

VACCINATION RESISTANCE, RELIGION AND ATTITUDES TO SCIENCE IN NIGERIA

Falade, Bankole Adebayo

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Abstract

The 2003 to 2004 revolt against the Oral Polio Vaccine (OPV) in Nigeria provides a case study for investigating how a new scientific phenomenon becomes part of common sense in a culture with high levels of religiosity.

Moscovici's Social Representations Theory about how society familiarises itself with the unfamiliar provides a framework for the research which includes two media analyses, historical texts, online and paper administered surveys and interviews. The media analyses examine the OPV controversy and science in the media. Correspondence analysis provides a geometric tool for visualising how the variables in both media analyses position themselves for the construction of genres of science news. Factor analysis groups the attitude items in the survey while logistic regression predicts outcomes controlling for other variables.

The media analyses found coverage of science in the period under review was generally positive and grew continually. The coverage of the OPV controversy was also generally positive but did not always mirror faithfully public opinion. Just as some Parisians in Moscovici's study likened psychoanalysis to a "symptom of an American invasion", the initial description of the OPV by the people of northern Nigeria was a "western conspiracy against Muslims."

The survey found different levels of trust in public institutions with scientists and religious leaders similarly rated. Pessimism, fear and progress characterise the attitude variables but the association with knowledge is not linear and confirms the influence of cultural values. Interviewees also confirm survey findings in that they simultaneously have faith in religion and in science.

Common sense in Nigeria is a mixture of science and religiosity and the public hold both in reverence: a phenomenon Moscovici refers to as cognitive *polyphasia*. The study also supports Durkheim's view that science (in Nigeria) depends on public opinion.

Key words: Resistance, religion, representations, media and science in Nigeria.

Table of contents

Abstract..... 3

Table of contents 4

Table of figures..... 7

List of Tables 9

Thesis overview 12

Research questions..... 15

Chapter summaries..... 19

Chapter 1 The Nigeria context: Science in religious and tribal pluralism..... 22

 1.1 Introduction..... 22

 1.2 The Oral Polio Vaccine Controversy..... 22

 1.3 The emergence of religious and tribal pluralism..... 24

 1.4 The emergence of democratic pluralism 29

 1.5 Science, religion, regions and democracy 33

 1.6 Summary 39

Chapter 2 Public resistance to vaccination programmes..... 42

 2.1 Introduction 42

 2.2 Vaccination resistance in history: 18th, 19th and 20th centuries..... 42

 2.3 Vaccination resistance in Northern Nigeria: 2001 to 2009 50

 2.4 Poliomyelitis: Aetiology and control..... 58

 2.5 Vaccines: Victim of success? 61

 2.6 Summary 63

Chapter 3 Theoretical elaboration: Science in common sense 66

 3.1 Introduction 66

 3.2 Science and religion..... 66

 3.3 Science and risk (the engineering approach) 70

 3.4 Science and the public (the scientific establishment) 74

 3.5 Science and Social Representations 80

 3.6 Social representations, public opinion, media and rumours 90

 3.7 Summary 96

Chapter 4 Triangulation of multiple data streams..... 98

 4.1 Introduction..... 98

4.2	Triangulation for social representations	98
4.3	Analysis of science news.....	103
4.4	Public understanding of science survey.....	115
4.4.1	Pilot online survey	115
4.4.2	The expanded survey	117
4.5	Living with science: Interviews, film reviews and field observations	128
4.6	Summary	129
Chapter 5	Analysis of science news.....	131
5.1	Introduction	131
5.2	The Oral Polio Vaccine controversy in the press (2001 to 2009).....	131
5.2.1	Methods	132
5.2.2	Intensity of coverage and disease incidence	134
5.2.3	The themes in the controversy	136
5.2.4	Actors, themes and evaluation	143
5.3	Science news in the press (Guardian newspaper: 2001 – 2009).....	152
5.3.1	Methods	153
5.3.2	Intensity of coverage	154
5.3.3	Journalistic practice	156
5.3.4	What is present, what is propagated?	157
5.3.5	How were the news sourced?	159
5.3.6	How were they presented?	161
5.3.7	The Guardian and herbal medicine	167
5.4	Summary	168
Chapter 6	Public understanding of science.....	170
6.1	Introduction	170
6.2	Methods.....	170
6.3	Trust in leaders and worldview.....	172
6.3.1	Interpretation of factors	174
6.4	General attitude to science	176
6.4.1	Interpretation of factors	178
6.5	Fundamental attitude to the world	180
6.6	Religiosity, gender and attitudes.....	182
6.7	Knowledge and facets of attitude to science: Model building.....	185
6.7.1	Progress of science facet of attitudes	186
6.7.2	Pessimism about science facet of attitudes	187
6.7.3	Fear of science facet of attitudes	188
6.8	Opposition to vaccination	189

6.9	Summary	190
Chapter 7	Living with faith in science and God	192
7.1	Synopsis.....	192
7.2	Methods.....	192
7.3	The doctor and God in the hospital	193
7.4	Faith in God and faith in science	202
7.5	Summary	217
Chapter 8	Summary and recommendations for future research.....	219
8.1	Synopsis.....	219
8.2	Common sense	219
8.3	Representations and the oral polio vaccine controversy.....	220
8.4	Science in the Nigerian media	225
8.5	Interest, Attitudes, knowledge and opposition to vaccination.....	226
8.6	Living with faith in science and religion	228
8.7	Recommendations for future research	229
References.....		231
	Books and Journal articles	231
	Newspaper articles	244
	Online sources.....	246
Appendices.....		249
	Appendix 1 Code book for coverage of immunization controversy	249
	Appendix 2 Code book for Science and Technology in The Guardian.....	251
	Appendix 3 Pilot survey of PUS	255
	Appendix 4 Integrated expanded (74) and pilot survey (14) questionnaires	258
	Appendix 5 Expanded (main) survey	261
	Appendix 6 Binary regression for main survey (N377).....	275
	Appendix 7 Thematic analysis of interviews	278
	Appendix 8 Interview consent form.....	284
	Appendix 9 Taiwan PUS 2012	285

Table of figures

Figure 1 Ethnic distribution in Nigeria (Paden, 2005).....	25
Figure 2 Nigeria on unification (Source: Library of congress/Paden, 2005)	30
Figure 3 Map of Nigeria’s 36 (Nigeria High Commission, London)	32
Figure 4 Gross primary school attendance ratio (GAR) for six zones (NPC, 2009)	35
Figure 5 University admission 2007/2008 (NBS, 2009).....	35
Figure 6 Submission to God: President Jonathan in Israel (AfricaSpotlight, 2013).....	37
Figure 7 (Left) Jonathan with Adebayo and wife. (2) Praying for Jonathan (Google).....	37
Figure 8 (1): Adebayo (right) with Buhari. (2): Adebayo (left) with Fashola. (Google)	37
Figure 9 Cartoonists’ depiction of the Brazilian revolt (Hochman, 2009).....	45
Figure 10 Polio victims in Northern Nigeria (The Guardian, Sept 14, 2000)	53
Figure 11 Typology of mass media effects (McQuail, 2005).....	93
Figure 12 Methods outlay showing time line for data gathering and analysis	101
Figure 13 Sample year and size (N822).....	109
Figure 14 Histogram of knowledge index	120
Figure 15 Zuma Rock with what looks like a human face (CRIENGLISH.com)	125
Figure 16 WPV cases and news coverage	134
Figure 17 Bi-plot of evaluation and main theme (2001 to 2009) N=212.....	145
Figure 18 Bi-plot of evaluation and themes (2001 to 2004) N=107	147
Figure 19 R output of evaluation, actors and themes (2001 and 2004) N=107	149
Figure 20 Bi-plot of evaluation and primary news value	162
Figure 21 Bi-plot of evaluation and modern technologies.....	164
Figure 22 R output for concatenated table of science news.....	166
Figure 23 Scree plot for trust structure	173
Figure 24 Histogram of distribution for independents, faith and public service	176
Figure 25 Scree plot for attitudes structure.....	177
Figure 26 Histogram of distribution for pessimism, progress and fear factors	180
Figure 27 Interaction: knowledge and fundamental attitude on fear	181
Figure 28 Interaction: knowledge and religiosity on progress.....	183
Figure 29 Interaction: knowledge and religiosity on the fear	184
Figure 30 Interaction: knowledge and gender on fear	184
Figure 31 Interaction: religiosity and gender on fear.....	185
Figure 32 Regression models (Otherwise=0; Progress=1).....	186

