%) felt that it was better than Europe and North America. Close to a fifth (18%) of the public thought that South Africa was better than Asian countries such as India, China, and Japan in this regard. On the other hand, 4% of the public thought that South African S&T achievements were much worse than in other parts of Africa, 21% felt they were much worse than Europe and North America, while 39% thought they were much worse than Asian countries.

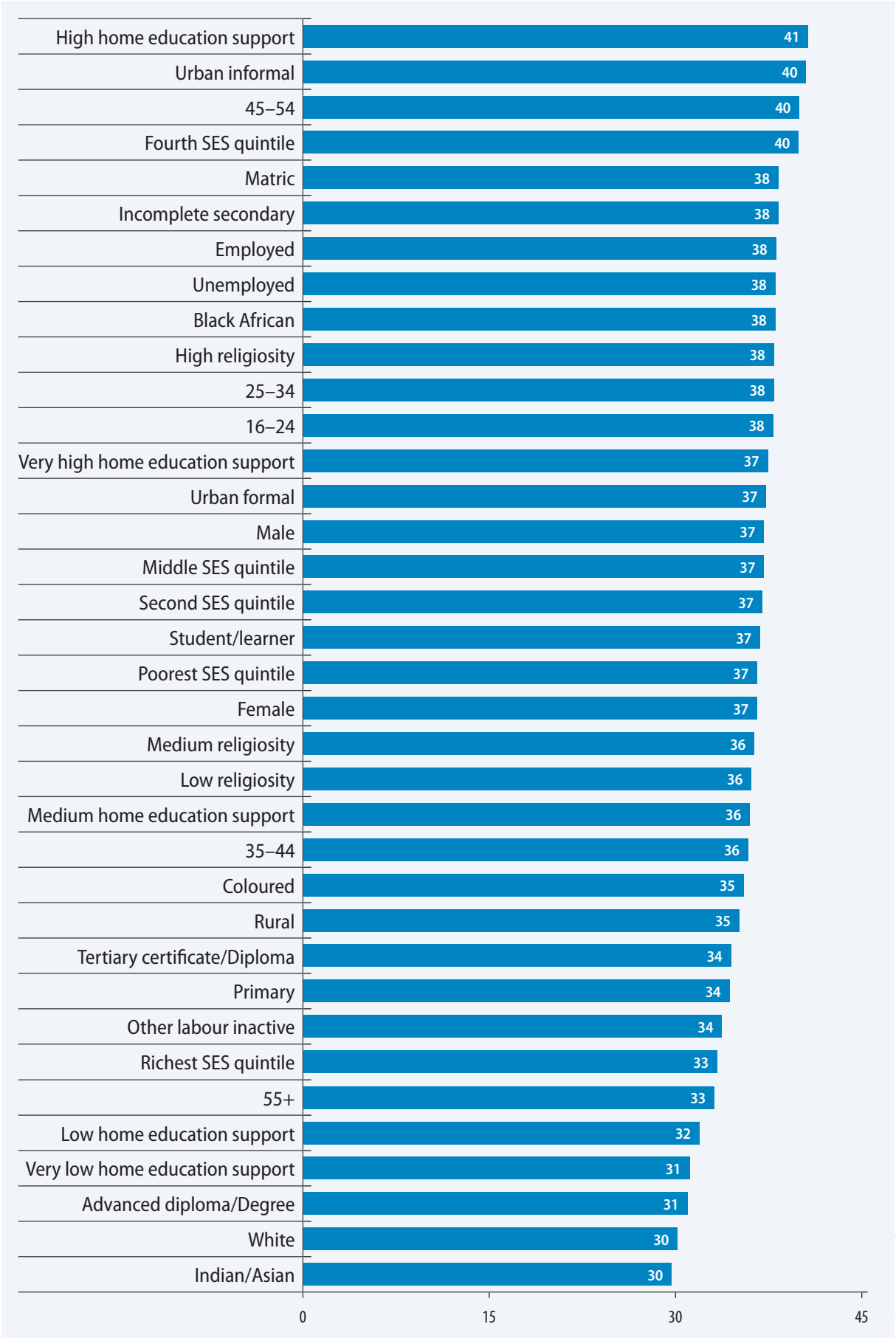
TABLE 60: South African achievements in S&T compared with other regions of the world (row percentage)

	SOUTH AFRICA IS MUCH BETTER THAN	SOUTH AFRICA IS A LITTLE BETTER THAN	SOUTH AFRICA IS ABOUT THE SAME AS	SOUTH AFRICA IS A LITTLE WORSE THAN	SOUTH AFRICA IS MUCH WORSE THAN	(DO NOT KNOW)	TOTAL
Other parts of Africa	37	30	16	9	4	3	100
Europe and North America (e.g. USA)	8	17	17	34	21	4	100
Asian countries (e.g. China, India and Japan)	7	11	15	25	39	3	100

An index was constructed and transformed to a 0–100 score based on the three items relating to South African S&T achievements being better than other world regions. A score of 0 on the index indicated that S&T achievements in South Africa were not rated as better than other world regions, while a score of 100 indicated that S&T achievements in South Africa were regarded as better than all other world regions. In Figure 47, the mean scores are presented for various social and demographic characteristics. The bar chart is ranked from highest to lowest based on mean scores using the 0–100 composite index. The levels varied among the public within a low and narrow range of 30 to 41 across the different characteristics examined.

The highest index scores (i.e. those who viewed South Africa as better than all other regions) were evident among those adults who reported high levels of home education support, those living in urban informal areas, those aged between 45 and 54 years, those with lower levels of education, as well as Black African adults. Conversely, lower scores (i.e. those who viewed South Africa as not better than all other regions) were found among Indian/Asian and White adults, those with higher levels of education, adults from higher SES homes, those aged 55 years and older, and those with low home education support.

FIGURE 47: South African achievements in S&T compared with other regions of the world by select socio-demographic attributes (ranked)



To test whether the sub-group differences presented in Figure 47 were significant, One-way ANOVA tests were conducted. Significant differences in the characteristics associated with achievements in S&T in South Africa were found based on all characteristics, except for gender. In Table 61, a summary of significant sub-group differences associated with the assessment of achievements is presented.

TABLE 61: Personal characteristics associated with S&T achievements in South Africa relative to the rest of the world

LIKELY TO INDICATE THAT SOUTH AFRICA S&T ACHIEVEMENTS ARE BETTER THAN ALL OTHER WORLD REGIONS	LIKELY TO INDICATE THAT SOUTH AFRICAN S&T ACHIEVEMENTS ARE NOT BETTER THAN ALL OTHER WORLD REGIONS	F	SIG.	RANGE
16–24, 25–34	55+	7.5	***	33–40
Black African and Coloured adults	Indian/Asian and White adults	14.7	***	30–38
Incomplete secondary, matric or equivalent	Primary or less schooling, advanced diploma/bachelor's or higher	8.0	***	31–38
High and very high home education support	Very low, low and medium home education support	16.7	***	31–41
Employed and unemployed	Other labour inactive	7.0	**	34–38
Fourth SES quintile	Richest SES quintile	6.5	***	33–40
Urban informal	Rural	5.7	*	35–40

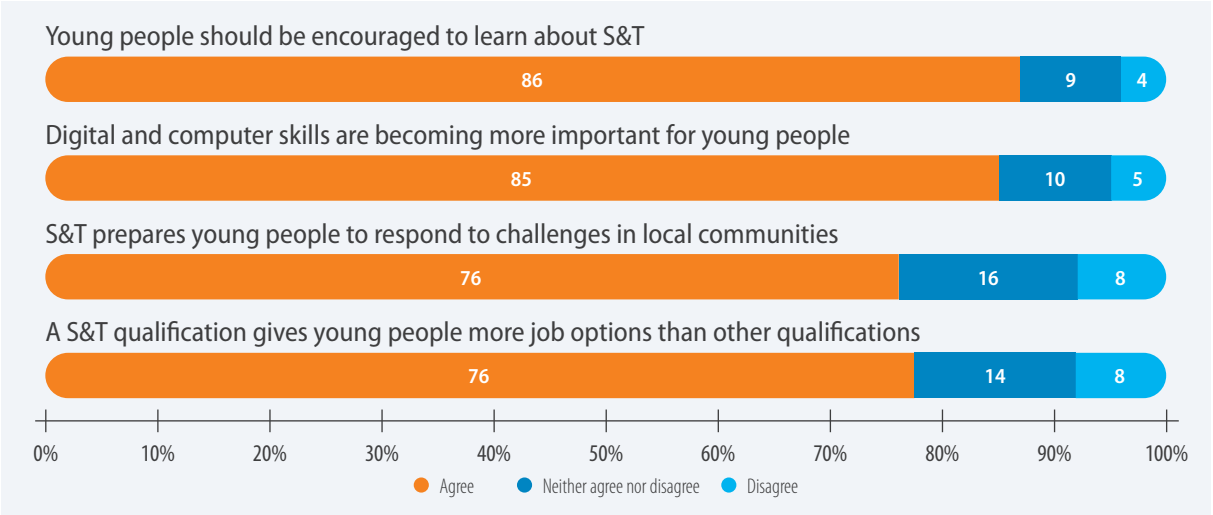
Note: The F-statistic is a measure used to determine whether the mean scores between groups are significantly different from one another. Higher F-statistic values suggest that there may be significant differences between group mean scores. Statistical significance is denoted as * $p<0.05$ (95% level), ** $p<0.01$ (99% level), *** $p<0.001$ (99.9% level). The range of values reflects the minimum and maximum index values on the index for the specific personal attribute.

Promise of S&T skills for young people

Two-thirds of the South African population are under the age of 35 years (see Table 3 for socio-demographic description) and are encouraged to acquire S&T skills to respond to personal, social and economic challenges (DST, 2019b). We sought the views of the public regarding the promise of S&T skills for young people (Figure 48).

In general, over three-quarters of the public agreed on the promise of S&T skills for young people – that young people should learn about S&T (86%), acquire computer skills (85%), and gain a S&T qualification for better job opportunities (76%). In addition, the majority also felt that S&T prepares young people to respond to challenges in their communities (76%). The signal sent to young people is that S&T is important.

FIGURE 48: Promise of S&T for young people (row percentage)



Who was more and less likely to see the promise of S&T skills for youth?

To identify the characteristics of the individuals who expressed a stronger sense of the promise of S&T skills, we used the four items and created an *Index of Promise of S&T skills for youth* (Cronbach $\alpha = 0.788$) and transformed it into a 0–100 scale, with higher scores representing greater promise.

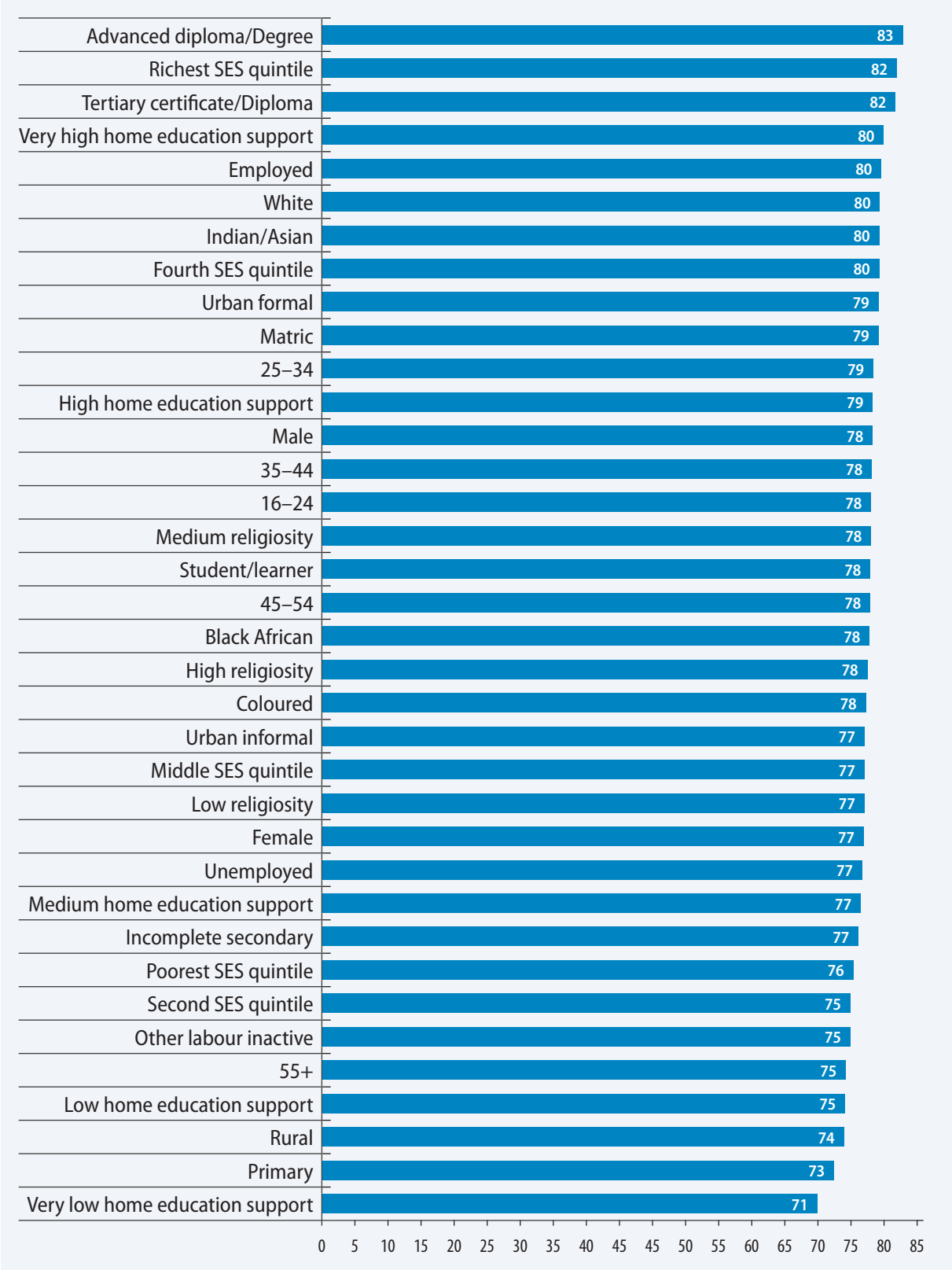
The scale scores were then divided into five categories: very low, low, medium, high and very high. Table 62 presents the distribution of the responses. In line with the publics' high rating of the promise of S&T skills for youth, the mean index score was 78 out of 100. Eight in ten adults viewed the promise of S&T skills for youth as "high" or "very high", while only one in twenty viewed the promise as "low" or "very low".

TABLE 62: Distribution of the promise of S&T skills for youth (row percentage)

VERY LOW (0–3)	LOW (34–49)	MEDIUM (50–65)	HIGH (66–80)	VERY HIGH 81–100	TOTAL	MEAN INDEX SCORE
2	3	15	31	50	100	78.1

In Figure 49, the mean scores for the promise of S&T skills for young people index are presented for various social and demographic sub-groups. The bar chart is ranked from highest to lowest based on the mean scores of the 0–100 composite index. The level of promise of S&T skills for youth varied only modestly among the public, with a generally favourable view evident across the public irrespective of socio-demographic background. The range of scores was between 71 and 83 across the different sub-groups examined. The highest scores were evident among those with higher levels of education, high home education support, students and learners, those in the richest SES quintile, and those aged 16 to 24 years. Conversely, lower scores were found among those with limited home education support, with primary or no formal schooling, as well as among Coloured adults, those aged 55 years or older, adults living in urban informal areas, and those from the poorest SES quintile homes.

FIGURE 49: Promise of S&T skills for young people by select socio-demographic attributes (ranked)



To test whether the sub-group differences in views of the promise of S&T skills for youth presented in Figure 49 were significant, One-way ANOVA tests were conducted. Significant differences in the characteristics associated with promise of S&T skills for young people were found for all characteristics, except sex. In Table 63, a summary of significant sub-group differences in the average levels is presented.

TABLE 63: Personal characteristics associated with the promise of S&T skills for young people

LIKELY TO REPORT HIGH PROMISE OF S&T SKILLS FOR YOUTH	LIKELY TO REPORT LOW PROMISE OF S&T SKILLS FOR YOUTH	F	SIG.	RANGE
16–24, 25–23, 35–44, 45–54	55+	6.5	***	76–79
Black African, Indian/Asian and White adults	Coloured	8.6	***	75–79
Incomplete secondary, matric, tertiary certificate tertiary certificate/diploma	Primary schooling	25.1	***	75–83
Medium, high and very high home education support	Very low and low home education support	65.2	***	71–82
Student/learners, unemployed	Other labour inactive, employed	29.6	***	75–82
Second, middle, fourth and richest SES quintile	Poorest SES quintile	9.5	***	75–80
High religiosity	Medium and low religiosity	22.0	***	77–80
Urban formal and rural	Urban informal	9.1	**	74–78

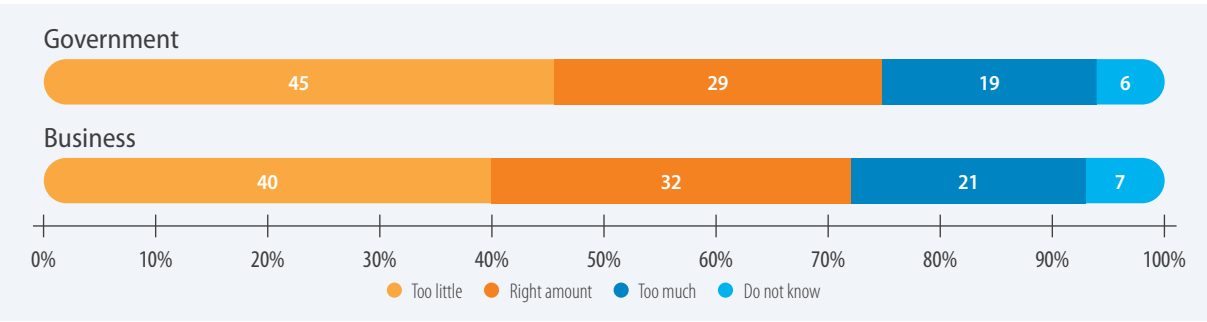
Note: The F-statistic is a measure used to determine whether the mean scores between groups are significantly different from one another. Higher F-statistic values suggest that there may be significant differences between group mean scores. Statistical significance is denoted as * p<0.05 (95% level), ** p<0.01 (99% level), *** p<0.001 (99.9% level). The range of values reflects the minimum and maximum index values on the index for the specific personal attribute.

