A unique fingerprint? Factors influencing attitudes towards science and technology in South Africa

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From an international perspective, research in the field of public attitudes towards science and technology has been conducted since the 1970s. A frequently articulated – and empirically supported – assumption is that strong interest in and knowledge about science in a society is associated with more favourable attitudes towards science. This positive attitude in turn affects support for public funding of science. However, this research field is not without controversy, and for the South African population many questions remain unanswered. Initial research has not explored the factors that shape attitudes towards science and technology in detail. We re-analysed data from the Human Sciences Research Council to explore the above assumption. Interestingly, for the South African population, higher levels of scientific literacy and use of information sources are associated with more promises but also more reservations towards science and technology. This is especially true for relatively young and educated survey respondents. In international comparison, South Africa shows a unique fingerprint to some extent, but also shares characteristics with industrially developing countries of Europe (such as Greece or Portugal). To understand the correlations better, future research should aim to examine the overall picture when investigating the diverse South African population more extensively.

Introduction

Starting in the 1970s, research on public perceptions of science and technology (S&T) was driven by the idea that national success is largely dependent on innovation in S&T, and that innovation requires a supportive public.[1] However, research programmes were initiated mainly because of a rising public scepticism towards science in Western countries.[2] Researchers were afraid that this scepticism would result in funding cuts for scientific programmes. As a result, surveys measuring public perceptions turned into a regular activity in many countries.[3] The idea behind this research field is that a combination of interest in and knowledge about science shapes attitudes towards science. In turn, these attitudes affect outcomes such as support for public funding among the voting population.[1]

For South Africa, certain initial findings have led researchers to conclude that this country has a *unique fingerprint* with regard to public attitudes towards S&T.[4] South Africans generally show a mix of positive and negative attitudes about S&T. In this paper, 'promises' refer to people's positive expectations and beliefs about the benefits of S&T, whereas 'reservations' refer to negative views about S&T. A comparison of recent data with earlier data[5] showed that for South Africans, scientific promises have dropped slightly whereas some reservations have increased significantly. Age and education seem to influence the promise–reservation ratio in South Africa.[4] However, the claim that South Africa has a *unique* fingerprint requires further empirical support.

Specifically, the influence of scientific literacy and the use of information sources on 'promises' and 'reservations' regarding S&T has not been investigated in enough detail. According to the literature, these two factors play a crucial role in public perceptions of S&T.

Short theoretical review: Public perceptions of science and technology

Surveys conducted in other countries found that the more scientifically literate the public, the more favourable is their attitude towards S&T.[6] A meta-analysis showed a weak but positive correlation.[2] If there is a positive perception of science, then there is also more support for its public funding.[7] In addition, favourable attitudes towards S&T and higher literacy both seem to be influenced by sociodemographics, with gender (male), age (younger), and education level (higher) being among the important variables.[6,8]

In general, the correlation between scientific literacy and attitudes towards S&T has long been debated.[1,9] For some time, researchers have adhered to the so-called *deficit model*, believing that if the public were only more scientifically literate they would hold more favourable attitudes towards science, and scepticism would vanish.[6] That is why many educational initiatives have been carried out in Western countries.[10] However, the success of such initiatives as well as the whole terminology have been questioned. In addition, cross-cultural studies in Europe have shown that in industrially developing countries, a strong positive correlation exists between scientific literacy and attitudes towards S&T, whereas in post-industrial countries this correlation is weaker.[10] The reasoning is that in industrial societies, only a small elite is really knowledgeable (high socioeconomic stratification[11]), and greater knowledge leads to a more positive attitude.