Figure 33 Regression models (otherwise=0); Pessimism=1)..... 187
Figure 34 Regression models (Otherwise=0; Fear=1)..... 188
Figure 35 Regression models (Otherwise=0; opposition to vaccination=1) 189
Figure 36 The Church inside the Lagos University Teaching Hospital complex 193
Figure 37 Cover of Tunde Kelani’s adaptation of ‘Magun’ 198
Figure 38 Global themes..... 202
Figure 39 Organising themes A 203
Figure 40 Organising theme B 204

List of Tables

Table 1 List of Nigeria’s heads of state	31
Table 2 Categorisation of Nigeria’s 36 states into zones	32
Table 3 Vaccine preventable diseases (MMWR, 2011).....	61
Table 4 Vaccines and associated diseases	62
Table 5 Vaccination resistance across cultures	64
Table 6 Paradigms, problems and proposals (Bauer et al., 2007)	77
Table 7 Vaccination resistance: Communication styles	85
Table 8 Methods of data elicitation	102
Table 9 Newspapers number of stories: entire corpus (643) sample (212)	106
Table 10 Positive and negative evaluation criteria.....	107
Table 11 Evaluation criteria for science in the media	110
Table 12 Reliability test for OPV content analysis	111
Table 13 Reliability test for <i>The Guardian</i> content analysis	112
Table 14 Pilot and main survey procedures	115
Table 15 Ranking of interest and being informed (N=377) compared with EU (2005)	118
Table 16 Ranking of engagement with science and religion (N=377).....	119
Table 17 Ranking of textbook knowledge of science for main survey (N=377).....	119
Table 18 Scientific literacy test by item difficulty (N=377) compared with EU (2005)	121
Table 19 Ranked statistics of attitude variables (N=377).....	122
Table 20 Cronbach’s Alpha for 13 attitude questions	122
Table 21 Percentage of Don’t Know responses to attitude questions (N=377).....	123
Table 22 Summaries of trust in leaders and scientists (N=377)	123
Table 23 List of interview participants (N=12 conducted September, 2012).....	129
Table 24 WPV cases and news coverage index (Polio N=4818; media coverage N=643) ..	134
Table 25 Newspapers and percentage coverage of vaccination (N=212)	135
Table 26 Themes and year of occurrence in column percentages (N=212).....	135
Table 27 Tabulation of primary themes and primary actors in percentages (N=212)	144
Table 28 Systems of communication adapted from Castro and Gomez (2005).....	144
Table 29 Tabulation of primary themes and evaluation in percentages (N=212)	144
Table 30 Inertia accounted for evaluation and themes 2001 to 2009	145
Table 31 Numerical solution for evaluation and themes 2001 to 2009.....	146
Table 32 Inertia accounted for evaluation and themes 2001 to 2004	147

Table 33 Numerical solution for evaluation and themes (2001 to 2004)	148
Table 34 Concatenated table of evaluation, actors and themes (2001 to 2009) N=212	149
Table 35 Inertia accounted for evaluation, actors and themes 2001 to 2009	149
Table 36 R output of numerical solution for actors, themes and evaluation	150
Table 37 Percentage of column inches for science news (N=822)	154
Table 38 Column inches per publication sample (N=822).....	155
Table 39 Year and primary news value in row percentages (N=822)	157
Table 40 Year and main agent in row percentages (N822)	157
Table 41 Year and Academic field in row percentages (N=822).....	158
Table 42 Source of news and primary news value in row percentages (N=822)	159
Table 43 Year and story writer in row percentages (N=822).....	160
Table 44 Systems of communication adapted from Castro and Gomez (2005) N=822.....	161
Table 45 Chi square values for genre analysis	162
Table 46 Inertia accounted for primary news value and evaluation.....	162
Table 47 Numerical solution for evaluation and primary news value	163
Table 48 Inertia accounted for strategic tech and evaluation.....	164
Table 49 Numerical solution for evaluation and modern technology	165
Table 50 Concatenated table for genres.....	166
Table 51 Inertia explained for three concatenated variables of science news	166
Table 52 R output of the numerical solution for concatenated table of science news.....	167
Table 53 Correlation matrix showing levels of significance for trust variables N=377	173
Table 54 Structure matrix for trust items (N=377).....	174
Table 55 Mean and standard deviation for trust variables.....	175
Table 56 Kendal Tau_b correlation matrix for attitudes N=377	176
Table 57 Structure matrix attitude items N=377	177
Table 58 Mean, standard deviation and skewness for attitude variables N=377	179
Table 59 Interaction effects.....	181
Table 60 Model statistics for progress.....	186
Table 61 Model statistics for pessimism.....	187
Table 62 Model statistics for fear	188
Table 63 Model statistics for opposition to vaccination.....	189
Table 64 Themes, organising themes and global themes.....	205

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Thesis overview

My thesis is about common sense making; how a new phenomenon, in this instance science, is absorbed into our existing pictures of the world drawn through personal and shared experiences, conversation, writing and other forms of communication.

We can only view the world through our existing pictures of the world. Thus, for the unfamiliar phenomenon, idea or concept to become familiar, we must integrate it into our existing categories in order to be able to name and classify it. However, at times these existing categories are threatened by the new, particularly science which has established itself as a reliable form of knowledge but when this happens, how we initially react is determined largely by our shared experiences of similar objects, our culture and aspirations. Thus, for new science to become fashionable, even as important as old and contemporary science have been to changing our lives, it requires public support at every stage, without which it will wither like a beautiful rose uprooted from the soil; the source of its life.

The oral polio vaccine controversy in northern Nigeria provides a case study for investigating how vaccination, the scientific method for preventing poliomyelitis and a new way of looking at the disease became a part of common sense. Moscovici's study of the reception of psychoanalysis in France (Moscovici, 1971; 1976) found that the images, ideas and languages shared by a group always seem to dictate the initial direction by which it tries to come to terms with the unfamiliar. A psychoanalyst's dealings with his patients was seen by some through the lens of priests and penitents and likened to a confession while others saw it as a symptom of an American invasion. In the Nigerian controversy, vaccination was seen by northern elites through the lens of a western world that is against Islam and it became part of a western conspiracy. For some Muslim clerics, it was seen as science playing God and described as un-Islamic. Yet for another group, the traditional healers, the OPV was a spiritual cure. For the federal government and international donor agencies, it was an effective vaccine. The controversy raises the question

of the relationship between science and religiosity in a country split between the two main Abrahamic faiths that exist alongside African traditional beliefs.

The first part of the research examines media coverage of the oral polio vaccine controversy from 2001-2009, to identify the representations and how they were formed, discarded or sustained in the process of sense making. Equally important to contextualise the vaccine coverage is the image of science in the media in the same decade. The third element of the research is a survey of knowledge, attitudes, interests and being informed, to map the culture of science in line with the National Science Foundation and Eurobarometer surveys. Two surveys were conducted; one online, one paper administered and the findings were then discussed in interviews designed to triangulate the data sources.