Public support for government and business research and development spending on S&T

The OECD (2012) argued that investments in research and development (R&D) can make a difference in addressing developmental challenges, such as providing access to drinking water, food and medicines. The public rated the South African government and big business (i.e. the private sector) in relation to the amount they spend on R&D in S&T on a five-point scale. We recoded the five-point scale variable to a three-point scale: too little, the right amount and too much (Figure 50).

There were similar views about R&D spending on S&T by government and big business, and the two variables had a strong positive correlation of 0.671 between them. Close to a third of the public rated the R&D spending by both government (29%) and the business sector (32%) as the right amount. A further 40% viewed business R&D spending as too little,[29] while 45% viewed government R&D spending as insufficient. Thus, close to three-quarters of the public signalled support for R&D spending on S&T and felt that the current spending, by both government and business, should either be maintained or increased.

FIGURE 50: Views of R&D spending on S&T by government and big business



In Figure 51 and Figure 52, the views on government and big business spending on R&D respectively are presented for various social and demographic characteristics. The view that the government and big business spent "too little" was more commonly expressed by White, Coloured and Indian/Asian adults,

29 Business sector R&D spending has been declining over the last decade and in the recent years contributed 30% to the total Gross Expenditure on R&D (NACI, 2023).

those with tertiary qualifications, and those in the richest SES quintile. Conversely, lower percentages supporting this viewpoint were observed among those with limited home education support, adults with primary or no formal schooling, persons from the poorer SES quintiles, those residing in rural areas, and Black African adults.

FIGURE 51: View on government R&D spending on S&T by select socio-demographic attributes (percentages)

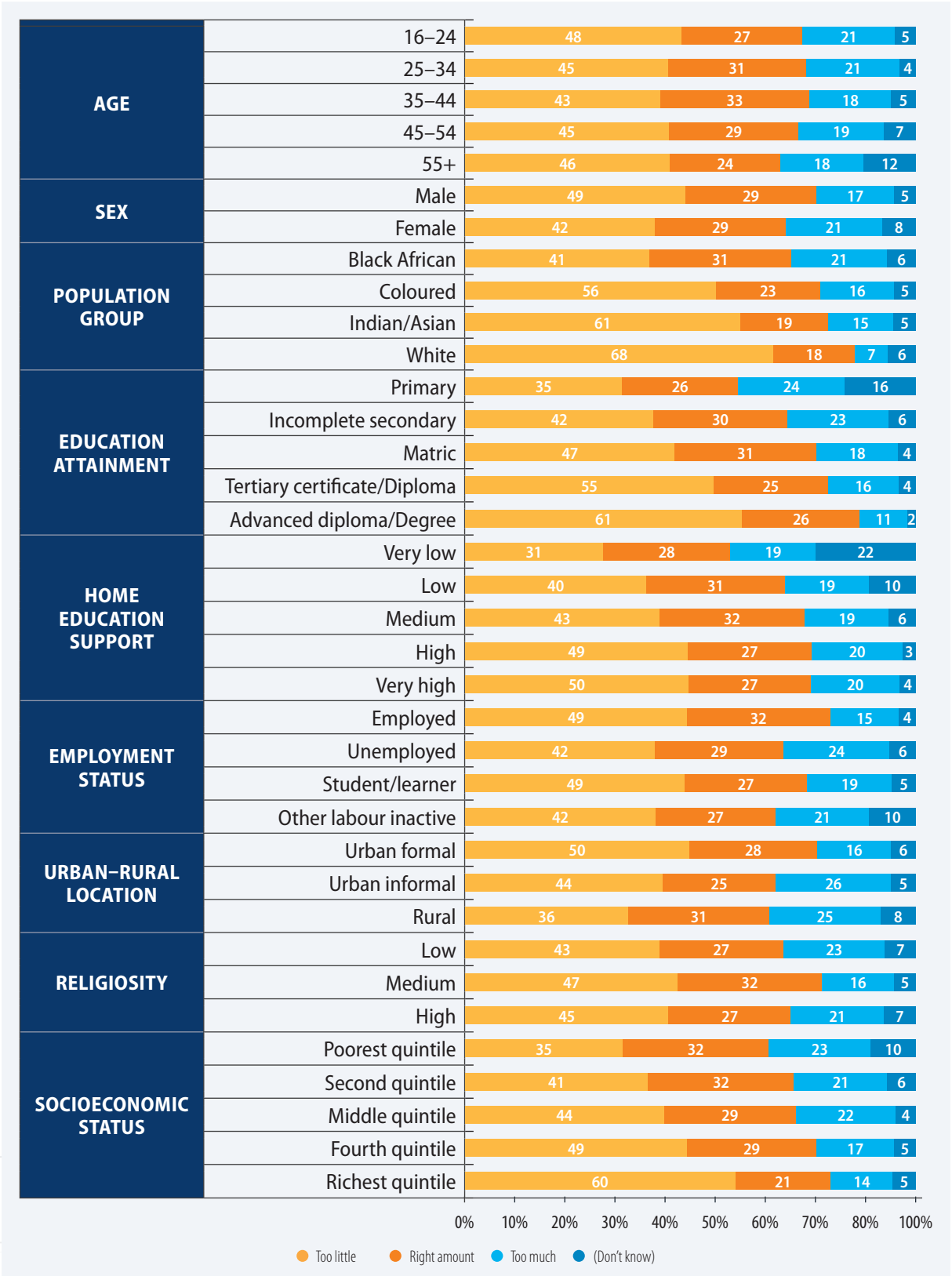
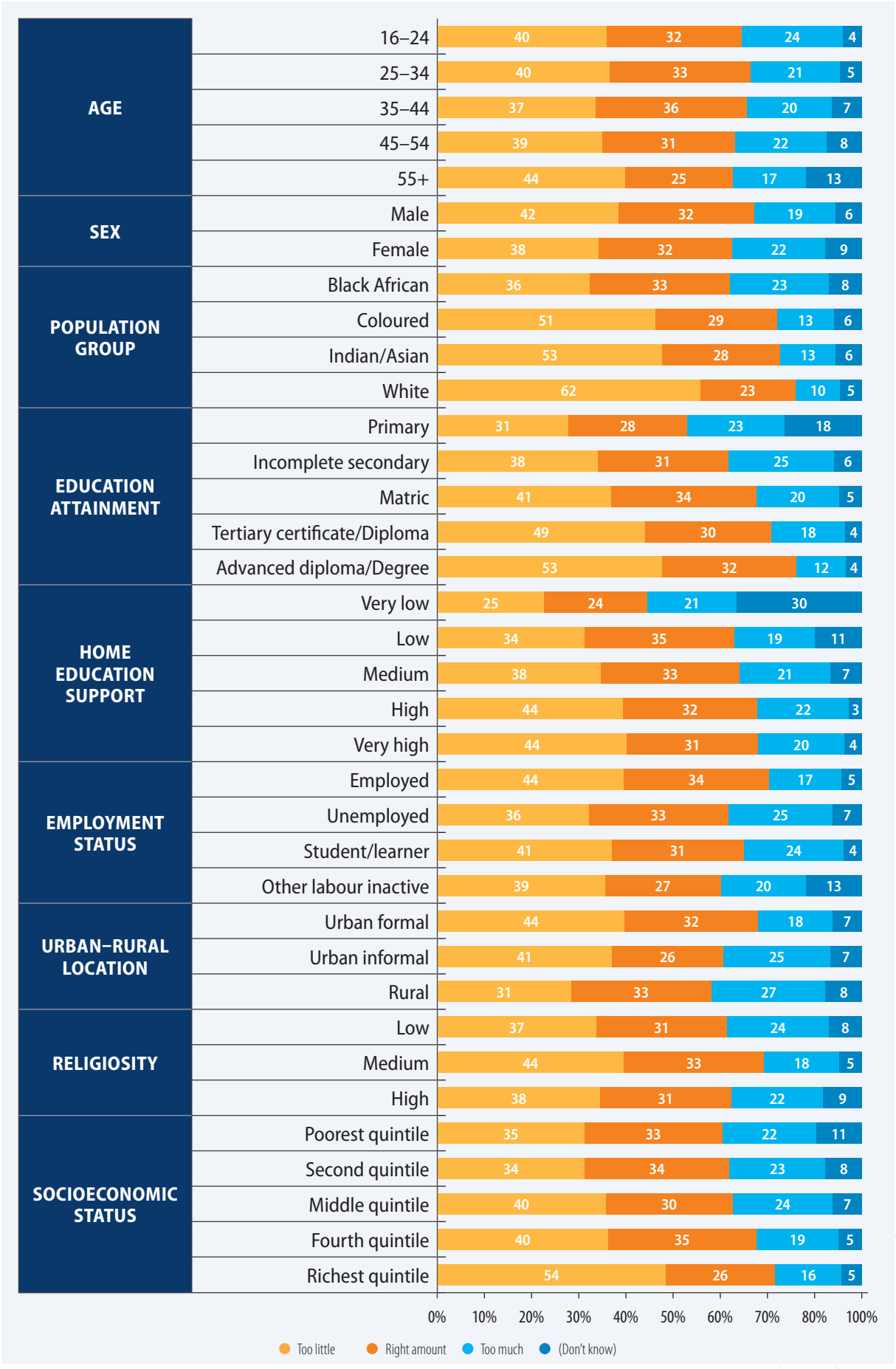


FIGURE 52: View on business R&D spending on S&T by select socio-demographic attributes (percentages)



S&T research priorities for South Africa

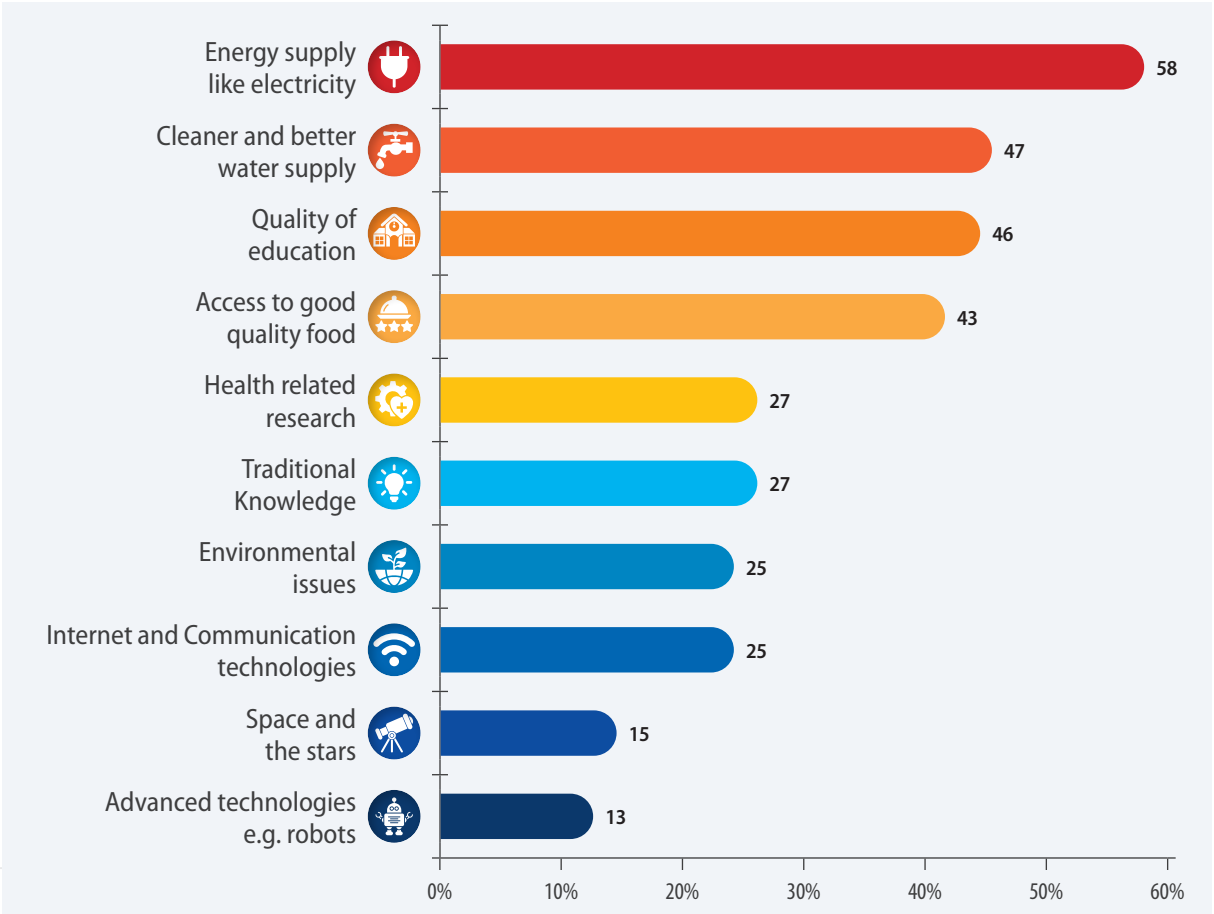
After rating their interest in, and knowledge of, a set of contemporary S&T research priorities (the results of which are reported in Chapter 3), the public was then asked to select four priority areas from the provided list that government should continue to fund (Figure 53).

The pattern of choices for continued research funding was similar to the patterns of interest in, and knowledge of, S&T priority areas. The highest research priority was energy supply (58%). The next most frequently rated research priorities were cleaner and better supply of water (47%), quality of education (46%), and access to good quality food (43%). The next cluster of research priorities, selected by around a quarter of the public, included health-related research, traditional knowledge, the environment, and ICT technologies.

The lowest research priorities that were selected were space and the stars (15%), as well as advanced technologies like robots (13%). This lower ranking is understandable in a country where most of the population lives in poorer socioeconomic conditions and therefore has more urgent basic priorities.

Based on the public choices, the first set of five priorities can be classified as *important and urgent* because they represent contemporary societal challenges, while the second set of three, can be thought of as "important, but not urgent". The third cluster of two is more likely to fall into the "blue-sky" research category, i.e. research where "real world" applications are not immediately apparent.

FIGURE 53: South Africans' priorities for future research funding



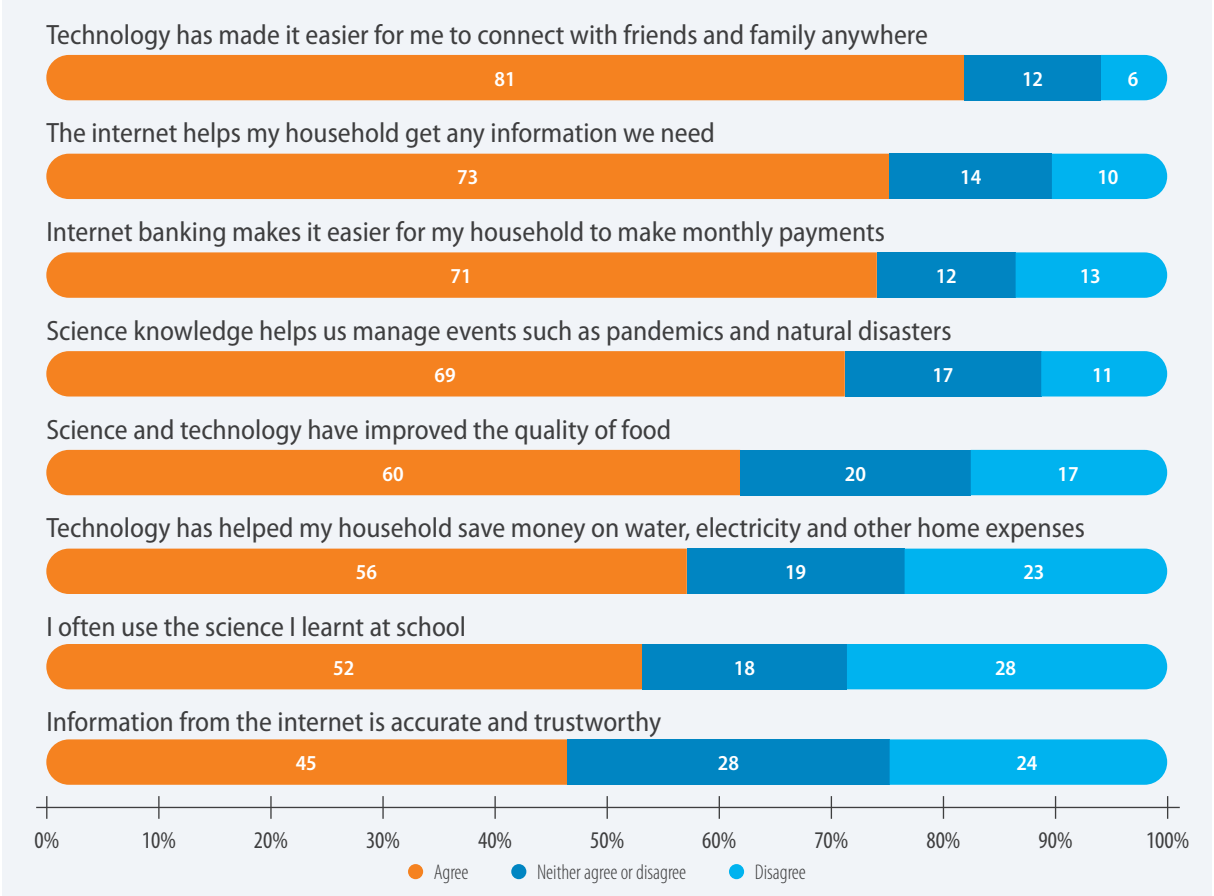
The value of S&T experiences in daily life

S&T plays an important role in our everyday lives: One values something if we see it as important and worthy of appreciation. Strictly speaking, values are not a science engagement activity or behaviour, but are part of the ethical compass that regulates people's daily behaviour. Given their importance, we therefore asked the public to rate the value of S&T in daily life in their home, social and civic life (Figure 54).