Moving along the continuum of economic development, in a post-industrial society one finds that knowledge is widely distributed, mainly because education is more accessible but also because developed countries make greater demands on their citizens in terms of scientific and technical skills.[12] Positive attitudes, then, become less predictable by scientific knowledge as public attitudes commonly become more sceptical.[13] That is why, in general, basic assumptions of the deficit model (i.e. greater scientific literacy leads to more favourable attitudes to science) are mainly confirmed in industrially developing countries. However, in these countries, overall, an ambivalent picture emerges: large parts of such societies also show strong pessimism towards science, as was found in some European countries.[11]

Interestingly, for South Africa, we have no reports answering whether and to what extent factors such as scientific literacy and use of information sources differentially influence attitudes towards S&T. Addressing this research gap was the central goal of our investigation. Our main research question was: *What are the strongest predictors influencing public attitudes towards S&T in South Africa?*

Method

Research design and sample

Our investigation was a secondary analysis of data from the Human Sciences Research Council 2010 wave of the South African Social Attitudes Survey (SASAS 2010). The number of participants (*n*) was 3183. To obtain a representative sample of the South African population, three stratification variables were used: province, geographic type and majority population group, and the data were weighted accordingly.[4] Data collection took place between November and December 2010, using face-to-face interviews. The SASAS 2010 included, among others, items to measure attitudes towards S&T, scientific literacy and sources of scientific information.[4]

Measurement

Within SASAS 2010, seven items measured respondents' attitudes to S&T (α=0.80) using a 5-point rating scale (1=strongly agree; 5=strongly disagree).[4] Our confirmatory factor analysis using principal component analysis and Varimax rotation (KMO=0.84) resulted in two factors. The first factor (4 items; α=0.79) was 'promises towards S&T' (Eigenvalue=3.25, explaining 46% of the variance). The second factor (3 items; α=0.65) was 'reservations towards S&T' (Eigenvalue=1.06, explaining 15% of the variance).

Hence, two additive indexes served as dependent variables in our study: promises (mean=2.52; *s.d.*=1.387) and reservations (2.77±1.225) towards S&T. These factors are congruent with the literature.[8,14] 'Promises' refer to positive expectations and beliefs in the benefits of S&T (sample item: 'S&T are making our lives healthier, easier, and more comfortable'), whereas 'reservations' refer to negative consequences and predispositions concerning S&T (sample item: 'Science makes our way of life change too fast').[15]

Table 1: Claims to measure scientific literacy and responses

Scientific claim	True	False	Don't know
The centre of the Earth is very hot.	79%†	9%	12%
Electrons are smaller than atoms.	39%†	33%	28%
Antibiotics kill viruses as well as bacteria.	43%	38%†	19%
Human beings developed from earlier species of animals.	34%†	46%	20%
The sun rotates around the Earth.	47%	42%†	10%
The oxygen we breathe comes from plants.	82%†	8%	9%

† = *correct answer*

We set the independent variables to be 'scientific literacy', 'sources of scientific information' and sociodemographic data. Scientific literacy had been measured using six items asking respondents to indicate whether a scientific claim is true or false, or that they did not know (α=0.84). The results of the analysis are shown in Table 1. Based on the number of correct answers, an additive index for scientific literacy (3.14±1.445) was created. Sources of scientific information (α=0.87) had been assessed on a 5-point rating scale (1=very often; 5=never) asking how often several sources were used by respondents to access information about S&T. The mean scores (with *s.d.*) were as follows: television 2.57±1.494; radio 2.86±1.396; newspapers 3.30±1.387; books/magazines 3.56±1.341; the Internet 4.19±1.274; other people 3.21±1.330; and public spaces 4.04±1.219.

Relevant sociodemographic variables for this investigation were gender (52% female), age (37.03±20 years), level of education (low 18%, medium 67%, high 15%), and social class (lower 42%, working 24%, middle 27%, upper middle 4%, upper 1%).

Findings

To answer the research question, hierarchical regressions for both dependent variables were tested (Table 2). Using 'promises towards S&T' as a dependent variable (F=683051.17; $d.f.$=12; p<.001), the findings showed that the more scientifically literate respondents were, the higher the promises towards S&T. Scientific literacy was the strongest predictor. Other meaningful findings were that the more respondents used television and books/magazines as sources of scientific information, the greater their perception of promises towards S&T. In addition, two sociodemographic variables had an important influence. In this sample, the younger the participants and the higher their level of education, the more favourable their attitude towards S&T.