The media coverage of science was found to be generally positive, although differences do exist among the various fields of science and other categories used in the analysis. Coverage grew continually throughout the review period and more space was allocated to technology with medicine in second place. Coverage of the vaccination controversy was also generally positive but did not always mirror faithfully public opinion about the vaccine. The initial representations which led to the revolt against the vaccine were sustained by cultural resonance, sponsor activities and media practices. Public opinion eventually swung in favour of the vaccine and its acceptance. It was experience with the vaccine that determinedly swayed opinion, and not scientific assessment of risk, which was largely contradictory and controversial.

The survey findings show different levels of trust in public institutions and actors and surprisingly, scientists and religious leaders were similarly rated as high, while politicians and military were rated low. Factor analysis shows three sets of actors: faith/science comprising religious leaders and scientists; public sector comprising the judiciary, politicians and military; and, independents made up of foreign and local Non-Governmental Organisations. Factor analysis also shows that there are three latent variables in the set of attitude items in the main survey: pessimism, fear and progress. Analysis of variance shows a significant interaction

between knowledge and the two fundamental attitudes to the world on the fear factor with polarity of views at mid knowledge. The polarity was however reversed at the high knowledge level as those with an aesthetic perspective of the world show much less fear than those with an engineering view. The interaction with religiosity on the progress and fear factors also shows a polarity at high knowledge. The interaction with gender on the fear factor likewise shows a polarity at high knowledge indicating that high knowledge can be a distinguishing factor, and not necessarily a sign of more positive attitudes.

Regression analysis shows that average knowledge, average religiosity, trust and belief in destiny are good predictors of a progressive attitude to science. Trust is the only good predictor of pessimism, while gender and high knowledge are good predictors of the fear factor. Regression analysis also shows that respondents with very strong religiosity are not opposed to vaccination. Progress and engineering fundamental attitudes are also good predictors of support for vaccination. The association between knowledge and attitudes to science is thus not linear and simple, but complex.

The interviews confirm the results of the survey which shows the same levels of trust in religious leaders and scientists. Interviewees express a concurrent faith in God and science. These are two contrasting rationalities: one based on scientific evidence and the other on religiosity; a phenomenon Moscovici refers to as *cognitive polyhasia*. This perhaps illuminates the rationale for respondents who answered yes to the question “father’s gene decides sex of child” and also answered yes to “God determines sex of child.” Both science and religion are seen to have roles in determining the sex of a child. Having faith in God and science also offers plausible explanations for the reluctance by some respondents to agree with the scientific explanation for the evolution of man but this would be an antithesis in Europe where both are separate, but may align with the opinion of some groups in the United States and some other Eastern countries where they continue to exist side by side.

Research questions

The specific hypotheses to be tested are the following:

Hypothesis 1: The OPV controversy in Northern Nigeria

There are several theories on the effect of the mass media on public opinion. McQuail (2005) created a typology of media effects on a two-dimensional plane of time and intentionality on which are spread a series of hypothesis such as propaganda, agenda setting, framing, policy effects, social control and social integration (more in Chapter 3).

This research focuses on salience and genres of communication. We can infer, for hypothesis testing, that if coverage of the vaccination controversy is negative, public opinion about the vaccine will be unfavourable.

Null hypothesis: Media coverage of the oral polio vaccine in Nigeria was predominantly negative.

Alternate hypothesis: Media coverage was not predominantly negative.

Method of analysis: Content analysis of the coverage of the oral polio vaccine controversy in the Nigerian press from 2001 to 2009.

Hypothesis 2: Media coverage of science in Nigeria

Genre analysis and salience are also the focus of the second hypothesis that coverage of science issues is low (comparatively) and negative; an indication of public opinion about science, and this may have plausibly contributed to resistance to the vaccine.

Null hypothesis: Intensity of coverage of science (quantity of stories) in the Nigerian press was low and predominantly negative.

Alternate hypothesis: Intensity of coverage of science is comparable with other contexts (United Kingdom and the United States) and not predominantly negative.

Method of analysis: Content analysis of science news in the Nigerian press form 2001 to 2009.

Hypothesis 3: Trust in institutions (science, religion, etc.)

Both science and religion are used as a basis of statements about the truth (Gaskell, et al., 2010), a situation that is often interpreted as incompatible since one cannot have two truths about the same phenomenon. Thus, the more religious a person is; the more likely that person is to oppose

the scientific establishment. For science communication therefore, where trust is a compensation for deficiencies at a cognitive level (Neidhardt, 1993; see also Nisbet and Scheufele, 2009; Wynne, 1992), the more trust the public have in scientists, the less they have in religious leaders. However, religious belief is a substitute for risk in some societies (Giddens, 1999; 2002). The question, then, is can we have faith in God and scientists at the same time? Can a society concurrently expect both Magnetic Resonance Imaging devices and miracles? Scientists, Shaplin (2008) also argues, give an account of the natural world, but it is political expediency and politicians who decide on many of those potentially life changing decision. What are the levels of trust in these institutions?

Null hypothesis: Levels of trust in scientists and religious leaders in Nigeria are negatively correlated in the context of trust in other institutions.

Alternate hypothesis: Levels of trust in scientists and religious leaders are positively correlated.

Method of analysis: Factor analysis.

Hypothesis 4: Structure of attitudes to science

The analysis of attitudes to science has evolved from the construction of two aggregated indexes capturing benefits and risks, to one continuum measuring negative to positive, to an aggregation of four items, and most recently to measures of promise and reservations (Pardo and Calvo, 2002).

Gaskell et al. (2010) classify attitudes to technology as optimism or pessimism and Durant et al. (2000) as progress, panacea, future shock and pessimism. This research adopts the two-factor solution as the null hypothesis to allow the data to reveal itself, as it can only have more factors and not less having been designed with positive and negative scales.

Null hypothesis: 2 facets: optimism and pessimism characterize the attitudes of Nigerians to science and technology.

Alternate hypothesis: Attitudes are characterized by more than two facets.

Method of analysis: Factor analysis.

Hypothesis 5: Knowledge and attitudes I (fundamental attitudes)

The association between knowledge and attitudes to science is moderated by a fundamental attitude to the world, between an existential view and an engineering perspective.

Null hypothesis: There is no interaction between knowledge and fundamental attitudes to the world in the public's attitude to science.

Alternate hypothesis: There is an interaction between knowledge and fundamental attitudes to the world in the public's attitude to science.

Method of analysis: ANOVA for interaction effects.

Hypothesis 6: Knowledge and attitudes II (religiosity)

The association between knowledge and attitudes to science is moderated by religiosity.

Null hypothesis: There is no interaction between knowledge and religiosity in the public's attitude to science.

Alternate hypothesis: There is an interaction between knowledge and religiosity in the public's attitude to science.

Method of analysis: ANOVA for interaction effects

Hypothesis 7: Knowledge and attitudes III

Public understanding can be equated with factual knowledge of science (Gregory, 2001) leading to a situation of knowledge equals appreciation: the more you know it, the more you love it.

Null hypothesis: Knowledge and attitudes to science are positively correlated.

Alternate hypothesis: Knowledge and attitudes to science are not positively correlated.

Method of analysis: Binary logistic regression of attitude facets on knowledge.

Hypothesis 8: Public understanding of vaccination

Opposition to vaccination is associated with knowledge, religiosity, trust in institutions and persons and attitudes to science in Nigeria.