Most of the public recognised the utility of S&T for daily activities: eight in ten (81%) agreed that it is "easier to connect with family and friends anywhere" and seven in ten (73%) agreed that the internet helped their households access the information they needed and make monthly payments through internet banking (71%). However, despite the high usage of the internet, the public were still cautious about the information available online, with less than half agreeing that this information was accurate and trustworthy (45%).

Most of the public also recognised the value of science knowledge in managing events such as pandemics and natural disasters (69%), as well as improving the quality of food (60%).[30] Slightly more than half (56%) agreed that technology had helped them save money on household expenses, such as water and electricity. However, only half claimed to often use the scientific knowledge that they learnt at school (52% agree and 28% disagree).

FIGURE 54: Value of S&T experience in daily life



30 See Figure 52, on the public rating of priority of food production as a research priority.

To identify the characteristics of individuals who valued S&T highly in their daily lives, we constructed a *Value of S&T experience index* ($\alpha = 0.774$) and transformed this to a scale ranging from 0 to 100, with higher scores representing more positive appraisals. The scale scores were then divided into five categories: very low, low, medium, high, and very high.

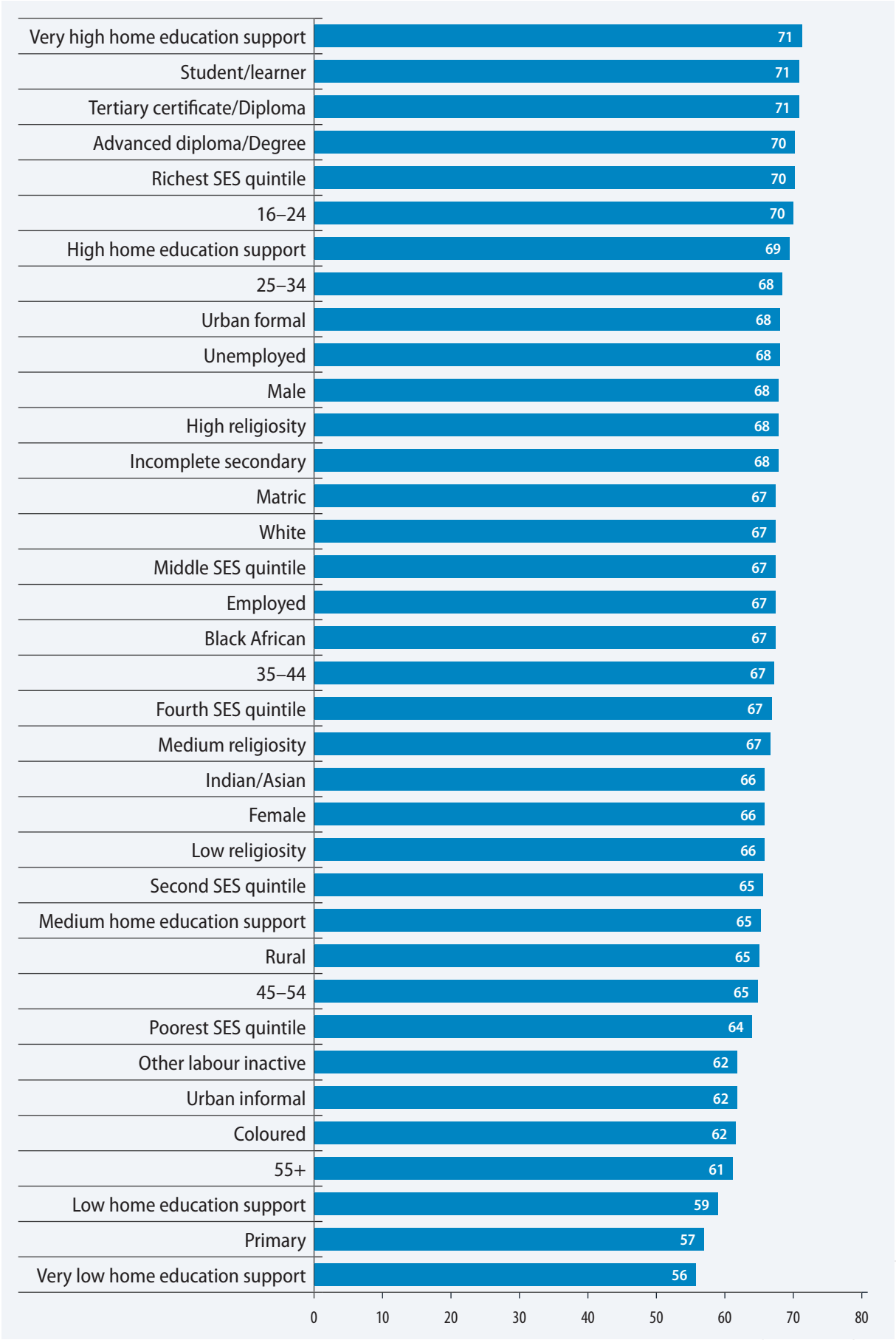
Table 64 indicates that most of the public rated the value of S&T highly, with a mean index score of 67 out of 100. At least six in ten adults reported a high value of S&T in their daily lives (62%), of which two in ten (19%) valued it very highly. A small share (13%) placed a low value on their experience of S&T in their daily lives.

TABLE 64: Distribution of the value of S&T in daily lives (row percentage)

VERY LOW (0–33)	LOW (34–49)	MEDIUM (50–65)	HIGH (66–80)	VERY HIGH (81–100)	TOTAL	MEAN INDEX SCORE
4	9	25	43	19	100	66.7

In Figure 55, the mean scores for the value of S&T are presented for various social and demographic characteristics. The bar chart is ranked from highest to lowest based on the mean scores of the 0–100 composite item index. The value of S&T experiences among the public varied within a narrow range of 56 to 71 out of 100 across the different characteristics examined. The highest levels were evident among those with high home education support and education attainment, student and learners, those in the richest SES quintile, and those aged 16 to 24 years. Conversely, lower scores were found among those with limited home education support and attainment, as well as Coloured adults, those aged 55 years or older, those living in urban informal areas, and adults in households classified in the poorer SES quintiles.

FIGURE 55: Value of S&T in daily life by select socio-demographic attributes (ranked)



To test whether the sub-group differences in the value of S&T in everyday life were significant, One-way ANOVA tests were conducted. Significant differences in the characteristics associated with value of S&T were found based on all characteristics examined. In Table 65, a summary of significant sub-group differences in the average levels of value of S&T experiences is presented.

TABLE 65: Personal characteristics associated with value of S&T experiences

MORE LIKELY TO SEE THE VALUE OF S&T IN EVERYDAY LIFE	LESS LIKELY TO SEE THE VALUE OF S&T IN EVERYDAY LIFE	F	SIG.	RANGE
16–24, 25–34	45–54, 55+	46.6	***	61–70
Male	Female	22.3	***	66–68
Black African, Indian/Asian and White adults	Coloured adults	18.7	***	62–67
Incomplete secondary, matric, tertiary certificate/ diploma, advanced diploma/degree	Primary schooling	80.6	***	57–71
Medium, high and very high home education support	Very low and low home education support	125.0	**	56–71
Student/learner, employed, unemployed	Other labour inactive	58.0	***	62–71
Urban formal residents	Urban informal and rural residents	35.2	***	62–68
High religiosity	Low religiosity	7.1	**	66–68
Middle, fourth and richest SES quintile	Poorest and second SES quintile	21.7	***	64–70

Note: The F-statistic is a measure used to determine whether the mean scores between groups are significantly different from one another. Higher F-statistic values suggest that there may be significant differences between group mean scores. Statistical significance is denoted as * p<0.05 (95% level), ** p<0.01 (99% level), *** p<0.001 (99.9% level). The range of values reflects the minimum and maximum index values on the index for the specific personal attribute.

Who values S&T in daily life?

We extended the analysis to identify the characteristics of the groups who were more and less likely to report a higher value of S&T in daily life. We computed a set of multivariate models with Models I, II and III containing value of S&T in daily life as the outcome variable of interest. All models included the demographic variables as controls. In line with our conceptual framework, and in addition to the demographic variables, we included exposure to S&T news as well as knowledge of and interest in priority S&T areas as predictor variables to test which factors remained significant when they were considered simultaneously (Table 66).

In Model I, we examined the role of socio-demographic variables in explaining the variance of valuing S&T in daily life. In general, age was negatively associated with the value of S&T in daily life. The level of educational attainment, home education support and SES were all positively associated with the value attached to S&T experiences. Being employed (relative to the reference categories), living in urban formal areas (relative to rural areas), as well as identifying as Black African (relative to Coloured and Indian/Asian), were also positively correlated with valuing S&T. Except for home education support for schooling, the other associations are fairly negligible.

The socio-demographic variables explained 17% of the variance in the value placed on S&T in daily life. There was a considerable degree of unexplained variance, indicating that other factors not included in Model I shape both of the outcome variables.

In Model II, we tested the role of the exposure to scientific news to determine how it associated with the outcome variable, over and above the role played by socio-demographic variables. Exposure to scientific news was strongly (and positively) associated with valuing of S&T in the home, social and civic

life (β = 0.257). The addition of the exposure to scientific news as predictor variable increased the model fit from 0.17 in Model I to 0.22 in Model II.

In Model III, knowledge of (β = 0.108) and interest in (β = 0.316) S&T had a strong association with valuing of S&T experiences. The addition of knowledge of, and interest in, S&T to the base model almost doubles the model fit: The degree of variance explained in the valuing of S&T in daily life by the public increased from 0.17 in Model I to 0.30 in Model III. It is noteworthy that the coefficient for interest is nearly three times greater than the one for knowledge – if you are interested in something you are more likely to value it and vice versa.

TABLE 66: The valuing of S&T experiences in daily life: Summary of OLS models

Full model, including all controls, showing only significant associations and their direction and beta coefficients: green = positive; red = negative

	OLS REGRESSIONS		
	Model I	**Model II**	**Model III**
OUTCOME VARIABLE	**Valuing of S&T in daily life**	**Valuing of S&T in daily life** *(incl. Exposure to news as predictor)*	**Valuing of S&T in daily life** *(incl. Knowledge and Interest in S&T as predictor)*
PREDICTOR VARIABLES			
Age (years)	–0.062*		
Female			
Population group (Ref: Black African)			
Coloured	–0.056**	–0.050*	–0.040*
Indian/Asian	–0.052**	–0.044**	–0.054***
White			
Years of education	0.088**	0.064*	
Home support for schooling	0.188***	0.135***	0.139***
Employment status (Ref: employed)			
Unemployed			
Student/learner			
Other Labour inactive	–0.056*	–0.053*	
Geographic type (Ref: urban formal)			
Urban Informal			–0.050*
Rural	–0.07**		–0.050*
Religiosity scale (low to high)			
Socioeconomic status (low to high)	0.074**	0.084**	
Frequency of exposure to scientific news	…	0.257***	…
Knowledge of S&T priority areas	…	…	0.108***
Interest in S&T priority areas	…	…	0.316***
R-squared	0.17	0.22	0.30
N	5 263	5 263	5 256

Notes: *** p<.001; ** p<.01; * p<.05. The symbol '…' indicates the variable was not included in the model. Analyses were weighted. Province of residence was included in all models as a control variable. The regression coefficients displayed in the models are standardised Betas.

Key results: Pride, Promises and Priorities in the NSI

This chapter, firstly, reported the levels of pride in South African S&T achievements, the promise of S&T skills for youth, public support for R&D spending on S&T, the future research priorities for South Africa and the valuing of S&T experiences in daily life. Secondly, it identified the characteristics of those who were more and less likely to have higher pride in S&T achievements, saw higher promise of S&T for young people, and supported government and business spending on R&D. Thirdly, we explored the role of knowledge of and interest in S&T, attitudes of promise and reservation towards S&T, and trust and exposure to S&T information in shaping views of pride. Further, we explored the role of exposure to S&T information as well as knowledge of and interest in S&T, in appreciating the value of S&T in daily lives.

LEVELS OF PRIDE, PROMISE AND PRIORITY OUTCOMES

- South Africans were proud of the country's S&T and creative arts achievements. More than two-thirds (69%) of the public reported that they were "very" or "quite" proud of S&T achievements, while the corresponding share for the creative arts was three-quarters (75%).
- While the public had high pride in the nation's S&T achievements, they were realistic in their comparisons with other countries. Two-thirds of the public rated South Africa as better than other parts of Africa in terms of S&T achievements, while a quarter felt that the country performed better than Europe and North America and almost a fifth felt that South Africa was better than Asian countries such as India, China, and Japan in this area of performance.
- The public saw the promise of S&T skills for youth, with eight in ten adults rating the promise of S&T skills for youth as "high" or "very high".
- Close to three-quarters of the public signalled support for R&D spending and felt that current spending by government and the business sector should be maintained or increased. Close to a third of the public rated the R&D spending on S&T by the government and the business sector as the right amount, while 40% viewed business R&D spending and 45% viewed government R&D spending as "too little".
- The top four priorities for future research were related to energy supply (58%), a cleaner and better supply of water (47%), quality of education (46%) and access to good quality food (43%).
- The public appreciated and valued S&T in daily life, with 62% rating its value highly.

CHARACTERISTICS OF THOSE WHO WERE MORE LIKELY TO HAVE HIGHER PRIDE IN AND PROMISE OF S&T

- The variation in pride in South African S&T across the different socio-demographic subgroups examined ranged between scores of 56 to 75 out of 100. The highest levels of pride were evident among students and learners, Black African adults, those with higher than primary education attainment, those who reported higher home education support, as well as those who were younger than 35 years.
- The levels of pride varied appreciably based on the different S&T indices that were created. The scale of difference in pride ranked from largest to smallest, was observed across the following S&T measures: knowledge of S&T areas, interest in S&T areas, promise attitudes, reservation attitudes, exposure to S&T news, and trust in information from science organisations. This implies that efforts to promote S&T knowledge and interest should directly influence pride in domestic S&T developments and have an indirect effect on pride through its influence in shaping attitudes to the promise and reservation of S&T. Increasing public exposure to S&T news and credible information from science organisations should have a similar, albeit lesser, effect on pride.
- The share of the public who thought South Africa was better than other regions of the world in terms of their S&T achievements varied within a low and narrow range of 30 to 41 across the different subgroups examined. The characteristics of those who thought South Africa was better were evident among those with lower levels of education, persons aged 16 to 34 years, and Black African and Coloured adults.
- The rating of the promise of S&T skills for youth was high and varied within a narrow range between 71 and 83 across the different characteristics examined. The highest levels were evident among those with higher levels of education, higher home education support and student and learners.
- The subgroups that strongly expressed the view that the government spent "too little" on S&T were White and Indian/Asian adults, those with tertiary education, and those belonging to households in the richest SES quintile.
- Those rating the value of S&T in daily life highly had an education higher than primary school attainment, were from homes that offered moderate to high home education support, were students and learners, and were aged 16 to 34 years.

ROLE OF ATTITUDINAL AND SCIENCE ENGAGEMENT MEASURES IN EXPLAINING PRIDE IN AND VALUING OF S&T

- The socio-demographic variables explained less than 10% of the variation for pride in the NSI, and 17% of the variation in valuing S&T experiences in daily life.
- These findings suggest that cognitive engagement (knowledge and interest), public attitudes toward S&T, informational trust, as well as media exposure are key factors informing positive sentiments towards, and prioritisation of, S&T in South Africa. The relatively limited impact of socio-demographic factors suggests their influence may be indirect, primarily shaping knowledge of, interest in, and attitudes towards science in society. This largely reaffirms the hypothesised relationships in the SAPRS conceptual diagram in Figure 4.
- Exposure to scientific news, as well as knowledge of and interest in S&T was strongly associated with valuing of S&T in the home, social and civic life.

SECTION D

In Conclusion

Results from the 2022 SAPRS survey

- Levels of science knowledge, attitude and engagement measures
- Variation in science knowledge, attitude and engagement measures
- Role of socio-demographic characteristics in shaping science knowledge, attitudes and engagements

Recommendations from the SAPRS 2022 results for enhancing the public relationship with science

CHAPTER 9

Results and Recommendations for Enhanced Public Relationship with Science

The South African Public Relationship with Science (SAPRS) 2022 survey report refers to two aspects of the relationship between science and the public. On the one hand, we collectively refer to science knowledge and the attitudes of promise, reservation and trust as science attitudes. On the other hand, we refer to access to science and technology (S&T) information, and science engagement outcomes in the form of activities, behaviours and views of the National System of Innovation (NSI), as science engagements.

The purpose of this SAPRS survey report was, firstly, to measure and describe each of the science knowledge, attitude and engagement sub-indicators using the mean scores, as well as the score variations. Secondly, we identified the socio-demographic characteristics that were more likely to lead to greater knowledge, more positive attitudes and higher science engagements. Thirdly, we explored the role of the science attitude and engagement measures themselves in influencing more positive science attitudes and engagement outcomes.

This chapter presents the results from the survey as well as the recommendations to promote greater science knowledge, and more positive science attitudes and engagement outcomes.