For 'reservations towards S&T' as a dependent variable (F=338065.82; $d.f.$=12; p<.001), the findings showed that the more scientifically literate the respondents, the higher their reservations towards S&T. Again, scientific literacy was the strongest predictor. In addition, for the sample we studied, reservations towards S&T increased the more respondents used television, radio, newspapers, or public spaces as sources of scientific information. However, reservations decreased when books/magazines or the Internet were used as a source. Three sociodemographic variables were among the strongest predictors: reservations were stronger for younger people, more educated respondents, and people from lower social classes.

Conclusion

In terms of the South African population, our study showed that knowledge (greater knowledge), age (younger) and education (more educated) were associated with more favourable attitudes to S&T. In an international comparison, South Africa shares characteristics with industrially developing countries of Europe, such as Greece and Portugal.[11] In post-industrial European countries, the correlation between knowledge and positive attitudes is weaker.[10] In the USA, promises and reservations are negatively correlated.[14] For Europe, researchers found that lower social classes of the population in less advanced countries hold stronger reservations towards S&T than higher social classes.[15] In South Africa, however, scientific literacy increased both promises and reservations towards S&T; hence, South Africa indeed has a *unique fingerprint*.

A rationale for this finding could be that more knowledgeable, educated and younger South Africans see S&T as the route to progress; however, they also have reservations that science changes their lives too much.[11] In a recent international study, the South African sample was the one that agreed most strongly that people believe too often in science and not enough in feelings and faith. However, South Africans also believed most strongly that science is able to solve problems[16] – perfectly representing this ambivalence. One finding of our study, namely that a lower social class also shares more reservations, shows that future investigations need to explore in greater detail the specific correlations between the variables.

Despite these illuminating findings, our investigation was merely a secondary analysis of existing data. We thus had no control over the type of constructs and items tested, and as a result can present only a partial picture. Further research questions should include whether this attitudinal ambivalence among relatively more literate and educated South Africans leads to greater support of public funding. In addition, the role of trust in science and scientific institutions, or interest in science, needs to be further explored, because both are central when measuring public perceptions of science.[12] To understand the role of information sources fully, a qualitative design could explore what kinds of sources shape public attitudes. Because South Africa is on many levels a highly diverse country, it would also be interesting to see to what extent the life-worlds of different segments of the public influence people's perceptions of science. We propose to answer these research questions in our future investigations.

Table 2: Results of hierarchical regressions

	Model 1		Model 2		Model 3	
Variables	***β***	***t***	***β***	***t***	***β***	***t***
Dependent variable: Promises towards science and technology						
Scientific literacy	-.384	-2322.37	-.350	-2077.90	**-.328**	-1905.79
Television as information source			.189	793.49	**.175**	735.21
Radio as information source			.001	5.94	.019	79.53
Newspapers as information source			-.017	-65.67	-.030	-116.30
Books/magazines as information source			.070	274.17	**.054**	210.21
Internet as information source			-.018	-87.01	-.034	-163.08
Other people as information source			-.012	-58.69	-.007	-34.31
Public spaces as information source			.019	89.99	.013	62.11
Gender					.013	80.14
Age					**.078**	467.59
Level of education					**-.080**	-435.49
Social class					-.012	-69.46
Adjusted R^2	14.8		19.5		20.8	
Dependent variable: Reservations towards science and technology						
Scientific literacy	-.230	-1316.08	-.227	-1273.38	**-.221**	-1210.62
Television as information source			.131	518.98	**.128**	505.87
Radio as information source			.049	188.56	**.053**	204.91
Newspapers as information source			.078	288.14	**.079**	290.11
Books/magazines as information source			-.063	231.78	**-.074**	-269.24
Internet as information source			-.096	443.43	**-.092**	-418.72
Other people as information source			.050	229.10	.047	218.51
Public spaces as information source			.067	302.54	**.067**	305.04
Gender					.039	225.01
Age					**.051**	287.12
Level of education					**-.050**	-257.40
Social class					**.054**	292.43
Adjusted R^2	5.3		10.7		11.6	

Note. All results are significant ($p<.001$). Bold numbers in Model 3 are the strongest predictors.

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Authors' contributions

L.G. analysed the data and was the main author. P.W. was the project manager and was involved in conceptualising the study and writing.

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