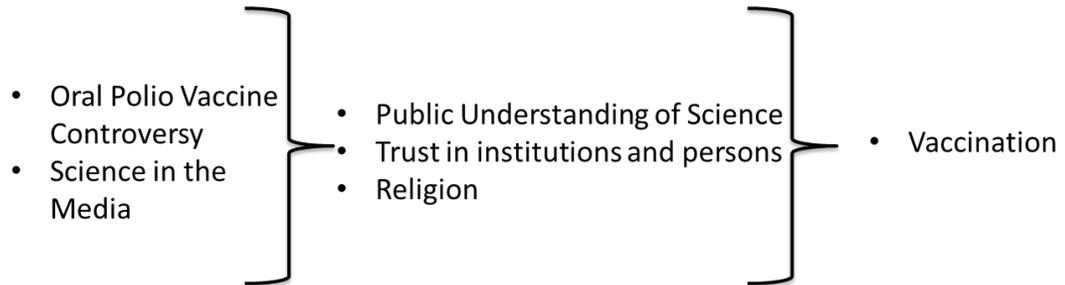
Null hypothesis: There is no association between Public Understanding of Science (PUS; knowledge, trust, attitudes) and opposition to vaccination.

Alternate hypothesis: There is an association between PUS (knowledge, trust, attitudes) and opposition to vaccination.

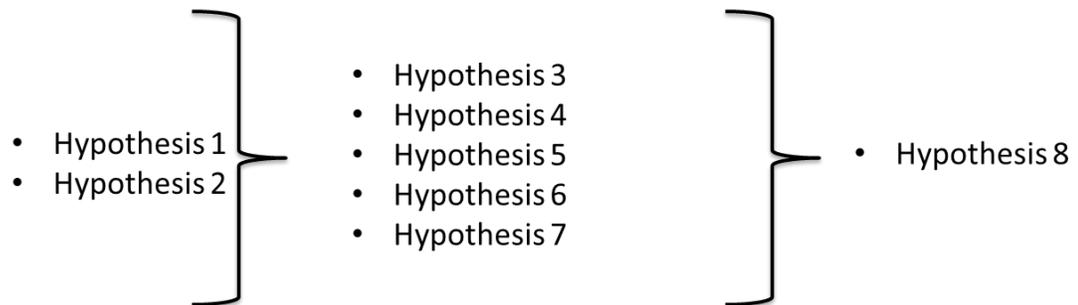
Method of analysis: Binary logistic regression.

Research model

Model for theoretical concept



Model for hypothesis testing



Chapter summaries

Here I present an overview of all eight chapters of the thesis to give a quick insight into what they contain and address as part of the whole narrative.

Chapter 1 The Nigerian context: Science in religious and tribal pluralism

In this chapter, I trace the history of Nigeria to reveal how its status as a country with several tribes, regions and religions emerged. It describes the emergence of Islam in the north and Christianity in the south, the continued existence of the African traditional religion they sought to replace and the scientific method. The coexistence of several faiths, tribes and science is a reminder of the plurality of common sense, but also a source of tension among faiths and with science. Against this background unfolded the revolt against the oral polio vaccine (OPV) in Northern Nigeria between 2003 and 2004 described by antagonists as a western conspiracy against Muslims. The controversy, which split the country along the North/South divide, provides the stimulus for this study.

Chapter 2 Public resistance to vaccination programmes

This chapter examines some occurrences of vaccination resistance in 18th and 19th century Europe and America. Controversy resurfaced in the 20th century in the United Kingdom as well as Tanzania, Cameroon, Uganda and Kenya, while in Nigeria, resistance to the OPV marked the early part of the 21st century. I examine the main issues of the Nigerian controversy between 2001 and 2009, the disease aetiology, choice of OPV and its limitations in controlling the disease in Northern Nigeria. The current debate over the continued use of vaccines, especially in communities already free of the disease, is also examined, as well as the link between vaccination and rising incidences of diseases such as asthma, autism and diabetes in children.

Chapter 3 Theoretical elaborations: Science in common sense

This chapter provides the theoretical perspective for the study. The vaccination controversy in Nigeria revolved around public perception of risk and/or the public understanding of science,

trust in actors (both local and international) as sources of risk or science communication and conflict between science and religion, among others, in the process of familiarization with the oral polio vaccine. Here, I examine two perspectives of science in society, namely; the risk and Public Understanding of Science (PUS) paradigms recognising that both have converged on the contextual models. Moscovici's Social Representations Theory provides a framework to examine both the risk and PUS perspectives. The Social Representations Theory is elaborated, as well as the plausible roles of media and public opinion in sense making.

Chapter 4 Methodology: Triangulation of multiple data streams

The research involves a triangulation of various sources of evidence including media archives, surveys and interviews. Using content analysis, I examine science in the media and also how the media covered the OPV controversy. Both analyses span 2001 to 2009 covering the period before and after the 2003 to 2004 revolt against the OPV. A pilot online survey was conducted with respondents living in Nigeria and abroad (N=168). The main survey (N=377) was conducted in Lagos, South West of Nigeria, which has a population in excess of 15 million. Finally, interviews were conducted with Nigerians from various tribes and faiths to triangulate the other findings. The study also gains from past and contemporary history through books and films of local culture.

Chapter 5 Results 1: Science in the mass media

This chapter examines science in the Nigerian media from two perspectives: the general and the particular. The purpose is to categorise actors, themes, events, etc. These categories, when combined with evaluation present an estimation of the different fields of science and technology in local culture. Content analysis turns words to numbers and correspondence analysis turns numbers into a geometrical representation for easy identification of the genres of science news. The overarching objective is to construct a map of the public's mind about science: what the newspapers draw attention to, what they tell the public to think about its value as a loss or a gain, and the likely consequences for science and society.

Chapter 6 Results 2: Public understanding of science

This chapter presents the results of the expanded survey which was designed with major input from the Eurobarometer, National Science Foundation, Taiwan and Malaysia science in society surveys and was administered mainly in Lagos State, South West Nigeria. There were 377 respondents. Factor analysis is used to examine the latent dimensions of trust in leaders and organisations and attitudes to science variables. The factor scores were used in Analysis of Variance and logistic regression models.

Chapter 7 Results 3: Living with science and God

This chapter looks at how modern day Nigerians live with science and God. It presents the results of interviews conducted on the relationship between God and science and whether the interviewees consider it contradictory or complimentary, or if they place one ahead of the other. This follows survey results which found that answers to some knowledge questions may have been influenced by religiosity. The interviews also examine the relationship between Islam and Christianity, the North and the South and the possibility of science acting as a bridge between the two Abrahamic faiths and the countries' peoples.

Chapter 8 Summary and recommendations for future research

This chapter summarises the results of the research which shows that science is part of common sense but the acceptance of any new scientific phenomenon depends on public opinion. Notwithstanding the revolt against the oral polio vaccine, the research shows that the people of Nigeria are not anti-science, rather they hold both science and religion in high esteem. They trust scientists, just as they trust God and see no contradiction. They believe in miracles just as they look up to MRI's for health and wellbeing. The chapter also makes recommendations for future research.

1.1 Introduction

In this chapter, I trace the history of Nigeria to reveal how its status as a country with several tribes, regions and religions emerged. It describes the emergence of Islam in the north and Christianity in the south, the continued existence of the African traditional religion they sought to replace, and the scientific method. The coexistence of several faiths, tribes and science is a reminder of the plurality of common sense, but is also a source of tension among faiths and with science. With this background unfolded the revolt against the oral polio vaccine in Northern Nigeria between 2003 and 2004 described by antagonists as a western conspiracy against Muslims. The controversy, which split the country along North/South divide, provides the stimulus for this study.

1.2 The Oral Polio Vaccine Controversy

The international drive to eradicate poliomyelitis, a highly infectious disease spread by a virus that kills or paralyses from the waist downwards, began in 1988, with the Global Polio Eradication Initiative (GPEI) spearheaded by the World Health Organisation (WHO), Rotary International, the United States Centers for Disease Control and Prevention (CDC) and UNICEF (WHA, 1988; WHO, 2005; 2008). This move followed the successful eradication of smallpox in 1980 and the goal was to rid the world of polio by 2000. Although the 2000 goal was not met as a global target, substantial gains were made through the routine immunisation of infants with trivalent oral polio vaccine (tOPV), supplemental national or regional rounds of tOPV among young children, active surveillance of acute flaccid paralysis and rapid response to disease outbreaks (Modlin, 2010). According to Modlin, by year 2000 cases had fallen by 99% to fewer than 1000 annually, continuous endemic transmission was halted almost everywhere and the

extinction of Type 2 wild-type (naturally occurring) polio virus proved that eradication was possible.