Results from the 2022 SAPRS survey

Our survey instrument, administered to a nationally representative sample of 6 400 South African adults, asked respondents questions based on the indicators derived from the Department of Science and Innovation's (DSI) Science Engagement Monitoring and Evaluation Impact Indicator Framework. These items were analysed, and in most cases composite indices were created and then transformed to produce a 0 to 100 scale. Mean scores and score distributional differences amongst sub-groups of the population were computed. We present the following results:

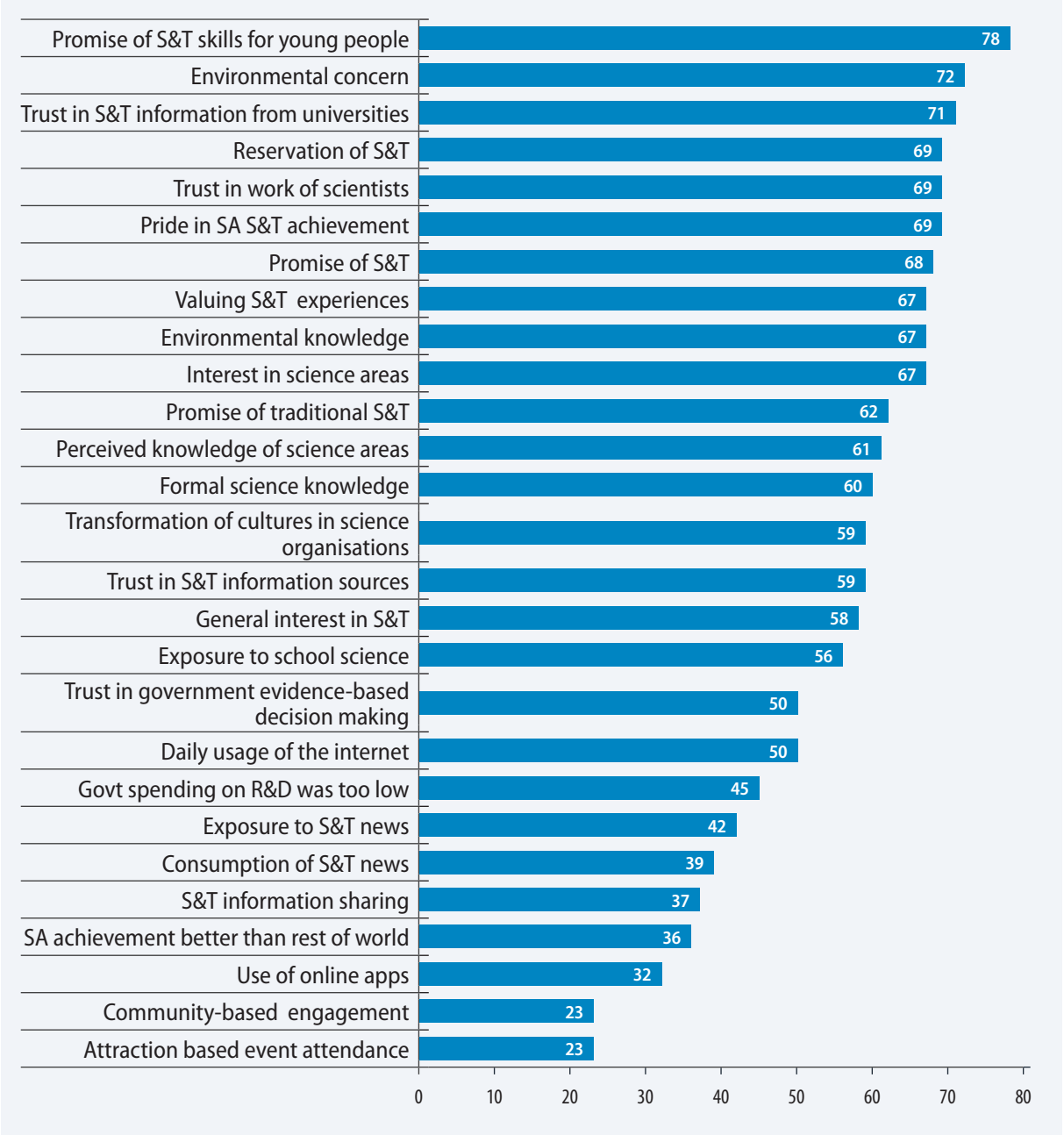
- levels of the science knowledge, attitudes and engagement measures;
- variation in the science knowledge, attitude and engagement measures;
- the role of socio-demographic characteristics in shaping science knowledge, attitudes and engagements;
- structural inequalities related to science knowledge, attitudes and engagements; and
- the role of science knowledge, attitudes and engagement measures in shaping science attitudes and engagements.

The levels of science knowledge, attitudes and engagement measures

In chapters 3 to 8, we calculated the mean scale score for each of the identified science knowledge, attitude and engagement measures. These measures, with the mean scores, are presented from highest to lowest in Figure 56.

The measures with the highest mean scores are evident among outcomes that recognise the promise (and reservation and concern) of science and science skills, those that trust in the work of scientists and the information received from scientists and universities, and those that reflect pride in South Africa's S&T achievements; while the lowest scores are for those measures related to engagements that require financial resources to access, namely participation in attraction-based and community-based engagement activities and the use of online apps. Additionally, a small number of the public held the view that South African S&T achievements are better than the rest of the world, which is contrary to reality.

FIGURE 56: Mean scores for science knowledge, attitudes and engagement measures



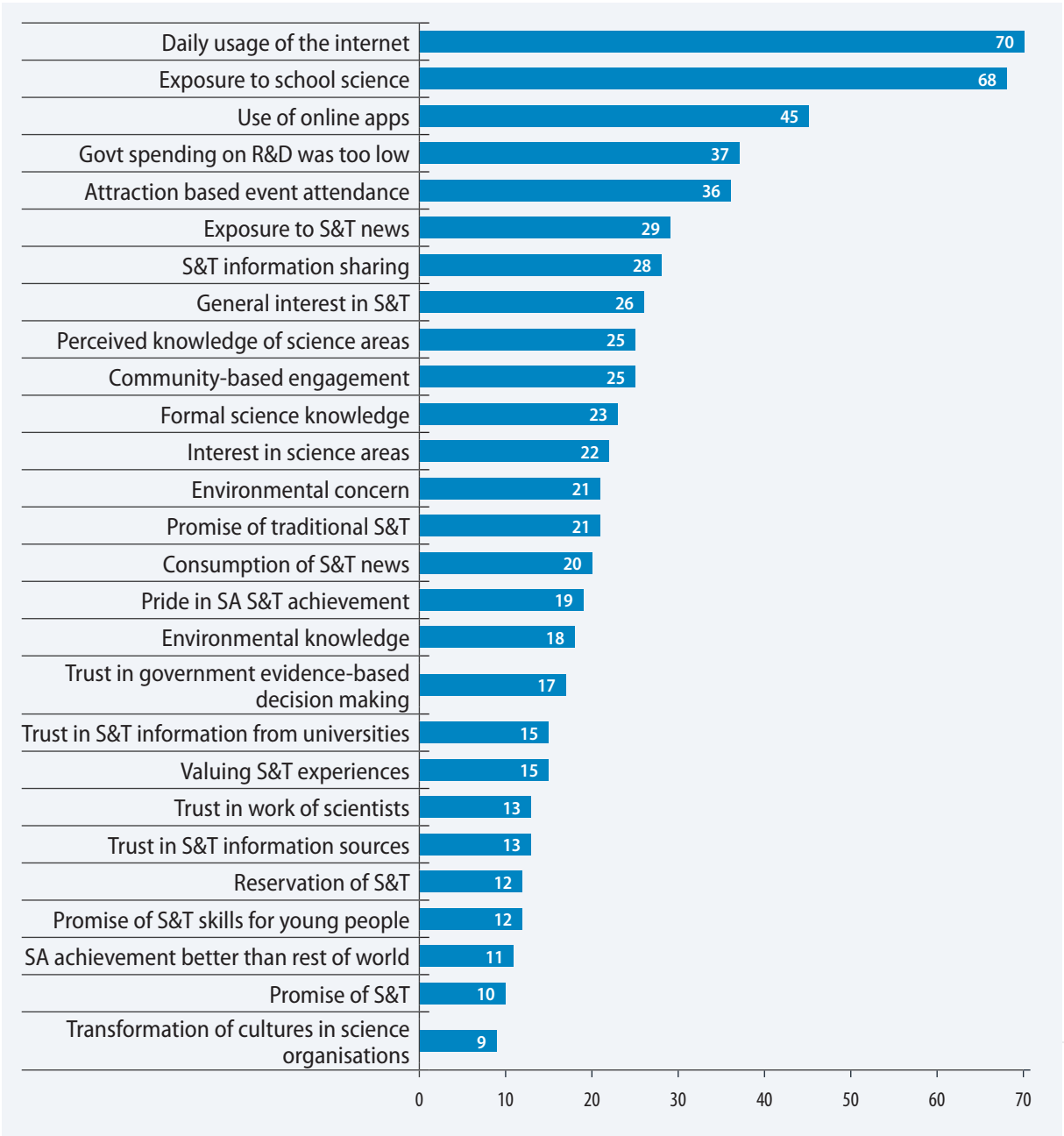
Variation in science knowledge, attitude and engagement measures

We next observed the extent of the variation in scores, by sub-groups, for each of the science knowledge, attitude and engagement measures, based on a select set of socio-demographic factors. We computed the score variation based on the difference between the highest and lowest scores for each of the measures. The score variations are presented from highest to lowest in Figure 57.

A low score variation implies that the views of the public on the measure are similar, irrespective of the socio-demographic diversity, while a high score variation indicates the inequality due to the socio-demographic diversity of the adult population. We termed the measures with narrow variation as egalitarian in character, while those measures with wide variations are referred to as diverse in character.

The science knowledge, attitude and engagement measures which were more egalitarian in character, are the transformation of cultures within science organisations, the promise and reservation attitudes, valuing of S&T experiences, trust in scientists and science information, and pride in South African S&T achievements. The measures with the largest score diversity were access to and use of the internet and online apps, exposure to secondary school science, attendance at attraction-based events and concern that government research and development (R&D) spending was too low. The egalitarian measures tend to be more value-based, whereas the diverse ones are more resource-dependent.

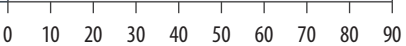
FIGURE 57: Variation in scores for science knowledge, attitude and engagement measures



Next, we created the social fingerprint for the South African public relationship with science, by mapping the mean scores and score variations associated with each science knowledge, attitude and engagement measure. Figure 58 lists the science knowledge, attitude and engagement indicators and sub-indicators, the mean scores and score variations (by plotting the lowest and highest values of the score range for each sub-indicator). The mean scores ranged from a low of 23 (attendance at attraction-based events and participation in community engagements) to a high of 78 (promise of S&T skills for young people). The variation in scores ranged from a high of 70 (daily use of the internet) to a low of 9 (transformation of cultures within science organisations). The relationship between the mean scores and the score variations was inconsistent for the 27 measures. Those with high mean scores had either low, moderate or high levels of variation. Similarly, those with low mean scores had low, moderate or high levels of variation.

FIGURE 58: Science knowledge, attitude and engagement indicators, sub-indicator measures, mean scores and score variations (range)

INDICATOR	SUB-INDICATOR MEASURES	MEAN SCORE	VARIATION CALCULATED BY DIFFERENCE BETWEEN HIGHEST AND LOWEST SCORES
Interest	Environmental concern	72	21
	Interest in science areas	67	22
	General interest in S&T	58	26
Knowledge	Environmental knowledge	67	18
	Perceived knowledge of science areas	61	25
	Formal science knowledge	60	23
Promise & Reservation	Reservation of S&T	69	12
	Promise of S&T	68	10
	Promise of traditional S&T	62	21
Trust	Trust in S&T information from universities	68	15
	Trust in work of scientists	69	13
	Transformation of cultures in science organisations	59	9
	Trust in S&T information sources	58	13
	Trust in government evidence-based decision making	50	17
S&T Information	Daily usage of the internet	50	70
	Exposure to S&T news	42	29
	Consumption of S&T news	39	20
Science Engagements	Exposure to school science	56	68
	S&T information sharing	37	28
	Use of online apps	32	45
	Community-based engagement	23	25
	Attraction-based event attendance	23	36
Pride & Promise	Promise of S&T skills for young people	78	12
	Pride in SA S&T achievement	66	19
	Valuing S&T experiences	67	15
	Govt spending on R&D is too low	49	37
	SA achievement better than rest of world	36	11



Note: All, except three measures report the mean index score. For the three measures – general interest in S&T, daily usage of the internet and South African achievement better than rest of the world, we report the median score.

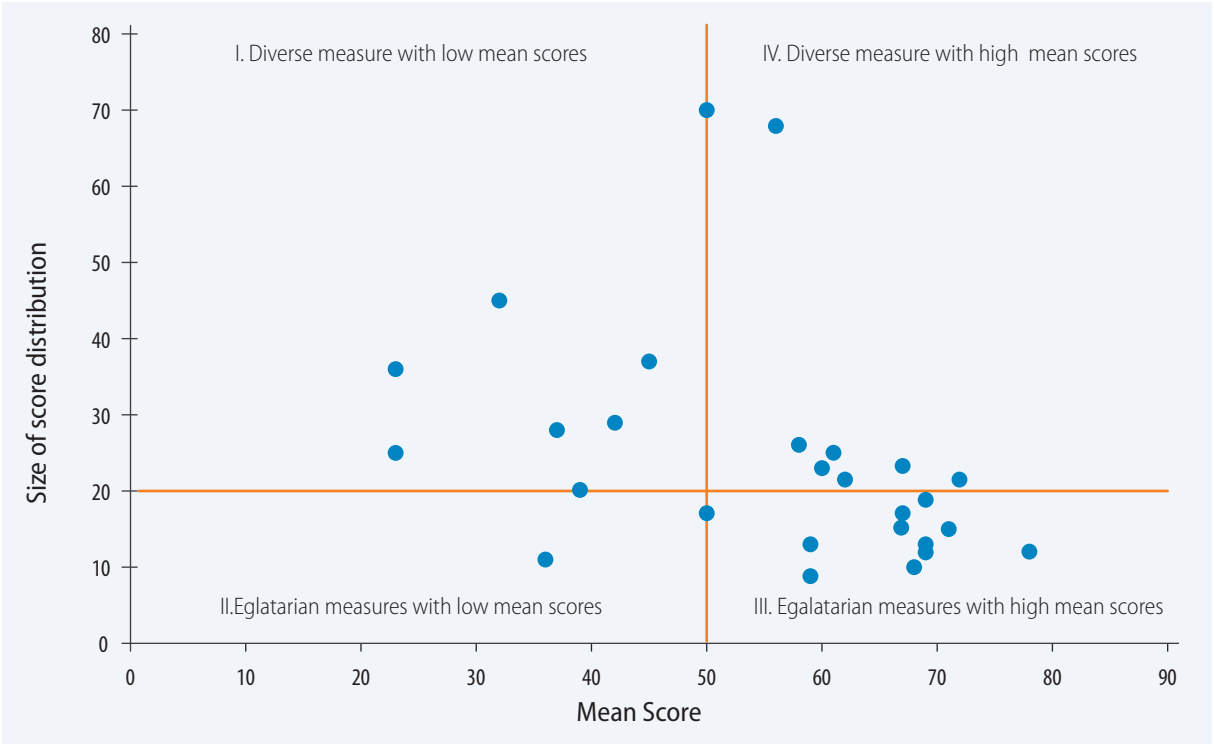
Combining the mean scores and score variations for the science attitudinal and engagement measures

In the next step of our analyses, we further examined the relationship between the mean scores and score variations. Using the mean score and the size of the variation for each measure, we drew a scatterplot to illustrate this relationship (Figure 59). For each of the measures, we plotted the mean score on the X-axis, and the size of the distribution of the corresponding measure on the Y-axis.

We conducted a segmentation analysis to identify the measures that favoured particular outcomes. This analysis provides information to support the development of different recommendations for the different segments. For the segmentation analysis, we created four groupings to capture the mean score-variation score relationship: (i) high mean score-high variation score; (ii) high mean score-low variation score; (iii) low mean score-high variation score; and (iv) low mean score-low variation score.

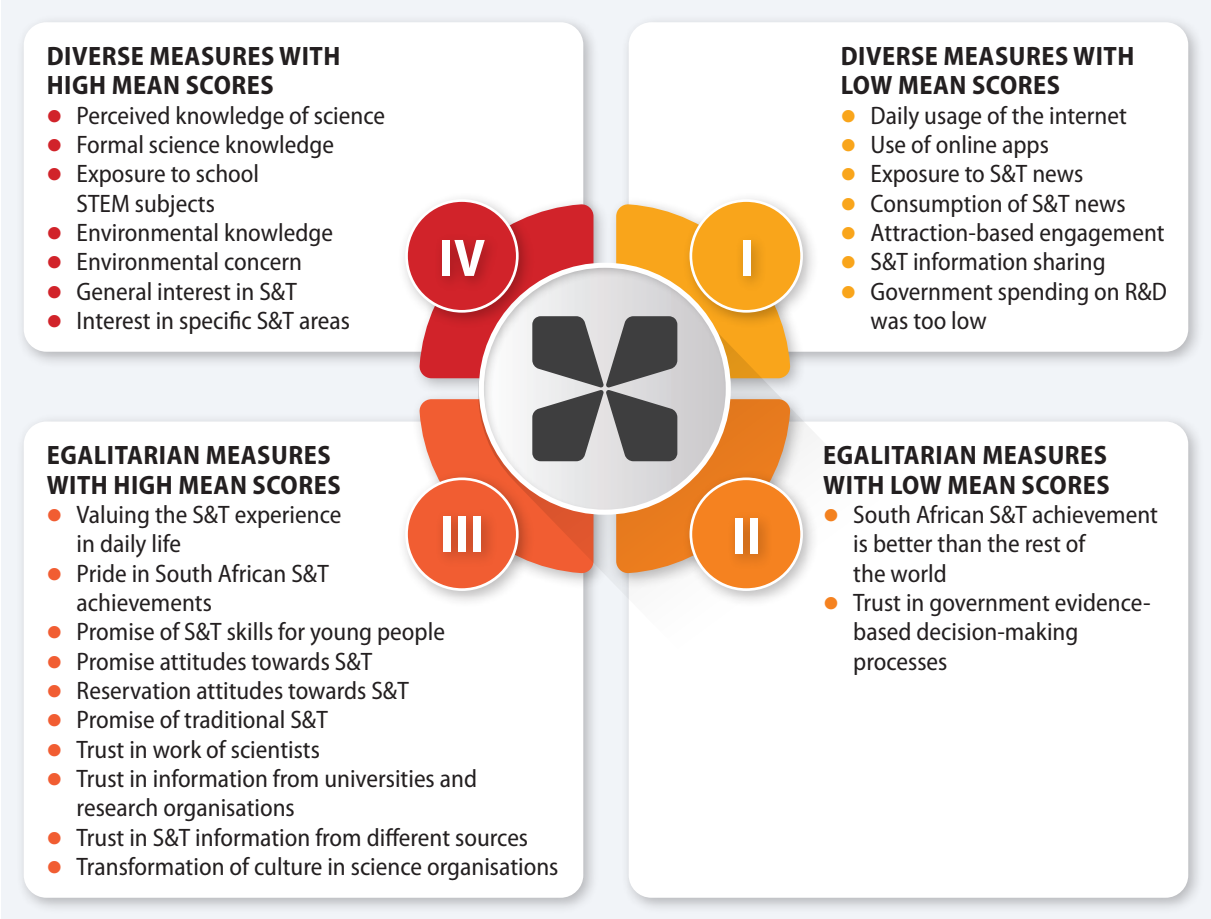
We divided the mean scores into high and low levels using the midpoint of 50 as the cut-off point. Those with a mean score higher than 50 were classified as high, while those with a mean score of 50 or below were classified as low. Measures with a score distribution range of 20 or less (out of 100) were categorised as having a narrow variation, while those with a score range distribution higher than 20 were categorised as having a wide variation. The red line on the scatterplot demarcates the different segments.

FIGURE 59: Mean score and size of score distribution for the science knowledge, attitude and engagement measures



We extended the typology of Egalitarian and Diverse measures to include whether the mean score and variation were high or low – thus creating four segments: (I) Diverse measures with low mean scores; (II) Egalitarian measures with low mean scores; (III) Egalitarian measures with high mean scores; and (IV) Diverse measures with high mean scores. Figure 60 categorises each of the science knowledge, attitude and engagement measures into the four typologies.

FIGURE 60: Categorisation of the measures into four typologies



The role of socio-demographic characteristics in shaping science knowledge, attitudes and engagements

Less than half of the measures (40%) had a narrow score variation, indicating that South Africans tend to have a similar view of S&T on these measures, irrespective of their backgrounds. For these egalitarian measures, few distinctive socio-demographic characteristics were strongly associated with the attitudes or views. The narrow distribution of scores, and the fact that the socio-demographic model fit is less than 10%, suggests that there are factors beyond the socio-demographic that contribute to shaping these views and behaviours. It is noteworthy that only two measures fell into segment II – low mean score and low variation. There is a small part of the population who are overly optimistic about South African S&T achievement, viewing the country as better than the rest of the world. There is also a concerningly low share of the population who trust government evidence-based decision-making processes.

The other 60% of the measures had a wide variation of scores. In addition, the socio-demographic model fits were higher for these measures, with the highest model fit being for daily usage of the internet (R-squared = 37%) and use of online apps (R-squared = 33%), whereas there were moderate model fits (between 15% and 22%) explaining the measures of science knowledge and interest, exposure and consumption of S&T news and participation in community-based engagements, attendance at attraction-based events and information-sharing behaviours.

In the next step, we aggregated the measures to reflect a broader construct for each of the typologies. We examined which socio-demographic characteristics were more likely to contribute to achieving higher levels of these measures (Figure 61).

For the egalitarian measures, the sub-groups that were most likely to have positive outcomes were those with at least some educational attainment, those who are younger and Black African adults. The diverse measures are associated with those with higher levels of educational attainment, higher SES, and those who are categorised as students or learners.

FIGURE 61: Aggregated measures associated with each typology and the socio-demographic characteristic more likely to lead to higher levels of the measure

TYPOLOGY	AGGREGATED MEASURES	SOCIO-DEMOGRAPHIC CHARACTERISTICS INFLUENCING THE MEASURE
I Diverse measures with low mean scores	• Usage of internet and online apps • Exposure to and consumption of S&T news • S&T engagements (attending events, community-based participation and information sharing). • View that government spending on R&D was too low.	• Those with grade 12 or higher educational attainment and from higher SES homes, students/learners and younger adults. • Indian/Asian and White adults, those with tertiary education and from highest SES homes.
II Egalitarian measures with low mean scores	• Trust in government evidence-based decision-making processes. • Belief that South African S&T is better than rest of world.	• Those with lower educational attainment, from lower SES homes, Black African and Coloured adults, and youth.
III Egalitarian measures with high mean scores	• Promise and Reservation of modern and traditional science • Promise of S&T skills for young people • Trust in science, science institutions • and science information • Trust in transformation of cultures in science organisations • Pride in South African S&T achievements • Valuing the S&T experiences in daily life	• Those with more than primary education, Black African adults, students/learners and younger adults.
IV Diverse measures with high mean scores	• Knowledge of and interest in S&T • Environmental knowledge and concern • Exposure to school STEM subjects	• Higher levels of educational attainment, from higher SES homes, students and learners. • White and Indian/Asian adults have higher knowledge, White, Indian/ Asian and Black African adults have higher interest.

Structural inequalities and science attitudes and engagements

South Africa is characterised as a country with high levels of poverty, inequality and unemployment. The survey results confirm that socio-demographic traits and context matter in relation to the levels of science knowledge, attitudes and engagements. This suggests that the structural inequalities that persist in the country cannot be overlooked in efforts to promote the science-in-society relationship. In this section, we draw attention to how population group identity, gender and class differences, as they manifest in socioeconomic status (SES), influence science knowledge, attitudes and engagements.

The South African past and present is defined by population group identities. White and Indian/Asian adults have significantly higher S&T knowledge, while White, Indian/Asian and Black African adults have higher interest in S&T. For the resource-based indicators, White and Indian/Asian adults have higher access to, and usage of, the internet, are more likely to participate in S&T events, use online apps more often and have higher exposure to science subjects in secondary school.

Earlier we reported that there was low variation in attitudinal scores across sub-groups. Within this context, Black African adults reported moderately higher promise and reservation attitudes towards modern S&T, higher trust in scientists and S&T information, higher trust in government evidence-based decision-making processes and more positive views about changes in culture in science organisations. However, there was a more distinctive pattern with respect to promise attitudes towards traditional S&T, with Black African adults reporting stronger positive attitudes in comparison to White, Indian/Asian and Coloured adults. In general, there was a higher trust deficit evident among White and Indian/Asian adults. It is notable, and concerning, that for most of the measures, Coloured adults reported significantly lower scores.

Studies have shown a gender bias favouring males in science achievement in both the schooling and tertiary sectors (Reddy & Mncwango, 2021). Gender differences were not prominent among the South African adult population for knowledge, attitudinal and science engagement measures in the survey. There were small significant gender differences, favouring males, for knowledge of, and interest in, S&T; access to, and usage of, the internet; exposure to, and consumption of, news; and levels of participation in science engagement activities. In line with the low variations in scores for S&T promise and reservation, trust and pride, there were negligible or no gender differences evident for these measures.

In the context of South Africa's high-income inequality, we also explored the relationship between class differences and the science knowledge, attitude and engagement measures. Adults from higher SES homes were more likely to have significantly higher science knowledge and interest; more trust in S&T information from universities and research organisations; greater access to, and usage of, the internet; as well as more exposure to, and consumption of, S&T news. Those from higher SES homes were also more likely to report higher attendance at S&T events, more frequent usage of online apps and greater exposure to science in secondary schools. In addition, they displayed more pride in South African S&T achievements, recognised the promise of S&T skills for the youth, and placed more value on the S&T experiences in their daily lives.

On the other hand, those from lower SES households had higher trust in government decision-making processes, were more positive about changes in the culture of science organisations, and had a stronger sense of the promise of traditional S&T.

The role of science knowledge, attitudes and engagement measures in shaping science attitudes and engagements

Our conceptual framework (Figure 4) reflects the complexity of the formation of science knowledge, attitudes and engagement outcomes. In addition to the role of the socio-demographics, we hypothesised the role of the science knowledge, attitude and access to S&T information measures themselves in influencing science attitudes and engagement outcomes.

In the section above, we showed the extent to which the science knowledge, attitude and engagement measures were influenced by socio-demographic factors. For under half of the measures there was very little variation in the scores, suggesting that the socio-demographic factors played a very small role in shaping the behaviour or view. For the other 60%, the measures displayed a wider score variation, with the socio-demographics contributing more to shaping the science attitudes and science engagement outcomes.

We tested – using multivariate linear regressions – how the socio-demographic variables were associated with science knowledge and attitudes, access to S&T information and science engagement outcomes. The model fits account for the variance from a very low 2% to a moderate 37% of variation accounted for. The low model fits for the role of socio-demographic factors indicate that there are other factors that contribute to shaping science attitudes and engagement outcomes, but also that socio-demographic influences may be indirect in nature, operating, for instance, through their bearing on science knowledge and interest. We thus extended the socio-demographic model to include the science knowledge, attitude and engagement measures themselves as predictor variables. We conducted a series of multivariate regressions, with socio-demographics as controls, to test the following hypotheses:

- Knowledge of, and interest in, S&T, and the interactions between them, shape the promise and reservation attitudes towards S&T, as well as trust in science and science institutions.
- Access to, and trust in, scientific information shapes knowledge of, and interest in S&T, as well as the promise, reservation and trust attitudes.
- Knowledge of, and interest in, S&T, promise and reservation attitudes, access to, as well as trust in S&T information all shape the science engagement outcomes.

From the analyses presented in the preceding chapters, we identified the following relationships among the science attitude and engagement measures (Figure 62).

Firstly, science knowledge, interest and concern are strongly interrelated. Further, the nature of these relationships suggests that knowledge and interest have a clear effect on science promise, reservation and trust attitudes, that, in turn, shape science engagement practices. Secondly, exposure to and trust in S&T information are associated with greater knowledge of, and interest in, S&T as well as higher promise, reservation, pride and trust attitudes. Exposure to S&T news and proximity promotes the attendance of attraction-based sites, while knowledge of S&T as well as exposure to S&T news promotes the use of online apps.

The pattern of these findings is broadly in line with what we hypothesised in Chapter 1, though the subtleties and nuances of the associations are more complex than we envisaged prior to conducting the baseline 2022 SAPRS survey.

Importantly, from a science engagement perspective, the identification of these associations enhances our understanding of what the potential implications of certain types of S&T policy and programmatic interventions are. This, together with the planned SAPRS monitoring, is crucial for ongoing efforts to make sustained progress towards the vision of the South African White Paper on Science, Technology and Innovation (STI) (DST 2019b) and other related strategy and framework documents of a more science literate and science aware society.

FIGURE 62: Relationships between the science attitude and engagement measures

Science knowledge, attitude and engagement measures as predictors	Association with science knowledge, attitude and engagement measures
KNOWLEDGE AND INTEREST IN S&T AND THE ENVIRONMENT	
Interest in S&T	**Strong positive association with:** • Knowledge of S&T areas (β = 0.605) • Promise of S&T (β = 0.267) • Reservation towards S&T (β = 0.282) • Promise of traditional science (β = 0.243)) • Promise of the work of scientists (β = 0.247) • Valuing daily S&T experiences (β = 0.316) • Pride in S&T achievements (F statistic = 153)
Knowledge of S&T	**Strong positive association with:** • Interest in S&T areas (β = 0.605) • Promise of the work of scientists (β = 0.152) • Pride in S&T achievements (F statistic = 112) • Valuing daily S&T experiences (β = 0.108) • Use of online apps (β = 0.130) **Small positive association with:** • Promise of S&T (β = 0.096)
Environmental knowledge	**Strong positive association with:** • Concern for the environment (β = 0.627)
Knowledge of traditional S&T	**Strong positive association with:** • Promise of traditional science (β = 0.153)
Interest in traditional S&T	**Strong positive association with:** • Promise of traditional science (β = 0.273)
PROMISE AND RESERVATION ATTITUDES	
Promise of S&T	**Strong positive association with:** • Promise of the work of scientists (β = 0.361) • Pride in South African S&T achievements (F statistic = 76)
Reservations towards S&T	**Small positive association with:** • Promise of the work of scientists (0.054) • Pride in South African S&T achievements (F statistic=34)
ACCESS TO AND TRUST IN S&T INFORMATION	
Frequency of internet access and usage	**Small positive association with:** • Knowledge of S&T (β = 0.064) **Small negative association with:** • Trust in scientists (β = –0.050) • Trust in government decision-making processes (β = –0.048)
Exposure to S&T news	**Strong positive association with:** • S&T knowledge (β = 0.207) • Interest in S&T (β = 0.121) • Government evidence-based decision-making processes (β = 0.110) • Attendance at attraction-based events (β = 0.222) • Use of online apps (β = 0.319) • Valuing of S&T experiences (β = 0.257) **Small positive association with:** • Promise of traditional S&T (β = 0.081) • Pride in South African S&T achievements (F statistic = 30) **Small negative association with:** • Reservation towards S&T (β = –0.07)
Consumption of S&T news	**Strong positive association with:** • Attendance at attraction-based events (β = 0.335)
Trust in S&T information	**Strong positive association with:** • Interest in S&T (β = 0.236) • Knowledge of S&T (β = 0.142) • Promise of S&T (β = 0.329) • Reservation towards S&T (β = 0.259) • Promise of traditional S&T (β = 0.136) • The work of scientists, (β = 0.353) • Government evidence-based decision-making processes (β = 0.274) **Small positive association with:** • Pride in South African S&T achievements (F statistic = 29)

Recommendations from the SAPRS 2022 results for enhancing the public relationship with science

Based on the results from this extensive and comprehensive survey, we make the following recommendations to enhance the public relationship with science by promoting S&T knowledge, positive attitudes and engagements in South Africa.

1 SCIENCE ENGAGEMENT MUST EMBRACE THE SCIENCE AND SOCIETY PARADIGM

The present study, as well as the approach to the programme of science engagement by the Department of Science and Innovation, is located within a science-in-vsociety paradigm. This paradigm recognises the bi-directional and dialogical nature of the relationship between science and the society. In this paradigm, while the results of science inform and influence society, the science agenda must also respond to the needs and challenges of the communities and society in which it is located. This paradigm includes the role of both individuals and institutions in shaping the relationship. This approach should be continued and strengthened.

2 WE MUST CHANGE THE NARRATIVE ABOUT HOW WE CHARACTERISE AND DESCRIBE THE SOUTH AFRICAN PUBLIC

Overall, the results paint the picture of a society with views that are thoughtful, considered, balanced and reflect an awareness of S&T developments. For close to half the measures (promise, pride and trust) examined, the public displayed similar views, irrespective of their socio-demographic backgrounds. For the other measures, there were variations among the pubic that were largely due to differences in educational attainment, socioeconomic status and access to resources, as well as population group identity and, in some cases, age and geographical location.

3 YOU CAN'T GO WRONG WITH IMPROVING SCIENCE KNOWLEDGE

Education, in the form of attainment and home support, was associated with positive science attitudes, participation in science engagement activities, confidence in the South African S&T system, as well as access to, exposure to and consumption of S&T news. In addition to general educational attainment, those with higher science knowledge were more likely to have positive attitudes, access to S&T information and more positive science engagement behaviours and views. The schooling system is one route to enhance education and improve science knowledge levels. In addition to that route, we recommend a structured public science awareness and education programme to increase science knowledge. The public science awareness programmes should be delivered through multiple traditional and social media platforms, embedding the science that is part of individuals' lived experience within the public discourse. During the COVID-19 pandemic, we witnessed the effects of public education programmes on promoting awareness and knowledge. The results of the knowledge quiz in the SAPRS survey showed that the items related to COVID-19 and the petrol price had the highest correct responses. These were topics that were constantly in the news cycles and impacted individuals' everyday lives. The implications are that efforts to improve scientific knowledge and interest are likely to have a direct positive impact on promise, reservation and trust attitudes.

4 INCREASE INTEREST IN S&T AND BUILD A SOCIETY THAT PROMOTES A SCIENCE CULTURE

Interest in science was associated with science awareness and knowledge, as well as positive science attitudes and engagements. While there are existing programmes promoting interest in S&T, the scale and reach of these programmes are limited. The scale and reach of present programmes should be expanded, and new programmes with relevant and engaging content should be initiated and communicated through different channels. One of the aims of these programmes should be to instil a culture of curiosity and inquiry in society at large. This culture begins in homes and carries through to adulthood. In all our measures, we found that interest and concern scores exceeded knowledge scores, indicating that a segment of the population remains curious or concerned about S&T and the environment, even in the absence of deep understanding of or expertise about these areas. This presents a good starting point to work towards building a society that is embedded in a culture of science.

5 KNOWLEDGE OF, INTEREST IN AND CONCERN TOWARDS S&T ARE STRONGLY INTERRELATED AND INTERTWINED

To raise any one of them will undoubtedly raise the others, irrespective of the individual and demographic characteristics accounted for. However, a focus on interest may be more amenable for interventions. This has the potential to create a virtuous cycle and the knock-on benefits and spillovers to the other measures are explored in this study.

6 HOME EDUCATIONAL INTERACTIONS AND ENGAGEMENTS MATTER

Throughout the analysis the standout indicator was home support for education in the form of encouraging reading, homework and discussion of the news, as well as taking and doing well in science subjects in school. Home education support was associated with knowledge, interest, promise and reservation towards modern and traditional S&T, trust in the work of scientists and government evidence-based decision making, use of online apps as well as valuing S&T experiences. This speaks to the importance of early exposure to and consumption of S&T information, and to attendance at science-related events to inculcate an appreciation for science knowledge. Home education support shows the importance of intergenerational curiosity and knowledge building.

7 VIEWS ABOUT THE PROMISE OF, AS WELL AS PRIDE AND TRUST IN, S&T ARE EGALITARIAN IN CHARACTER

The formation of attitudes is a complex process and goes beyond socio-demographic factors. South Africans tend to adopt a favourable, but not uncritical view of S&T, irrespective of background. This close alignment of views may be because these attitudes are dependent on societal values and the culture of science. To consolidate and further build these views requires ensuring a cultural system that values, celebrates and promotes S&T. We should create a cultural milieu that showcases evidence-based decision-making processes, debates, critique and contestation of ideas.