In line with the goals of the GPEI, African leaders in 1996 launched the polio eradication campaign tagged “Kick Polio out of Africa.” That year, polio was rampant in 41 African countries, but by 2002 most countries, including several states in Southern Nigeria, were declared free of the disease (WHO, 2005). As part of the global effort, national immunisation days were set aside in Nigeria by the federal government (four days set aside to administer over 40 million doses of the tOPV nationwide) commencing in the last quarter of the year 2000. This campaign was resisted from the onset by some religious leaders in the north who described the exercise as being against Islamic injunctions (Ogundipe, 2001; 30/01/2001) and rumours of contamination with the AIDS virus were also widespread (Abuh, 2002; 17/04/2002). The crisis was further aggravated in July 2003, when in the midst of a nationwide campaign, two very influential Islamic groups in the North: the Supreme Council for Shari’ah in Nigeria (SCSN) and the Kaduna State Council of Imams and Ulama held a news conference during which they declared that the vaccine contained anti-fertility substances and was part of a western conspiracy to reduce the population of the developing world (Madugba, 2003; 16/11/2003). Given the revered status of the two groups among Muslims, the stage was set for a major revolt. Notably however, politicians in the south campaigned for the use of the vaccine (Obinna, 2003; 14/10/2003, Nkwopara, 2004; 20/02/2004) thereby distancing themselves from the western conspiracy theme. The country was split along regional and religious lines on the issue and it soon transformed from a conspiracy against the developing world to one against Muslims. The revolt peaked when some states in Northern Nigeria banned the use of the OPV citing its “contamination by sterilizing substances” (Sabiou and Shobayo, 2003; 27/10/2003). The ban raised world-wide fears of the reversal of the gains already made and between 2003 and 2005, several previously polio free countries, including Nigeria’s neighbours: Ghana, Benin, Chad, Niger, Burkina Faso and Togo were re-infected (UNICEF, 2009). The rumours of a western plot

to sterilise Muslims even spread beyond Africa to Pakistan where some clerics issued a ‘Fatwa’ or decree against vaccination (New Scientist, 2007).

Vaccination, the scientific method for disease prevention and eradication, became enmeshed in local and international politics. It became a war between God and science. What the different peoples, faiths and regions of Nigeria made of the oral polio vaccine reflected the social nature of common sense as people sought to familiarise the unfamiliar (more on this later in theoretical perspective). Understanding this process of familiarisation requires some background knowledge of the history and composition of the common sense of the people of modern day Nigeria before and after colonisation and the relationship between God, gods, regions and science.

1.3 The emergence of religious and tribal pluralism

“At last Ezinma was born, and although ailing, she seemed determined to live. At first, Ekwefi accepted her, as she had accepted others – with listless resignation. But when she lived on to her fourth, fifth and sixth years, love returned once more to her mother, and with love anxiety. She was determined to nurse her child to health, and she put all her being into it. She was rewarded by occasional bursts of health during which Ezinwa bubbled like a fresh palm-wine. At such times she seemed beyond danger. But all of a sudden she would go down again. Everybody knew she was an Ogbanje.”

- Chinua Achebe in *Things Fall Apart* (Achebe, 1958; 2010, p. 57)

Ekwefi, Ezinma’s mother, in Chinua Achebe’s classic novel about life in Igbo land, South Eastern Nigeria in the 1890s, had given birth to ten children, nine of whom had died before the age of three. Her husband, Okonkwo, after the death of their second child, had gone to a medicine man, who was also a diviner of the Afa oracle on their predicament. The priest told him the child was an Ogbanje, “one of those wicked children who, when they died, entered their mother’s womb to be born again.” Achebe said the medicine man’s antidote was that there should be no mourning and he used a razor to mutilate the dead child, dragged it on the streets and buried it in the “Evil Forest.” The belief was that after such treatment, it would think twice

before coming again, and if it did, would carry the stamp of their mutilation. But for Ekwefi and Okonkwo, the next one came and died. One was named Ozoema – meaning may it not happen again, but she died in her 11th month and two others after her and the next was called Onwuna – meaning death may please himself, and surely death did. Ekwensi’s *Things Fall Apart* (Achebe, 1958; 2010) along with two other novels, “No Longer at Ease” and “Arrow of God”, form Achebe’s chronicle of the cultural and political changes that brought about what is now seen as a modern African state.

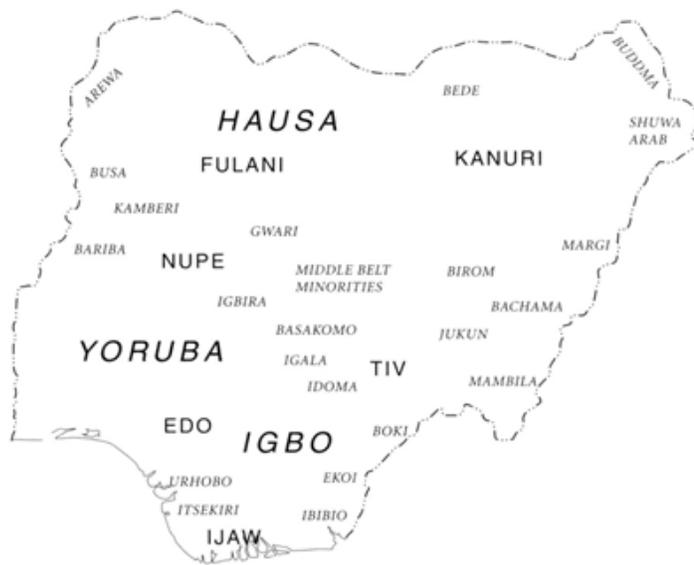


Figure 1 Ethnic distribution in Nigeria (Paden, 2005)

The Igbo are one of Nigeria’s three main tribes in a country with over 370 ethnic groupings (NPC, 2009). In other parts of southern Nigeria, the myth of the Ogbanje was similarly feared by all. Among the Itshekiri tribe, like the Igbo, it was called Ogbanje but the Yoruba named it Abiku. According to Odebode and Onadipe (2011), Abiku was believed to belong to a band of demons and they were given names like Beyioku - meaning if this one does not die, and Ikuforiji - death has forgiven, and if it died again the body was also mutilated to recognise them. What the Igbo call the Afa oracle is what the Yoruba call the Ifa oracle and the Hausa call Bori. There are however, other “messengers of God” bearing several names. Bori, according to Anderson, (2002), an anthropologist who studied the group in Jos, Northern Nigeria, was often described

by academics as a pre-Islamic spirit possession cult. Muslim sceptics, he observed, refer to it as a “falsity” while the practitioners themselves associate it with illness and healing. Anderson said he found the distinction between Islam and Bori quite blurred and current theories of being a cult were more of a perspective than simply true or false. The Ifa as a divination system, according to Abimbola (1994) can be found among many tribes in Nigeria and West Africa and was exported to the United States, Puerto Rico, Venezuela, Brazil, and other parts of the world during the slave trade. Professor Abimbola, former Vice Chancellor of Obafemi Awolowo University, South Western Nigeria argues that it has become the cornerstone of Yoruba culture in spite of increasing Christian and Islamic evangelical activities in West Africa. The Yoruba, he said, believe in Ori, a concept of destiny which is, however, counterbalanced by an equally salient belief in free will. Ori is what the Igbos call Chi; a star that a person is born with that predetermines their course through life.

Also, Daniel Fagunwa MBE, a teacher, pioneered Yoruba language novels with “Ogboju Ode Ninu Igbo Irumale” in 1938. All Fagunwa’s books examined the relationship between African beliefs and Christianity and are generally acknowledged as compelling narratives dealing with the process of Black Africa’s march into modernity (George, 1997). However, is this march into modernity one without gods? Nobel laureate in literature, Professor Wole Soyinka’s storytelling of his childhood days in Abeokuta, South Western Nigeria (Soyinka, 1989), includes accounts of the relationship between Christianity and spirits called Egungun (ancestral masquerade). One of the narratives in his autobiography titled: *Ake: The years of childhood*, was of an encounter between the Egungun and Revd. J. J. Ransome-Kuti, one of the early converts to Christianity and a missionary in Abeokuta. J. J., as he was fondly called, had been warned not to preach on a particular day, which was the day for an Egungun outing, but he persisted and held the service. The Egungun approached while the service was in progress and, using his ancestral voice, called on the preacher to stop and come to pay obeisance, but J. J. ignored him. The Egungun, on passing the main door of the church, tapped on it with his wand three times. The last member of

his procession had barely left the church premises when the building collapsed. Miraculously however, Soyinka writes, the walls fell outwards while the roof supports fell along the aisles or fell outwards - anywhere but on the congregation itself. J. J., according to Soyinka's narrative, then calmed the worshippers, paused in his preaching to render thanksgiving prayer, and then continued his sermon. Even the Egungun respects God and his followers, while at the same time stamping their authority, the story implies. The old belief in spirits and the new Christian God of the colonial masters exist side by side in the population, one not subsumed by the other, both constantly expressing their powers to achieve the miraculous.

The history of northern Nigeria is interwoven with the spread of Islam. "Rawan Bagaja: The Water of Cure" (Iman, 1934: 1978) was the first of several books written by Alhaji Abubakar Imam in Hausa language in 1934. Rawan Bagaja was a narrative about life in the northern region, the place of Islam, the belief in the supernatural and an acknowledgement of the historical links between Judaism and Islam. In northern Nigeria, Ogbanje is called Wabi in Hausa language while paralytic polio is called Shan-inna. Among the Hausa communities, both Muslim and minority Christians, Shan-inna is a powerful female spirit that consumes the limbs of human beings and traditional healers who are well respected are believed to have powers that enable them to interact with the spirit world (Yahaya, 2007). The belief in the spiritual dimension to disease is quite entrenched in the population and one of the traditional healers even referred to the polio vaccine as "a spiritual cure produced by the white man" (Yahaya, 2006).

The north is home to numerous ethnic groups and religious communities, but the predominant tribes are the Hausa, the Fulani and the Kanuri. The three are predominantly Muslim while many of the smaller ones, about 160, are Christian or animist (ICG, 2010). Between the 11th and 17th century, Islam was introduced largely peacefully by clerics and merchants from North Africa, the Arab world and from across West Africa. In the 19th century, a Fulani preacher, Shehu Usman Dan Fodio led a jihad, aimed at purifying Islamic practices throughout the region, which

overran the then 14 Hausa states and installed Fulani Emirs. The rulers entrenched Islamic values and applied Sharia laws more rigidly (ICG, 2010).

Over 95 per cent of Nigeria's Muslims are Sunni, belonging to either the Qadiriyya or Tijaniyya Sufi orders. These orders are represented by a number of organisations including the Jama'atu Nasril Islam (JNI), the Nigerian Supreme Council for Islamic Affairs (NSCIA) headed by the Sultan of Sokoto and the Supreme Council for Shari'ah in Nigeria (SCSN). The others are a Shiite minority, although in some cases, the label Shiite refers more to a radical political attitude and admiration for the Iranian revolution than to doctrinal differences (ICG, 2010).

Be it in the north or the south of Nigeria, Ifa, Afa, Egungun, Islam and Christianity were part of common sense before, during and after colonial times. Just as Shehu Usman Dan Fodio's jihad had hoped for a purification of Islam and the entrenchment of Shari'ah law in the Muslim north, the Christian missionaries and the colonial lords had also hoped for a cleansing of the south of its several gods and their replacement with God. Did the communities abandon their gods for God after colonisation? Three outcomes were visible from these attempts at changing common sense, by either the jihadists or the missionaries: outright rejection, outright acceptance and those who mix both by expanding their common heritage to include the new ways.

The drama at the Okija shrine in Anambra State, South East Nigeria exemplifies this curious combination of God and gods in modern day Nigeria. According to Ellis (2008), the police found that several rich people and politicians who were publicly prominent Christians, had links to the shrine. The emergence of the Bakassi Boys in South Eastern Nigeria in the last decade is another case in point. According to Smith (2004), their tremendous popularity reveals complexities and contradictions and draws on idioms of accountability rooted in the supernatural. For McCall (2004) the rise of 'folk justice' is due to the disenchantment of the public with the scientific methods used by the regular police and the need for more supernatural means to fish out and punish criminals. For Paden (2005), all the religions rest on a solid foundation of

African cultural traditions and religious identity may not have the same meaning in Nigeria as it does elsewhere, whether in Saudi Arabia or Texas.

Despite the multiplicity of tribes and religion, Nigeria's interwoven groups share very strikingly similar ways of naming and classifying events and objects. Abiku, Ogbanje, Wabi, Shan-inna refer to the same phenomenon, a world full of spirits and the traditional way to appease them is through the oracle, be it Ifa or Afa or Bori. God or gods, the boundaries have become fuzzy and it's more like finding a place on a sliding scale. According to Adedayo, (2010) it is the why, and not the how, which sets the three faiths apart from one another. Wale has been part of all three religions. He was born a Muslim, converted to Christianity and is a believer in the efficacy of the African traditional religion.

1.4 The emergence of democratic pluralism

Nigeria occupies a land area of 923,768 square kilometres; much bigger than France (643,801), about three times the size of Germany (357,022) and about four times the size of the United Kingdom (243,610). It's the 8th most populous country in the world with a population estimate of 170 million (140m by 2003 census) accounting for roughly one-fifth of the population of Africa, but 14th largest in terms of size.

Most of Nigeria was conquered by the British between 1880 and 1905. First, the south along the coast (Southern Region) and later, the north (Northern Region) and there were various separate cultural, ethnic and linguistic groups including Oyo, Benin, Nupe, Jukun, Kanem Bornu and Hausa Fulani empires. The colonial lords identified three distinct political and cultural components in the north: the Sokoto empire also called the Fulani empire; the Borno empire (or Kanuri empire) and the minorities of the middle-belt. The south comprised the Yoruba of the south west, the Igbo of the south east and the minorities in the mid-west and the east (Paden, 2005). While in the south, the people were governed directly and the traditional rulers were relegated, in the north, the people were ruled indirectly through the traditional rulers.

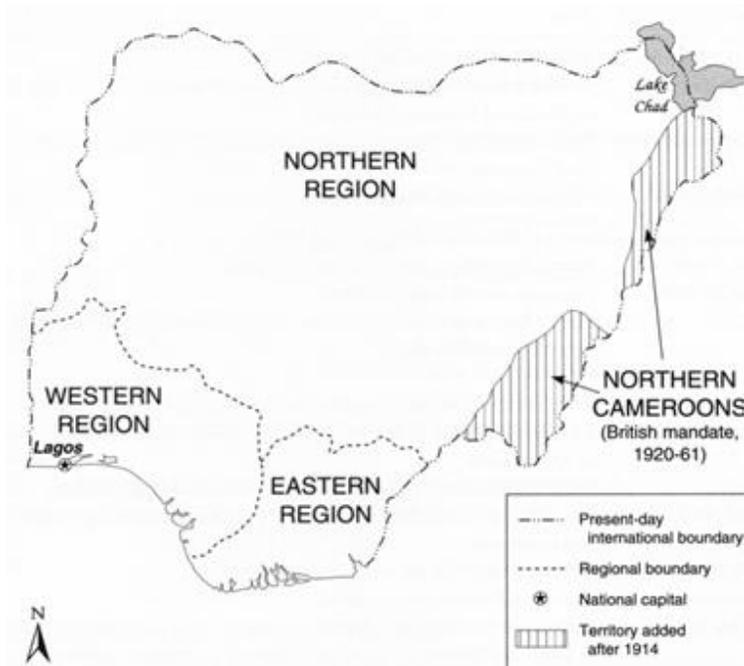


Figure 2 Nigeria on unification (Source: Library of congress/Paden, 2005)

While in the south, the people were converted to Christianity, in the north, they were allowed to keep their faith. It was Lord Frederick Lugard, appointed governor of both regions in 1912, who merged the two in 1914 and called it Nigeria.