8 LEVELS OF SCIENCE KNOWLEDGE AND ACCESS TO S&T INFORMATION ARE DIVERSE IN CHARACTER

The patterns of science knowledge and interest, as well as access, exposure to and consumption of S&T information are diverse in nature. The sub-group characteristics that inform this diversity are educational attainment, SES and being a student or learner. The extant literature has consistently shown the relationship between educational achievement and socioeconomic circumstances. Within the South African context, we recommend continued supplementary tuition and public science awareness programmes to enhance knowledge and interest. Increased science communication and engagement through multiple channels, from print to broadcast to social media, should be both encouraged and mandated. The zero rating of science educational sites, and the creation of content that is relevant to the life experiences of different segments of the society, should be encouraged.

9 INCREASE ACCESS TO S&T INFORMATION

Three quarters of the public have internet access. Presently, the main use of the Internet is for communication (on chat apps such as WhatsApp) and engaging with social media (on platforms such as Facebook and X). The public trusts S&T news presented by television and radio but are cautious about news on social media. S&T information should be communicated in easily understandable ways on television and radio. Only 5% of the public actively accessed S&T information. As in point 8, we need to infuse a culture of curiosity for information and an awareness of the rich information that can be found on the Internet.

10 LARGE DIFFERENCES IN SCIENCE ENGAGEMENT BEHAVIOUR PERSIST BUT CAN BE POSITIVELY INFLUENCED BY PROMOTING SCIENCE KNOWLEDGE AND INTEREST AND OVERCOMING STRUCTURAL BARRIERS TO ACCESS

The survey findings demonstrated that some of the largest differences evident among the public were in relation to different types of science engagement behaviour. Five types of engagement were examined: academic, event-based, community-based, information sharing, and the use of online apps. Generally, low engagement levels were observed across all types, with the lowest for attraction-based events. Participation was shaped by age and socioeconomic status, the availability of S&T sites for attraction-based events nearby, science knowledge and interest, as well as the frequency of exposure to, and active consumption of, S&T information. Campaigns to boost information consumption, interest and knowledge, combined with efforts to promote greater access to S&T sites and events, would be expected to have a positive effect on science engagement.

11 EDUCATE THE PUBLIC ABOUT THE VALUE OF TRADITIONAL S&T

While the South African public reported moderate awareness of and decreasing reservations over time about traditional S&T, the characteristics of those who were more likely to see the promise of traditional S&T were largely Black African adults, those with less education and those living in rural areas. Despite attempts by institutions such as the DSI and the National Research Foundation to institutionalise the study and practice of traditional S&T, it would seem there is still a need for a concerted effort to communicate, inform, educate, celebrate and create awareness about this rich field of S&T for the larger population.

12 METHODOLOGICAL CONSIDERATIONS FOR THE NEXT SAPRS SURVEY

SAPRS 2022 was the first comprehensive survey measuring the relationship between the public and science in South Africa. The science knowledge, attitude and engagement measures included in the survey enabled us to describe the unique fingerprint of the South African publics' relationship with science. These measures form the baseline information against which subsequent performance can be tracked. Subsequent surveys could use this report as a template of what to focus on. The instrument used in 2022 should be adjusted based on a determination of the effectiveness, usefulness and accessibility of the items that were included in the survey. All measures should be created from multi-item indices. Subsequent surveys could be administered to a sample size of 3 500 respondents. The analyses of the survey results should include both descriptive and inferential statistics.

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Appendix 1: Readers Guide

Terminology

Awareness: Being informed and cognisant of events, particular situations, or developments. Awareness does not necessarily imply understanding.

Institutional trust or confidence: Trust that individuals have in an organisation or institution within society. It reflects the extent to which people believe that these institutions are competent, reliable, and ethical in fulfilling their roles and responsibilities.

Interest: Wanting to know or learn more about some subject matter or issue.

Knowledge: In this report, scientific knowledge has been measured by two separate but related constructs – firstly an understanding of science terms and concepts and secondly, a self-reported assessment of knowledge of scientific concepts.

Perception: Individuals' subjective interpretations of various phenomena. It encompasses how people perceive and interpret information, events, policies, and other aspects of their environment, often shaping their attitudes, beliefs, and behaviours.

Promise of S&T: Attitudinal construct associated with the view that S&T provides useful results and products for society, and that future benefits from S&T are likely.

Publics: The use of the plural publics signals structural differences, emerging from both historical and contemporary contexts, which result in differences between groups.

Relationship: Refers to the connection or association between the public and S&T – this encompasses the dialogical and bi-directional dynamic between the public and science.

Reservations towards S&T: An attitudinal construct that reflects public concerns about the speed of change in modern life and a sense that S&T may pose too many risks or may conflict with traditional values or belief systems.

Science and technology: We adopted a broad notion of knowledge generation that includes modern science, as well as traditional or indigenous science. The all-encompassing term is used to refer to the natural sciences such as mathematics, statistics, engineering, technology and medicine, as well as the social sciences and its application.

Science communication: Use of appropriate skills, media, activities and dialogue to promote awareness, interest, enjoyment, opinion-forming or understanding of science.

Science engagement: An overarching term that refers to access to S&T information, participation in science engagement activities and views about the NSI.

Science knowledge: In this report, scientific knowledge has been measured by two separate but related constructs – firstly an understanding of science terms and concepts, (i.e. objective knowledge); and secondly, a self-reported assessment of knowledge of scientific concepts, (i.e. perceived knowledge).

Study population: Adults aged 16 years and older.

Traditional knowledge: Local knowledge that is unique to a given culture or society and usually passed from generation to generation. It is also referred to as indigenous knowledge.

Socio-demographic categories used in this study

Age: For analytical purposes, a categorised age measure was produced from the continuous age variable. The defined age categories were: 16 to 24 years, 25 to 34 years, 35 to 44 years, 45 to 54 years, and 55 years and older.

Educational attainment: Level of education completed by individuals. This was categorised as: none, primary, incomplete secondary, completed secondary (matriculation), and attained a post-secondary education.

Formal urban: Residing in an area characterised by high population density, extensive infrastructure, and concentration of residential, commercial, and industrial activities (StatsSA).

Home education support: Support available to individuals based on the frequency with which a set of educational activities were conducted in their home, by parents or other adults, when they were 15 years old. These activities were: (i) encouraged you to read, (ii) discussed news events with you, (iii) assisted with or asked about your homework, (iv) encouraged you to do well in school, and (v) encouraged you to take science subjects at school.

Informal urban: Residing in an area where aspects of urban living and development occur outside formal planning and regulatory frameworks. Often referred to as informal or shack settlements, these are typically highly populated urban areas that lack infrastructure and contain densely built dwelling units made of poor-quality materials (StatsSA).

Population group: Respondents chose from a set of five categories, the population group they identified with. The five categories were: Black African, Coloured, Indian or Asian, White and Other.

Religious beliefs: Extent to which a person considered themselves to be religious on a 0–10 scale, with 0 being 'not at all religious' to 10 being 'very religious'.

Rural: Residing in an area that is not urban, often characterised by low population density and predominantly agricultural, natural, or undeveloped land (StatsSA).

Sex: Self-reported identification as either male or female. An "Other" category was included in the survey; however, it was only selected by three respondents.

Socioeconomic status: Categorisation of an asset index (produced through a factor analysis of how many of a predefined set of assets were present in the home in working order) into socioeconomic quintiles, which were labelled as: poorest, second, middle, fourth and richest.

Labour market status: Labour inactive: Individuals who are not actively participating in the labour force. such as retirees, students, homemakers, and those who have given up looking for work. In this study we separated out Student/Learners from the labour inactive and referred to the remainder as Other Labour Inactive.

Labour market status: Learners: Individuals who are in a formal school setting. Given the focus of the survey on adults aged 16 and older, learners in this instance would refer to those in a secondary school setting.

Labour market status: Students: Individuals who are enrolled in a post-secondary educational institution (such as a college or university) to acquire knowledge, skills, and qualifications through formal instruction and learning activities.

Labour market status: Unemployed: Individuals who are of working age (typically between 15 and 64 years old) and are actively seeking employment but are unable to find work.

Statistical terms

Beta coefficient: A coefficient that measures the strength and direction of the relationship between an independent (predictor) variable and the dependent variable in a regression model, while controlling for the effects of other variables in the model. A standardised beta coefficient compares the strength of the effect of each individual independent variable on the dependent variable. The higher the absolute value of the beta, the stronger the effect of that variable. For example, a beta of –0.9 has a stronger effect than a beta of +0.8. Standardised beta coefficients have standard deviations as their units. This means the variables can be easily compared to each other.

Bivariate analysis: The simultaneous analysis of two variables to explore the relationship between them. This type of analysis can help determine whether there is an association, correlation, or causal relationship between the two variables. This approach differs from multivariate analysis, which examines the relationships among three or more variables simultaneously.

Correlations: Correlation coefficient is a statistical measure of the strength of a linear relationship between two variables. Possible values of the correlation coefficient range from –1 to +1, with –1 indicating a perfectly linear negative correlation and +1 indicating a perfectly linear positive correlation. In the report, the absolute values of 0.0 to 0.2 are interpreted as a negligible association, 0.2 to 0.4 a weak association, 0.4 to 0.6 a moderate association, 0.6 to 0.8 a strong association, and above 0.8 a very strong association.

Cronbach alpha (α): Statistic used to measure the internal consistency or reliability of a set of items or variables in a dataset. It assesses how closely related a set of items is as a group, indicating the extent to which the items measure a single underlying construct or concept. Cronbach alpha values range from 0 to 1, with higher values indicating greater internal consistency among the items. Values of less than 0.4 are less reliable, 0.4 to 0.6 are quite reliable, 0.6 to 0.8 reliable and over 0.8 very reliable.

F-statistic: Measure used to determine whether the mean scores between groups are significantly different from one another. Higher F-statistic values suggest that there may be significant differences between group mean scores. The range of values reflects the minimum and maximum index values for the specific personal attribute.

Linear regressions (OLS models): Statistical technique used to model the relationship between a dependent variable and one or more independent variables by fitting a linear equation to observed data. It aims to find the best-fitting straight line (in simple linear regression) or plane/hyperplane (in multiple linear regression) that minimises the difference between actual and predicted values of the dependent variable. When generating a linear regression model we use the Ordinary Least Squares (OLS) method to estimate unknown parameters. This method minimises the sum of squared differences between the observed dependent variable values and the values predicted by the linear function.

One-way analysis of variance (ANOVA): Statistical technique used to compare the means of three or more groups to determine whether there are statistically significant differences between them. It tests the null hypothesis that the means of all groups are equal, using the variance within groups and between groups to make this determination. In our analysis we conducted One-way ANOVA tests with Scheffé post-hoc multiple comparison tests. The Scheffé post hoc test is a statistical method used to make multiple comparisons between group means after performing an ANOVA. This test indicates which group means are significantly different from each other.

Principal component analysis: This is a statistical method used to simplify complex data. It transforms the data into a smaller set of new variables, called principal components, that still capture most of the important information from the original data. This helps in making the data easier to understand and work with, especially when dealing with lots of variables. Principal components analysis is similar in aim to factor analysis but is an independent technique.

R-squared: Statistical measure that represents the proportion of the variance in the dependent variable that is explained by the independent variables. It ranges from 0 to 1, with higher values indicating a better fit of the model to the data. Essentially, R-squared quantifies the goodness of fit of the regression model: the closer it is to 1, the better the model fits the data, and the more variance in the dependent variable is explained by the independent variables.

Statistical significance: Likelihood that an observed effect or relationship between variables is not due to random chance. It indicates whether the results are likely to be real and reproducible, based on a predetermined threshold (expressed in this report by a p-value). In the report, we report significance at the 95% ($p<0.05$ *), 99% ($p<0.01$ **) and 99.9% ($p<0.001$ ***) levels.

Appendix 2: SAPRS Survey Instrument

PUBLIC RELATIONSHIP WITH SCIENCE SURVEY 2022
Questionnaire

HSRC Human Sciences Research Council

RESPONDENTS AGED 16 YEARS +

Good (morning/afternoon/evening), I'm _____ and we are conducting a survey for the Human Sciences Research Council (HSRC).

In this survey we ask you about your knowledge, attitudes and behaviour related to **SCIENCE AND TECHNOLOGY.** Science and technology are an important part of our everyday lives and help us to increase our knowledge and understanding of the world. The answers you give us will help us to understand what South Africans know and how they feel about science and technology.

Your views are important in this research. To obtain reliable information we ask that you answer the questions that follow as honestly as possible.

The area in which you live and you yourself have been selected randomly for this survey. The information you give us will be kept confidential. You and your household members will not be identified by name or address in any of the reports we plan to write.

The survey should take you no more than an hour to complete and you are free to end the interview at any point. There are no risks to participating in this research and neither are there any direct benefits to you.

I will read out a number of statements and ask for your views.

PARTICULARS OF VISITS

	Day	Month		Time Started		Time Completed		**Response	
				HR	MIN	HR	MIN		
First visit	/	/	2022						
Second visit	/	/	2022						
Third visit	/	/	2022						

**RESPONSE CODES		
Completed questionnaire	=	01
Partially completed questionnaire (specify reason)	=	02
Revisit		
Appointment made	=	03
Selected respondent not at home	=	04
No one home	=	05
Do not qualify		
Vacant house/flat/stand/not a house or flat/demolished	=	06
No person qualifies according to the survey specifications	=	07
Respondent cannot communicate with interviewer because of language	=	08
Respondent is physically/mentally not fit to be interviewed	=	09
Refusals		
Contact person refused	=	10
Interview refused by selected respondent	=	11
Interview refused by parent	=	12
Interview refused by other household member	=	13
OFFICE USE	=	14

STRICTLY CONFIDENTIAL

SASAS PRS QUESTIONNAIRE

Name of Interviewer _____

FIELDWORK CONTROL

CONTROL	YES	NO	REMARKS
Personal	1	2	
Telephonic	1	2	
Name	SIGNATURE		
.....	DATE … … … … … … … /… … … … … … /… … … … … … 2022		

RESPONDENT SELECTION PROCEDURE

Number of households at visiting point ☐☐

Number of persons 16 years and older at visiting point ☐☐

Please list all persons at the visiting point/on the stand who are 16 years and older and were resident 15 out of the past 30 days, and who eat out of the same cooking pot. Once this is completed, use the Kish grid on next page to determine which person is to be interviewed.

Names of persons aged 16 and older	
	01
	02
	03
	04
	05
	06
	07
	08
	09
	10
	11
	12
	13
	14
	15
	16
	17
	18
	19
	20
	21
	22
	23
	24
	25

Name of respondent:	
Address of respondent:	
Tel No.:	

GRID TO SELECT RESPONDENT

Number of questionnaire				Number of persons from which respondent must be drawn																								
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1	26	51	76	1	1	1	3	2	4	1	3	5	8	6	5	12	10	1	6	8	7	19	19	13	21	13	24	25
2	27	52	77	1	2	3	4	3	1	2	2	3	4	8	3	7	2	5	14	4	15	4	8	6	16	14	22	19
3	28	53	78	1	1	2	1	4	2	7	6	9	3	5	11	2	1	3	11	7	10	16	16	10	5	2	2	3
4	29	54	79	1	2	3	2	1	3	5	8	6	2	4	2	4	8	11	10	16	6	9	10	15	11	12	11	18
5	30	55	80	1	1	1	4	5	6	3	5	7	5	9	8	14	3	2	13	5	18	1	4	1	20	11	5	24
6	31	56	81	1	2	2	2	3	5	7	7	8	7	1	4	9	14	8	2	17	17	14	12	14	22	10	3	14
7	32	57	82	1	2	1	1	4	1	4	1	4	6	3	6	5	7	13	9	2	3	13	14	8	2	7	20	4
8	33	58	83	1	1	2	3	2	5	1	4	2	1	7	10	6	5	4	15	10	5	2	13	4	17	5	17	8
9	34	59	84	1	1	3	2	5	6	2	2	1	9	10	1	10	4	6	6	1	9	10	1	5	6	9	1	12
10	35	60	85	1	2	2	4	1	3	3	6	9	10	11	12	3	9	15	7	8	11	6	3	9	4	3	10	1
11	36	61	86	1	1	1	3	1	4	5	3	1	6	2	9	13	11	14	4	11	4	15	15	17	1	1	23	2
12	37	62	87	1	2	3	1	3	2	7	5	6	5	7	7	8	6	10	3	3	1	12	20	7	13	22	12	16
13	38	63	88	1	1	2	1	5	3	6	4	3	4	6	2	11	13	12	1	15	8	7	2	12	15	21	13	7
14	39	64	89	1	2	3	2	4	1	4	7	8	2	5	6	11	12	9	16	13	16	11	18	18	14	16	18	23
15	40	65	90	1	2	1	4	2	4	3	8	7	7	11	1	3	5	7	12	14	13	8	17	20	19	20	19	11
16	41	66	91	1	1	3	3	1	6	5	1	5	9	10	3	2	11	13	8	12	12	5	6	21	8	8	4	15
17	42	67	92	1	1	2	2	3	4	2	6	2	3	2	12	5	2	10	13	5	8	18	9	16	10	17	16	20
18	43	68	93	1	2	1	4	2	6	4	1	4	8	9	10	7	9	3	12	12	9	7	20	19	9	19	21	13
19	44	69	94	1	2	2	1	3	5	2	8	9	10	4	9	8	13	1	1	14	10	19	10	11	18	15	7	6
20	45	70	95	1	1	3	2	5	4	1	3	8	1	3	8	6	6	9	5	7	13	4	15	1	7	22	15	21
21	46	71	96	1	1	1	2	5	1	7	2	3	2	1	11	4	7	5	3	2	1	3	12	18	5	19	14	9
22	47	72	97	1	2	1	3	1	3	2	6	2	1	8	7	1	4	2	11	8	2	17	4	17	21	16	3	5
23	48	73	98	1	2	3	4	2	2	6	7	7	8	3	4	9	3	6	2	11	11	16	2	8	11	23	6	22
24	49	74	99	1	1	2	1	4	6	3	5	5	3	1	5	13	1	14	8	14	6	15	9	14	3	6	9	17
25	50	75	100	1	1	2	3	3	2	4	6	4	7	5	3	12	12	12	4	6	2	17	11	2	12	4	8	10

Number of persons in this household, including yourself? ☐

Number of persons 16 years and older in this household, including yourself? ☐

CITIZENS' SCIENTIFIC LITERACY AND KNOWLEDGE

1 **When you hear the word SCIENCE, what comes to mind? There are no right or wrong answers.**

INTERVIEWER: OPEN-ENDED QUESTION. PLEASE WRITE RESPONDENT'S ANSWER IN HIS OR HER OWN WORDS IN THE SPACE PROVIDED BELOW.