Shortly before independence, the colonial masters whittled down the powers of the Sultan of Sokoto and the emirs and also expunged the Shari'ah, the moral code and religious law of Islam, from the legal system on the grounds that some of its provisions were incompatible with the rights of all citizens in a religiously plural society and replaced it with a milder penal code (ICG, 2010). The emirate system was a centralised form of government that placed the ultimate decision making in the hands of the emir, whose influence or decisions on religious and political matters remains very strong today (Paden, 2005). The system was similar to the reign of Oba's in the south west, but the Igbo had a decentralised system and decision making rested, not on one man, but a council of elders.

Following decolonisation and constitutional talks, Nigeria was granted full independence in 1960 as a federation of three regions: Northern, Western and Eastern, with a parliamentary

system of government. The regional tribal arrangement was immediately apparent in the parties that formed governments in the three regions. The Northern People's Congress (NPC) dominated by the Hausa/Fulani won the elections in the north; the Yoruba dominated Action Group (AG) in the west and the National Council of Nigeria and Cameroons (NCNC) led by an Igbo man held office in the east. The first republic was short-lived as a crisis in the Western Region snowballed into a national crisis that culminated in the country's first military coup. The January 1966 coup, led by officers from the south failed and the country's most senior military officer, Major-General Aguyi Ironsi, an Igbo man from the east took over as head of state. Ironsi was killed six months later in another coup led by officers from the north following which Lieutenant Colonel Yakubu Gowon, a northerner was made Head of State on 1st August 1966. The crisis led to the declaration of independence by the Eastern Region and the formation of the Republic of Biafra. The civil war of unity or independence, depending on which side was making the argument, lasted from July 1967 to January 1970 when the Eastern region surrendered to federal forces.

Date	Name of ruler	Status	Religion	Origin	Comments
1/10/1960	Tafawa Balewa	Civilian	Muslim	North	Killed in a coup
16/01/1966	Aguiyi-Ironsi	Military	Christian	East	Killed in a coup
1/08/1966	Yakubu Gowon	Military	Christian	North	Deposed in a coup
29/07/1975	Murtala Mohammed	Military	Muslim	North	Killed in a coup
13/02/1976	Olusegun Obasanjo	Military	Christian	West	Elections
1/10/1979	Shehu Shagari	Civilian	Muslim	North	Deposed in a coup
31/12/1983	Muhammadu Buhari	Military	Muslim	North	Deposed in a coup
27/08/1985	Ibrahim Babangida	Military	Muslim	North	Resigned
26/08/1993	Eanest Shonekan	Civilian	Christian	South	Deposed in a coup
17/11/1993	Sani Abacha	Military	Muslim	North	Died in office
8/06/1998	Abdulsalami Abubakar	Military	Muslim	North	Elections
29/05/1999	Olusegun Obasanjo	Civilian	Christian	West	Completed 2 nd Term
29/05/2007	Umaru Yar'Adua	Civilian	Muslim	North	Died in office
9/02/2010	Goodluck Jonathan	Civilian	Christian	East	Still in office

Table 1 List of Nigeria's heads of state

Paden (2005) argues that the levels of religious commitment, belief and practice are extremely high among Christians and Muslims alike and secularism is a minority perspective in Nigeria. Thus, strategic to Nigeria's stability and development, he argues further, will be a political

system that recognises and balances ethno-religious and regional diversity. His views are reflected in current attempts to balance power at the federal level which has led to a principle which effectively rotates office between the two regions and religions. Thus, if the president is from the north, the vice president will be from the south, and if the president is a Christian, the vice president is expected to be a Muslim. This has not been made a constitutional issue and the recent controversy over the OPV exposed its limitations. Can a Christian president preside over issues seen as Islamic?

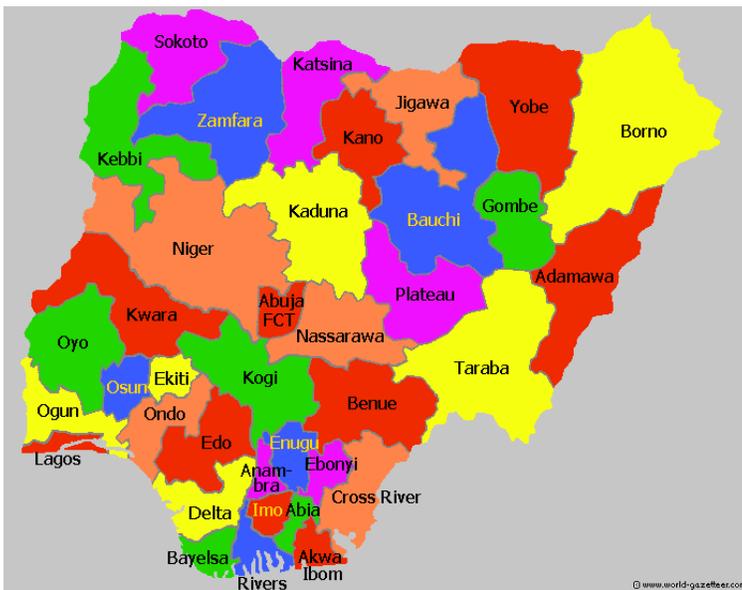


Figure 3 Map of Nigeria’s 36 (Nigeria High Commission, London)

The quest by the nation’s leaders to unite the country’s various tribes and religions has led to its partition several times from three regions to the present 36 states and a federal capital territory.

North West zone	North East Zone	North Central Zone	South West Zone	South East Zone	South South Zone
Sokoto	Borno	Plateau	Lagos	Edo	Enugu
Zamfara	Yobe	Benue	Oyo	Delta	Imo
Katsina	Gombe	Nasarawa	Ondo	Rivers	Abia
Kebbi	Bauchi	Kogi	Ogun	Akwa Ibom	Ebonyi
Kano	Adamawa	Kwara	Ekiti	Cross River	Anambra
Jigawa	Taraba	Niger	Osun	Bayelsa	
Kaduna		FCT			

Table 2 Categorisation of Nigeria’s 36 states into zones

The country also changed from a parliamentary system of government which was bequeathed to it at independence to a 3-tier presidential system involving federal, state and local government

councils. In recent years, the states have been further categorised into six zones (North West, North East, North Central, South West, South East and South South) in an arrangement that further breaks the old Northern and Southern Regions into three entities each.

For most of colonisation, the north and south were governed under different laws and some aspects of the country's judicial system remain separate with different legal regimes dividing the north and south. The Shari'ah which was expunged by the British shortly before independence has been re-introduced as a body of laws in some states in the north to operate alongside Nigeria's secular laws, but not in the south. The states are Zamfara, Kano, Sokoto, Katsina, Jigawa, Bauchi, Borno, Kebbi and Yobe. Another three: Kaduna, Niger and Gombe, have Sharia Law in some parts which have large Muslim populations.