2 **When you hear the word TECHNOLOGY, what comes to mind? Again, there are no right or wrong answers.**

INTERVIEWER: OPEN-ENDED QUESTION. PLEASE WRITE RESPONDENT'S ANSWER IN HIS OR HER OWN WORDS IN THE SPACE PROVIDED BELOW.

In this survey when we use the word science, we mean the knowledge and information you use every day at home or in your workplace. For example, heat or fire will cook your food, and keeping food in a cool place will make it last longer. Or you could think about science that happens in a laboratory to make medicines that we use.

When we use the word technology, we mean things that make our lives easier – for example, a fridge at home or a car or a cell-phone or an X-Ray machine – are all examples of technologies that we use.

SCIENCE AND TECHNOLOGY IN SOUTH AFRICA

The first set of questions ask about your views on South African science and technology achievements, and how you think South Africa compares to other countries. [PRS SHOWCARD 1]

		Very	Quite	Hardly	Not at all	(Do not know)
3	How knowledgeable or aware are you about science and technology internationally?	1	2	3	4	8
4	How knowledgeable or aware are you about science and technology in South Africa?	1	2	3	4	8
5	How interested are you in South African science and technology?	1	2	3	4	8
6	How proud are you of South African science and technology?	1	2	3	4	8
7	How knowledgeable or aware are you about South African creative arts (e.g. music, dance, painting)?	1	2	3	4	8
8	How interested are you in South African creative arts?	1	2	3	4	8
9	How proud are you of South African creative arts?	1	2	3	4	8

How does South Africa compare in terms of SCIENCE AND TECHNOLOGY to … ? [PRS SHOWCARD 2]

		South Africa is much better	South Africa is a little better	South Africa is about the same	South Africa is a little worse	South Africa is much worse	(Do not know)
10	… Other parts of Africa	1	2	3	4	5	8
11	… Europe and North America (e.g., USA)	1	2	3	4	5	8
12	… Asian countries like China, India and Japan	1	2	3	4	5	8

SCIENCE AND TECHNOLOGY KNOWLEDGE AND INTEREST

The following two sets of questions ask about your knowledge of, and interest in, science and technology areas.

***By knowledge* we mean the information you have.**

How much do you KNOW about each of the following scientific areas? [PRS SHOWCARD 3]

		Very knowledgeable	Somewhat knowledgeable	Not very knowledgeable	Not at all knowledgeable	(Do not know)
13	Space and the stars	1	2	3	4	8
14	The way people behave and act	1	2	3	4	8
15	Access to good quality food	1	2	3	4	8
16	Environmental issues (such as climate change)	1	2	3	4	8
17	A cleaner and better water supply	1	2	3	4	8
18	Advanced technologies such as robots or human-like machines	1	2	3	4	8
19	Internet and Communication Technologies	1	2	3	4	8
20	Energy supply like electricity	1	2	3	4	8
21	Health related research, like vaccines	1	2	3	4	8
22	The quality of education	1	2	3	4	8

The following question asks about your interest in various areas of science and technology.

***By interest* we mean wanting to know or learn more about something.**

How INTERESTED are you in each of the following scientific areas? [PRS SHOWCARD 4]

		Very interested	Somewhat interested	Hardly interested	Not at all interested	(Do not know)
23	Space and the stars	1	2	3	4	8
24	The way people behave and act	1	2	3	4	8
25	Access to good quality food	1	2	3	4	8
26	Environmental issues (such as climate change)	1	2	3	4	8
27	A cleaner and better water supply	1	2	3	4	8
28	Advanced technologies such as robots or human-like machines	1	2	3	4	8
29	Internet and Communication Technologies	1	2	3	4	8
30	Energy supply like electricity	1	2	3	4	8
31	Health related research, like vaccines	1	2	3	4	8
32	The quality of education	1	2	3	4	8

The following two sets of questions ask about your knowledge and concern about natural and environmental events.

How would you rate your level of KNOWLEDGE about these environmental events? [PRS SHOWCARD 3]

		Very knowledgeable	Somewhat knowledgeable	Not very knowledgeable	Not at all knowledgeable	(Do not know)
33	Droughts and water shortages	1	2	3	4	8
34	Air pollution	1	2	3	4	8
35	Water pollution	1	2	3	4	8
36	Soil erosion	1	2	3	4	8
37	Floods	1	2	3	4	8

How CONCERNED are you about the following issues? [PRS SHOWCARD 5]

		Very concerned	Somewhat concerned	A little concerned	Not at all concerned	(Do not know)
38	Droughts and water shortages	1	2	3	4	8
39	Air pollution	1	2	3	4	8
40	Water pollution	1	2	3	4	8
41	Soil erosion	1	2	3	4	8
42	Floods	1	2	3	4	8

For each of the following statements, please indicate whether you think they are true or false, or if you are uncertain. [PRS SHOWCARD 6]

		True	False	Uncertain
43	The Covid 19 Vaccine reduces illness, but won't prevent you from getting the virus	1	2	8
44	The cutting down of trees leads to increased soil erosion	1	2	8
45	The earth's climate has not changed over millions of years	1	2	8
46	Countries in Europe have their winter season when South Africa has its summer season	1	2	8
47	Antibiotics kill viruses and not bacteria	1	2	8
48	The petrol price in South Africa is determined by the price of world oil	1	2	8
49	The mother's genes determine if a baby is a boy or a girl	1	2	8
50	The Sun travels around the earth once a year	1	2	8
51	The continents which we live on have been moving for millions of years and will continue to move	1	2	8

TRADITIONAL KNOWLEDGE

The next few questions are about your views on traditional knowledge.

By *traditional knowledge* we mean the knowledge and skills that have been passed on from generation to generation within a community.

52 How KNOWLEDGEABLE are you about traditional science and technology? [PRS SHOWCARD 3]

Very knowledgeable	1
Somewhat knowledgeable	2
Not very knowledgeable	3
Not at all knowledgeable	4
(Refusal)	5

53 How INTERESTED are you in traditional science and technology? [PRS SHOWCARD 2]

Very interested	1
Somewhat interested	2
Hardly interested	3
Not at all interested	4
(Do not know)	8

To what extent do you agree or disagree with the following statements? [PRS SHOWCARD 7]

		Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree	(Do not know)
54	Traditional knowledge provides solutions to improve the quality of life	1	2	3	4	5	8
55	I trust more in modern science than in traditional and cultural practices	1	2	3	4	5	8
56	I always follow the advice of medical experts over traditional healers or home remedies	1	2	3	4	5	8
57	People should visit a traditional healer in times of difficulty	1	2	3	4	5	8
58	Traditional medicine or home remedies provide better solutions for health problems than modern medicine	1	2	3	4	5	8
59	Traditional small-scale farming provides healthy food for many South Africans	1	2	3	4	5	8

CITIZENS' CONFIDENCE IN SCIENCE AND TECHNOLOGY: SCIENTISTS, ORGANISATIONS, AND INFORMATION

The following questions ask about scientists and their work.

By *SCIENTISTS*, we mean people who produce knowledge and may work at universities or in laboratories.

60 In general, how much do you trust the work of scientists? [PRS SHOWCARD 8]

Strongly trust	1
Trust	2
Neither trust nor distrust	3
Distrust	4
Strongly distrust	5
(Do not know)	8

The next few questions are about your views on scientists.

To what extent do you agree or disagree with the following statements? [PRS SHOWCARD 7]

		Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree	(Do not know)
61	Scientists make life better for people	1	2	3	4	5	8
62	Scientists keep their work secret	1	2	3	4	5	8
63	Scientists provide the answers that explain the world we live in (e.g. Weather, illness)	1	2	3	4	5	8
64	Scientists sometimes harm people and animals	1	2	3	4	5	8
65	Scientists are honest about their work	1	2	3	4	5	8
66	There is so much information about science, it is hard to know what to believe	1	2	3	4	5	8

TRUST IN INFORMATION FROM SCIENCE ORGANISATIONS

The following questions ask about trust in science organisations.

Indicate the extent to which you trust or distrust SCIENCE AND TECHNOLOGY information that comes from each of the following sources? [PRS SHOWCARD 8]

		Strongly trust	Trust	Neither trust nor distrust	Distrust	Strongly distrust	(Do not know)	(Refusal)
67	Universities and research organisations	1	2	3	4	5	8	9
68	Religious leaders (e.g., priest, sangoma, rabbi, imam)	1	2	3	4	5	8	9
69	Traditional leaders (induna, nkosi)	1	2	3	4	5	8	9
70	Big business or the corporate world	1	2	3	4	5	8	9
71	National Government	1	2	3	4	5	8	9
72	Local Government (e.g., municipal officials)	1	2	3	4	5	8	9

VIEWS OF CHANGES IN SCIENCE ORGANISATIONS

How much do you agree or disagree with the following statements about science organisations? [PRS SHOWCARD 7]

		Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree	(Do not know)
73	Science organisations listen to the people before deciding what research they should do	1	2	3	4	5	8
74	Science organisations include traditional knowledge in their work	1	2	3	4	5	8
75	Scientists are representative of all racial groups in South Africa	1	2	3	4	5	8
76	Women are well represented in scientific jobs	1	2	3	4	5	8
77	Science organisations produce relevant knowledge about daily life in South Africa	1	2	3	4	5	8

SOURCES OF SCIENTIFIC INFORMATION

The following questions ask about SCIENCE AND TECHNOLOGY news.

78 **In general, how much SCIENCE AND TECHNOLOGY information do you get? [PRS SHOWCARD 9]**

None	1
Too little	2
The right amount	3
Too much	4
(Do not know)	8

79 **How often do you read, watch or listen to SCIENCE AND TECHNOLOGY NEWS? [PRS SHOWCARD 10]**

Every day or almost every day	1
A few times a week	2
A few times a month	3
Less often	4
Never	5
(Don't know)	8

How often do <u>you</u> get SCIENCE AND TECHNOLOGY news from each of the following sources? [PRS SHOWCARD 11]

		Daily	Weekly	Monthly or less often	Never
80	Television	1	2	3	4
81	Radio	1	2	3	4
82	Print newspapers	1	2	3	4
83	Printed books or magazines	1	2	3	4
84	Internet websites	1	2	3	4
85	Social media (e.g., Facebook, Twitter)	1	2	3	4
86	Online chat apps, like WhatsApp	1	2	3	4
87	Video Streaming Services (e.g., YouTube, Netflix, Showmax)	1	2	3	4
88	Government sources	1	2	3	4
89	Religious, traditional or community-based leaders	1	2	3	4
90	Friends and family	1	2	3	4
91	Workplaces or educational institutions	1	2	3	4

TRUST IN MEDIA

92 In general, how well does the media report on SCIENCE AND TECHNOLOGY NEWS in South Africa? (In any medium, including radio, print, tv, online)

Very well	1
Quite well	2
Not very well	3
Not at all well	4
(Do not know)	8

How much do you trust or distrust the SCIENCE AND TECHNOLOGY NEWS from each of the following media sources? [PRS SHOWCARD 8]

		Strongly trust	Trust	Neither trust nor distrust	Distrust	Strongly distrust	(Do not know)
93	Television	1	2	3	4	5	8
94	Radio	1	2	3	4	5	8
95	Print newspapers	1	2	3	4	5	8
96	Internet websites	1	2	3	4	5	8
97	Social media (e.g., Facebook, Twitter groups)	1	2	3	4	5	8
98	Online chat apps, like WhatsApp	1	2	3	4	5	8

How much do you trust or distrust news that you read, hear or watch about each of the following areas? [PRS SHOWCARD 8]

		Strongly trust	Trust	Neither trust nor distrust	Distrust	Strongly distrust	(Do not know)
99	News about Education	1	2	3	4	5	8
100	News about Health	1	2	3	4	5	8
101	News about Politics and Political Parties	1	2	3	4	5	8
102	News about your Local Community	1	2	3	4	5	8
103	News about Business and Finance	1	2	3	4	5	8
104	News about Science and Technology	1	2	3	4	5	8
105	News about Entertainment, Arts and Culture	1	2	3	4	5	8
106	News about Sports	1	2	3	4	5	8

TRUST IN THE WAY GOVERNMENT MAKES DECISIONS

The following questions ask your views about how the SOUTH AFRICAN GOVERNMENT makes decisions.

How much do you agree or disagree with the following statements? [PRS SHOWCARD 7]

		Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree	(Do not know)
107	Government considers information from expert groups when making decisions	1	2	3	4	5	8
108	Government meets with the public to discuss important decisions	1	2	3	4	5	8
109	Government considers the views of the community when making important decisions	1	2	3	4	5	8
110	Government uses research results to make good decisions	1	2	3	4	5	8

VALUE OF SCIENCE AND TECHNOLOGY

The following questions ask about your views on science and technology.

How much do you agree or disagree with the following statements? [PRS SHOWCARD 7]

		Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree	(Do not know)
111	Science and technology are making our lives healthier, easier, and more comfortable	1	2	3	4	5	8
112	Science and technology will make work more interesting	1	2	3	4	5	8
113	Science and technology makes our way of life change too fast	1	2	3	4	5	8
114	We depend too much on science and not enough on faith or religion	1	2	3	4	5	8

How much do you agree or disagree with the following statements? [PRS SHOWCARD 7]

		Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree	(Do not know)
115	Scientific advances tend to benefit the rich more than the poor	1	2	3	4	5	8
116	New technologies will result in people losing jobs	1	2	3	4	5	8
117	The benefits of science and technology are greater than the harmful effects	1	2	3	4	5	8
118	Science and technology will create more opportunities for future generations	1	2	3	4	5	8

VALUE OF SCIENCE IN EVERYDAY LIFE

The following questions ask about science and technology in your everyday life, such as using your phone, computer, cooking etc.

How much do you agree or disagree with the following statements? [PRS SHOWCARD 7]

		Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree	(Do not know)
119	Internet banking makes it easier for my household to make monthly payments	1	2	3	4	5	8
120	Science knowledge helps us manage events such as pandemics and natural disasters	1	2	3	4	5	8
121	Technology has made it easier for me to connect with friends and family anywhere	1	2	3	4	5	8
122	Technology has helped my household save money on water, electricity and other home expenses	1	2	3	4	5	8
123	Social media has made the spread of fake or false news easier	1	2	3	4	5	8
124	The internet helps my household get any information we need	1	2	3	4	5	8
125	Science and technology have improved the quality of food	1	2	3	4	5	8
126	I often use the science I learnt at school	1	2	3	4	5	8
127	Information from the Internet is accurate and trustworthy	1	2	3	4	5	8

SPENDING ON SCIENCE AND TECHNOLOGY

The following questions ask about your views on spending on science and technology by government, or big business and the corporate world.

128 Do you think the South African government spends too much or too little money on research and development in science and technology? [PRS SHOWCARD 12]

Far too little	1
Too little	2
The right amount	3
Too much	4
Far too much	5
(Do not know)	8

129 Do you think South African big business or the corporate world spends too much or too little money on research and development in science and technology? [PRS SHOWCARD 12]

Far too little	1
Too little	2
The right amount	3
Too much	4
Far too much	5
(Do not know)	8

130 Please choose the FOUR research priorities that government should continue funding. [PRS SHOWCARD 13]

INTERVIEWER: MULTIPLE RESPONSES ALLOWED. CIRCLE UP TO FOUR RESPONSES.

a	Understanding space and the stars	01
b	Improving traditional knowledge	02
c	Understanding the way people behave	03
d	Ensuring access to good quality food	04
e	Addressing environmental issues (such as climate change)	05
f	Providing a cleaner and better water supply	06
g	Developing advanced technologies, such as robots or human-like machines	07
h	Improving Internet and Communication Technologies	08
i	Improving energy supply like electricity	09
j	Health related research, like vaccines	10
k	Improving the quality of education	11
l	None of the above	98

131 **If you were making decisions about the spending of extra money on the secondary or high schools in this area, which one of these would be your top priority?**

Library and library books	1
Science and technology equipment and resources	2
Sports and recreation resources	3
Extra teachers	4
Other (specify)	5
(Do not know)	8

CITIZENS' SCIENCE ENGAGEMENT BEHAVIOUR

The following questions ask about your engagement with, and attendance at, science and technology events or activities.

How often do you do each of the following? [PRS SHOWCARD 14]

		Often	Sometimes	Rarely	Never	(Do not know)
132	Search for science or technology information online	1	2	3	4	8
133	Read or watch science fiction (e.g., books, movies)	1	2	3	4	8
134	Buy science or technology books or magazines	1	2	3	4	8
135	Watch or listen to science or technology shows	1	2	3	4	8

136 **How interested are you in attending science and technology activities and events? [PRS SHOWCARD 2]**

Very interested	1
Somewhat interested	2
Hardly interested	3
Not at all interested	4
(Do not know)	8

The following questions ask about your access to and attendance of science and technology places, events or activities.

137 **Which of the following are available close to where you stay? [PRS SHOWCARD 15]**

INTERVIEWER: MULTIPLE RESPONSES ALLOWED. CIRCLE ALL THAT APPLY.

a	Public library	1
b	Museum	2
c	Botanical gardens or nature reserve; zoo, aquarium or game reserve	3
d	Science and Technology Centre or Exhibitions	4
e	Public science activities such as river or community clean ups, nature walks	6
f	None of the above	7
g	(Refused)	8

Have you attended SCIENCE OR TECHNOLOGY activities at the following places? [PRS SHOWCARD 16]

		Yes, I have attended in the last 5 years	Yes, more than 5 years ago	No, I have not attended, but would like to attend	No, I have no interest in attending	(Do not know)
138	Public library	1	2	3	4	8
139	Museum	1	2	3	4	8
140	Botanical gardens or nature reserve; zoo, aquarium or game reserve	1	2	3	4	8
141	Science or Technology Centres or Exhibition	1	2	3	4	8
142	Public science activities such as river or community clean ups, nature walks	1	2	3	4	8

Have you participated in the following online SCIENCE OR TECHNOLOGY events or activities in the last year? [PRS SHOWCARD 17]

		Yes	No, but I would like to	No, I have no interest in this
143	Online science and technology seminars	1	2	3
144	Visited internet website about science or technology	1	2	3
145	Watched internet videos about science or technology	1	2	3

Thinking about SCIENCE OR TECHNOLOGY RELATED activities and events, how much do you agree or disagree with each of the following statements? [PRS SHOWCARD 7]

		Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree	(Do not know)
146	They are too expensive	1	2	3	4	5	8
147	They are not available in a language I understand	1	2	3	4	5	8
148	The content is too difficult	1	2	3	4	5	8

STUDYING AND WORKING IN SCIENCE, ENGINEERING, TECHNOLOGY AND MATHEMATICS (STEM)

149 Did you attend secondary school after Grade 9 (Standard 7/Form 2)?

Yes	1	ASK Q150
No	2	SKIP TO Q165

Did you study any of the following subjects at secondary school (high school) after Grade 9 (Standard 7/Form 2)?

		Yes	No
150	Mathematics or Mathematics Literacy	1	2
151	Physical Science	1	2
152	Biology or Life Science	1	2
153	Geography	1	2
154	History	1	2

155 Did you attend a tertiary institution (i.e. university, TVET colleges etc) after Grade 12 (Standard 10/Form 5)?

Yes	1	ASK Q156
No	2	SKIP TO Q165
(Not applicable, still at school)	3	SKIP TO Q165

Did you study any of the following subjects after Grade 12 at a tertiary institution (i.e. university, TVET colleges etc)?

		Yes	No
156	Agriculture and Related studies	1	2
157	Architecture and the Built Environment	1	2
158	Computer and Information Sciences	1	2
159	Life and Environmental Sciences	1	2
160	Physical Sciences	1	2
161	Mathematics and Statistics	1	2
162	Military Sciences	1	2
163	Engineering and Related Studies	1	2
164	Health and Related Sciences (including medicine)	1	2

The following questions ask about your view of science, technology, engineering, and mathematics as career choices.

165 **Please select the THREE things that most attract people to jobs in science, engineering and technology? [PRS SHOWCARD 18]**

Interviewer: multiple responses allowED. CIRCLE UP TO three options.

a	Science jobs are interesting	1
b	Science jobs pay well	2
c	Scientists get to discover and enjoy learning about new things	3
d	Scientists do work that is beneficial to society	4
e	Science jobs are secure and stable	5
f	Science jobs are well-respected	6
g	None of the above	7
h	(Do not know)	8

The following questions ask about young people, science and the future of working in science and technology areas in South Africa.

How much do you agree or disagree with the following statements about young people and science and technology? [PRS SHOWCARD 7]

		Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree	(Do not know)
166	Young people should be encouraged to learn about science and technology	1	2	3	4	5	8
167	A science and technology qualification gives young people more job options than other qualifications	1	2	3	4	5	8
168	Science and technology prepare young people to respond to challenges in local communities	1	2	3	4	5	8
169	Digital and computer skills are becoming more important for young people	1	2	3	4	5	8
170	Science and technology are careers suitable for women	1	2	3	4	5	8

USE OF TECHNOLOGY

The following questions ask about your use of various technologies. How often do you use the following technologies? [PRS SHOWCARD 14]

		Often	Sometimes	Rarely	Never	(Do not know about this)
171	Internet banking	1	2	3	4	8
172	Ride sharing applications (Uber, Bolt)	1	2	3	4	8
173	Health technologies (e.g., home digital blood pressure test, health monitor on cell phone)	1	2	3	4	8
174	Online shopping (e.g., Takealot, food deliveries, supermarkets)	1	2	3	4	8
175	Online Government services (Home affairs, SARS e-filing, TV Licences)	1	2	3	4	8
176	Online learning courses	1	2	3	4	8

PERSONAL OR INDIVIDUAL BEHAVIOUR CHANGES

How often have you participated in the following activities in the past five years? [PRS SHOWCARD 14]

		Often	Sometimes	Rarely	Never	(Do not know about this)
177	Recycled materials or reduced the use of plastic	1	2	3	4	8
178	Raised awareness for science-related issues	1	2	3	4	8
179	Participated in a national or international science awareness event	1	2	3	4	8
180	Took part in marches or demonstrations related to the environment	1	2	3	4	8
181	Participated in public hearings or official meetings on science issues	1	2	3	4	8

To what extent do you think each statement applies to you personally? [PRS SHOWCARD 19]

		Not at all	A little	Somewhat	Mostly	Completely	(Do not know)
182	I decide what happens in my life	1	2	3	4	5	8
183	If I work hard, I will succeed	1	2	3	4	5	8
184	What I do is mainly determined by others	1	2	3	4	5	8
185	Fate often gets in the way of my plans	1	2	3	4	5	8

PARTICIPANTS' SCIENCE AND TECHNOLOGY INFORMATION SHARING BEHAVIOUR

The following questions ask how often you share science and technology information, what information you choose to share, and why you share it.

How often do you talk about or share SCIENCE AND TECHNOLOGY information with the following groups? [PRS SHOWCARD 14]

		Often	Sometimes	Rarely	Never	(Don't know)
186	Your family, friends or colleagues	1	2	3	4	8
187	Your religious network (e.g. church, temple, etc)	1	2	3	4	8
188	At community meetings or with your community (face to face)	1	2	3	4	8
189	Through social media (e.g., Facebook, Instagram, Twitter)	1	2	3	4	8
190	Online chat apps (e.g., WhatsApp, Viber)	1	2	3	4	8

How much do you agree or disagree with the following statements about what SCIENCE AND TECHNOLOGY information you share? [PRS SHOWCARD 7]

		Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree	(Do not know)
191	I share all science and technology information that I find interesting	1	2	3	4	5	8
192	I only share science and technology information I have confirmed is true by checking different sources	1	2	3	4	5	8
193	I only share science and technology information from credible sources, such as well-known news programmes or websites or government sources	1	2	3	4	5	8
194	I only share science and technology information I have received from scientific and professional communities	1	2	3	4	5	8

195 **Why do <u>you</u> talk about or share SCIENCE AND TECHNOLOGY information? [PRS SHOWCARD 20]**

INTERVIEWER: MULTIPLE RESPONSES ALLOWED. CIRCLE ALL THAT APPLY.

a.	It is related to my job	1
b.	It is related to my studies	2
c.	It is related to my interests or hobbies outside of work	3
d.	It is related to my children's activities, interests or education	4
e.	It helps me make decisions about everyday life for me and my family	5
f.	I have a responsibility to share information about science	6
g.	None of the above	7

SQUARE KILOMETRE ARRAY (SKA)

[ASK ONLY IF RESPONDENT IS IN NORTHERN CAPE; FOR ALL OTHER PROVINCES SKIP TO Q.202]

The following items ask about the Square Kilometre Array telescope or SKA as it is commonly known, and its impact in the Northern Cape.

196 **Have you heard of the Square Kilometre Array telescope?**

Yes	1	ASK Q.197
No	2	SKIP TO Q.202

To what extent do you agree or disagree with the following statements? [PRS SHOWCARD 7]

		Strongly agree	Agree	Neither agree nor disagreed	Disagree	Strongly disagree	(Do not know)
197	We are proud that the SKA telescope was built in the Northern Cape	1	2	3	4	5	8
198	The SKA telescope has improved the quality of education in the Province	1	2	3	4	5	8
199	The SKA telescope has led to more science awareness in the Northern Cape	1	2	3	4	5	8
200	The SKA telescope has created more jobs in the Northern Cape	1	2	3	4	5	8
201	The SKA telescope will raise South Africa's science profile or image in the world	1	2	3	4	5	8

RESPONDENT CHARACTERISTICS

202 Sex of respondent

Male	1
Female	2
Other (specify)	3

203 Population group of respondent (for research purposes only)

Black African	1
Coloured	2
Indian or Asian	3
White	4
Other (specify)	5

204 Age of respondent in completed years

			Years
(Don't know) = 998			

205 What is the highest level of education that you have completed?

No schooling	00
Grade R/Grade 0	01
Grade 1/Sub A/Class 1	02
Grade 2/Sub B/Class 2	03
Grade 3/Standard 1/ABET 1 (Kha Ri Gude, Sanli)	04
Grade 4/Standard 2	05
Grade 5/Standard 3/ABET 2	06
Grade 6/Standard 4	07
Grade 7/Standard 5/ABET 3	08
Grade 8/Standard 6/Form 1	09
Grade 9/Standard 7/Form 2/ABET 4	10
Grade 10/Standard 8/Form 3	11
Grade 11/Standard 9/Form 4	12
Grade 12/Standard 10/Form 5/Matric	13
NTC 1/N1/NC (V) Level 2	14
NTC 2/N2/NC (V) Level 3	15
NTC 3/N3/NC (V) Level 4	16
N4/NTC 4	17
N5/NTC 5	18
N6/NTC 6	19
Diploma	20
Advanced diploma (AD)	21
Bachelor degree	22
Honours degree	24
Master degree	25
Doctorate degree, Laureatus in Technology	26
Other (specify)	27
(Do not know)	88

206 When you were 15 years of age, how many people lived in your household (including yourself)?

	☐☐
(Refused to answer)	97
(Don't know, inadequately described)	98

Thinking about the educational activities when you were 15 years old, how often did your parents or other adults in your home do the following? [PRS SHOWCARD 14]

		Very often	Quite often	Rarely	Not at all	(Do not know
207	Encouraged you to read	1	2	3	4	8
208	Discussed news events with you	1	2	3	4	8
209	Assisted with or asked about your homework	1	2	3	4	8
210	Encouraged you to do well in school	1	2	3	4	8
211	Encouraged you to take science subjects at school	1	2	3	4	8

212 What language(s) can you speak?

INTERVIEWER: MULTIPLE RESPONSES ALLOWED. CIRCLE ALL THAT APPLY.

a	Sesotho	01
b	Setswana	02
c	Sepedi	03
d	Siswati	04
e	IsiNdebele	05
f	IsiXhosa	06
g	IsiZulu	07
h	Xitsonga	08
i	Tshivenda or Lemba	09
j	Afrikaans	10
k	English	12
l	Other (specify)	13

213 What language do you mostly speak at home? (one response)

Sesotho	01
Setswana	02
Sepedi	03
Siswati	04
IsiNdebele	05
IsiXhosa	06
IsiZulu	07
Xitsonga	08
Tshivenda or Lemba	09
Afrikaans	10
English	11
Other African language	12
European language	13
Indian language	14
Other (specify) … … … … …	15

214 A lot of science is communicated in English. How would you rate your ability to READ ENGLISH? [PRS SHOWCARD 21]

Very good	1
Good	2
Neither good nor bad	3
Bad	4
Very bad	5
I can't read English at all	6
(Do not know)	8

215 How would you rate your ability to WRITE ENGLISH? [PRS SHOWCARD 21]

Very good	1
Good	2
Neither good nor bad	3
Bad	4
Very bad	5
I can't write English at all	6
(Do not know)	8

216 And how would you rate your ability to SPEAK ENGLISH? [PRS SHOWCARD 21]

Very good	1
Good	2
Neither good nor bad	3
Bad	4
Very bad	5
I can't speak English at all	6
(Do not know)	8

217 What is your current employment status? (Which of the following best describes your present work situation?)

Employed full time (whether self-employed or employed by someone else)	01
Employed part time (whether self-employed or employed by someone else)	02
Employed less than part time (casual work or piecework)	03
Temporarily sick	04
Unemployed, not looking for work	05
Unemployed, looking for work	06
Pensioner (aged or retired)	07
Permanently sick or disabled	08
Housewife, not working at all, not looking for work	09
Housewife, looking for work	10
Student or learner	11
Other (specify) … … … … … … … … … … … … … …	12

218 Do you consider yourself as belonging to any religion?

Yes	1		ASK Q.219
No	2	→	SKIP TO Q.220

219 Which one? Please specify denomination.

Roman Catholic	01
Anglican	02
Baptist	03
Lutheran	04
Methodist	05
Pentecostal/Evangelistic (e.g. Apostle Twelve, Assemblies of God, Full Gospel Church of God, African Evangelical Church, Faith Mission, Church of God and Saints of Christ, Pentecostal Holiness Church, Universal Church of God, Born Again, Rhema Church)	06
Zionist Christian Church	07
Other African Independent Churches/African Initiated Churches (e.g., Apostolic Church, Nazareth, Shembe)	08
Jehovah's Witness	09
Seventh Day Adventist	10
Reformed Church (e.g. Dutch Reformed Church, United Congregation Church, Uniting Reformed Church, Christian Reformed Church)	11
Christian without a specific denomination	12
Other Christian	13
Islam/Muslim	14
Judaism/Jewish	15
Hinduism/Hindu	16
Buddhism/Buddhist	17
Other (specify)	18
(Refused)	97
(Do not know)	98
(Not answered)	99

220 **How religious would you say you are? Please answer on a scale from 0 to 10, where 0 is 'not at all religious' and 10 is 'very religious' [PRS SHOWCARD 22]**

Not at all religious										Very religious	(Do not know)
00	01	02	03	04	05	06	07	08	09	10	88

221 **People sometimes describe themselves as being 'traditional' or as 'following cultural practices'. How would you describe yourself?**

Extremely traditional	1
Somewhat traditional	2
Slightly traditional	3
Not at all traditional	4
(Don't know)	8

222 **Do you or anyone in this household receive any social grants?**

Yes	1
No	2
(Don't know)	8
(Refused)	9

223 **Thinking about you and your family, would you describe yourself as… ?**

Wealthy	1
Very comfortable	2
Reasonably comfortable	3
Just getting along	4
Poor	5
Very poor	6
(Don't know)	8

HOUSEHOLD CHARACTERISTICS

224 **Indicate the type of main dwelling that the household occupies?**

House or brick structure on a separate/own stand or yard or on farm	01
RDP house	02
Traditional dwelling/Hut/Structure made of traditional materials	03
Flat or apartment in a block of flats	04
Town/cluster/semi-detached house (simplex, duplex or triplex)	05
Unit in retirement village	06
Dwelling/House/Flat/room in backyard	07
Informal dwelling/Shack in backyard	08
Informal dwelling/Shack not in backyard, e.g. in an informal/squatter settlement or on farm	09
Room/Flatlet	10
Caravan/Tent	11
Other, *specify*	12

225 Please tell me which of the following, if any, are presently in your household (in working order). Does your household have… ?

		Yes	No
a.	Running tap water inside your home	1	2
b.	Hot running water from a geyser	1	2
c.	Water flush toilets in your home	1	2
d.	Domestic worker (live-in or part-time)	1	2
e.	A fridge	1	2
f.	A washing machine	1	2
g.	A dishwashing machine	1	2
h.	Microwave	1	2
i.	Electric iron	1	2
j.	A computer (desktop or laptop) or tablet	1	2
k.	Internet connection at home	1	2
l.	A TV set	1	2
m.	Air conditioner	1	2
n.	M-Net, DStv, Netflix or other pay TV subscription or streaming service	1	2
o.	A motor vehicle	1	2

226 Do you have a cell phone?

Yes	1
No	2

227 Do you have any form of access to the internet?

Yes	1	
No	2	Skip to end

228 If yes, where do you access the internet?

INTERVIEWER: MULTIPLE RESPONSES ALLOWED. CIRCLE ALL THAT APPLY.

a.	At home	1
b.	At work	2
c.	At an educational institution	3
d.	At an internet café	4
e.	At a community centre	5
f.	Through a cellphone	6
g.	Other (SPECIFY)	7

229 How often do you access the internet?

Hardly ever	1
Only occasionally	2
A few times a week	3
Most days	4
Every day	5
(Refusal)	9
(Don't know)	8

230 On a typical day, about how much time do you spend using the internet? (on any type of device, for work or personal use)

Less than 30 minutes	01
Between 30 minutes and 2 hours	02
Between 2 and 4 hours	03
Between 4 and 6 hours	04
Between 6 and 8 hours	05
Between 8 and 10 hours	06
Between 10 and 12 hours	07
More than 12 hours	08
(Don't know)	88
(Refused to answer)	99

231 Which THREE of the following things do you mainly use the Internet for (what do you do online)? [PRS SHOWCARD 23]

INTERVIEWER: MULTIPLE RESPONSES ALLOWED. CIRCLE UP TO THREE RESPONSES.

a	Work	01
b	Entertainment (e.g., Netflix, YouTube, playing games)	02
c	Social media (e.g., Facebook, Twitter)	03
d	Communication (e.g., WhatsApp)	04
e	Information for your studies	05
f	General information	06
g	News	07
h	Banking or other financial services (payments, insurance)	08
i	(None of the above)	77
j	(Refused)	99

232 How often in the PAST 4 WEEKS have you spent time looking at social media websites like Facebook, Twitter and Instagram? [PRS SHOWCARD 24]

Never	1
Rarely	2
Sometimes	3
Often	4
Very often	5
(Refusal)	9
(Don't know)	8

233 How often in the PAST 4 WEEKS have you spent time using online chat apps like WhatsApp or Viber? [PRS SHOWCARD 24]

Never	1
Rarely	2
Sometimes	3
Often	4
Very often	5
(Refusal)	9
(Don't know)	8

INTERVIEWER RECORD

How long did the interview take to complete?

WRITE IN NUMBER OF MINUTES: | | |

(Don't know) = 88

LANGUAGE OF INTERVIEW:

Please record the language in which you conducted most of the interview.

Please write in any notes on the interview or specific comments on items in the questionnaire in the space below.

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