1.5 Science, religion, regions and democracy

While Christianity and Islam offered comfort for the bereaved of Ogbanje, (Achebe, 1958; 2010) they did not offer an explanation as to the cause, prevention or cure. The explanation came from another source; science, and one of its methods of inquisition, genetics. The reason so many babies died from the same woman was because of the sickle cell trait. Such babies often die young since the sickle cells are fragile, prone to rupture and can block blood vessels leading to organ damage and severe pain.

The traditional medicine men, although may have exaggerated their claims to have powers to intervene in the spirit world, were fairly successful in their claims to therapeutic herbal medicine. Some of their herbal mixtures have now been found by scientists to be fairly effective in managing pain and anaemia and are being prescribed as dietary supplements for sickle cell patients. Among those currently in use, according to Imaga (2010) are Fagara root noted for its anti-inflammatory properties which reduce pain and Niprisan (Nix-0699), a product of the extracts of four different kinds of plants and pigeon pea. Jobelyn, made from Sorghum extracts has also been proven as a viable substitute to folic acid in increasing blood count and reducing or

eliminating the need for transfusion for sickle cell patients (Erah, et al., 2003; Okochi, et al., 2003a; Okochi et al., 2003). Okochi et al. (2003; 2003a) observe that scientists are now being compelled to focus on identifying and standardising herbal medicine since the public believe in their efficacy and often cannot afford the high cost of western drugs and treatment. A World Health Organisation report (WHO, 2002) also observes that the use of traditional medicine remains widespread in developing countries due to affordability, accessibility and for historical and cultural reasons.

Malaria is another disease which is more deadly than the sickle cell and has been the cause of thousands of deaths for generations in the tropics. Despite the existence of a cure, in 2007 alone, there were 5.3 million reported infections of which an estimated 10,000 people died (NPC, 2009). Other problematic diseases include HIV/AIDS, pneumonia, tuberculosis, tetanus and cerebrospinal meningitis (NPC, 2009; NACA, 2012). While diseases such as smallpox and river blindness have been effectively controlled through the introduction of scientific remedies and practices, others like measles, diphtheria, mumps, polio, rubella and pertussis are being managed with preventive vaccines.

Science and technology have contributed significantly to the growth and development of the country and continue to do so. The decade 2000 to 2010 saw a massive expansion of telecommunication activities across the country. From less than 900,000 telephone land lines and a teledensity of 0.73 in 2001, to 111 million Global System for Mobile Telephony (GSM) lines and a teledensity of 63.1 in 2010 to a further 124 million GSM lines of which 95 million were active in 2011 (NCC, 2013). However, the country constantly grapples with severe fuel shortages, frequent outages, and gas flaring. Even the rapid spread of mobile telephony is evidence of the inherent failures of domestication of science, as many Nigerians own more than two mobile phones belonging to different networks due to regular disruption of services. Poor domestication of technology has far reaching implications for the image of science and technology in general.

The International Crisis Group (ICG, 2010) notes that there is some degree of admiration for science in the country, but with apprehension about western culture and values since they are often seen as morally deviant and a threat to local values. Muslims in the far north, the 2010 report states, view international affairs in terms of a subtle but continuous conflict between a Judeo-Christian West and an Arab centred Islamic world. This is different from the southern perspective. Western education, using primary school enrolment and university places as indicators shows a striking disparity between the core North (East and West) and the South.

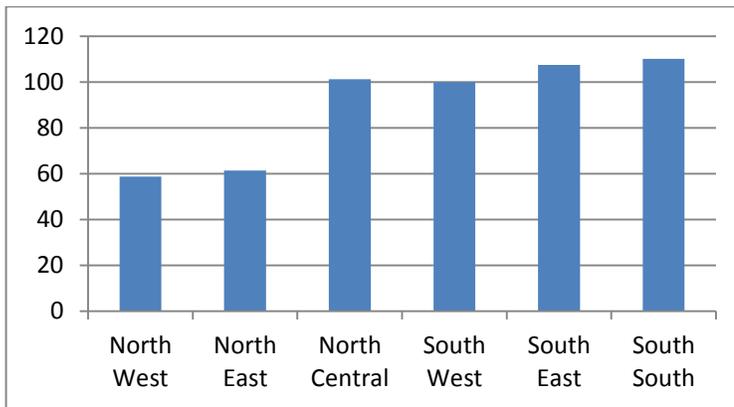


Figure 4 Gross primary school attendance ratio (GAR) for six zones (NPC, 2009)

(Note: The GAR for primary schools is the total number of primary school students, expressed as a percentage of the official primary-school-age population. If there are significant numbers of over-age and under-age students at a given level of schooling, the GAR can exceed 100 per cent (NPC, 2009)).

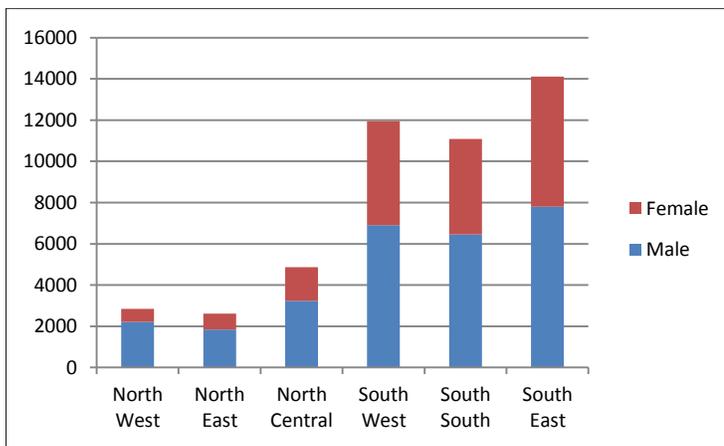


Figure 5 University admission 2007/2008 (NBS, 2009)

It must be noted however, that Koranic schools flourish in the North and may be taking away children expected to register for a western style education. There are also differences in university enrolment, which is lower in the north than south.

Also, the ‘war on terror’ (ICG, 2010) is seen as a Christian-Western campaign against Islam, and local Christians are seen as moral collaborators. So, it was not surprising that it became part of the debate over the oral polio vaccine as actors queried the motives of the Western sponsors of the exercise. Appeals from the president of Nigeria at that time, Olusegun Obasanjo, a Christian from the South fell on deaf ears, as it was hard to convince the doubters that the southern elites were not collaborators. In 2003 when the crisis reached its peak, the Minister of Health, Professor ABC Nwosu, the head of the National Immunisation Programme, Dr (Mrs) Dere Awosika, and her counterpart in the National Agency for Food Drug Administration and Control, NAFDAC, Dr (Mrs) Dora Akunyili were Christians from the South. The change of leadership in Kano state from Governor Rabiun Kwankwaso of the People’s Democratic Party, who openly campaigned for the acceptance of the vaccine (Abuh, A. 2002, 17/05/2002) to Ibrahim Shekarau of the opposition All Nigeria’s Peoples Party (ANPP) who banned the use of the vaccine (Abuh, 2004; 24/02/2004) also shows the effects of party democracy and its accompanying policy polarity on the public perception of science.

Also, democracy by western standards rests on the separation of the church and state but it has become increasingly clear over the last decade, particularly in the aftermath of the Arab spring, that this may not hold in other democracies; the state and religion seem inseparable.

The pictures below illustrate this. Nigeria’s president, Goodluck Jonathan in October 2013 went on a pilgrimage to Israel with several Christian governors and the pictures were broadcast worldwide. He was seen praying at the Wailing Wall and kneeling in front of a host of pastors including the president of the Christian Association of Nigeria at the tomb of Jesus Christ (Figure 6). Jonathan has also been pictured praying at the Redemption Camp (Figure 7) of the Redeemed Christian Church of God before Pastor Adejare Adeboye, arguably one of the country’s most influential men and once named by NEWSWEEK (Miller et al., 2009) as one of the top 50 most influential people in the world.



Figure 6 Submission to God: President Jonathan in Israel (AfricaSpotlight, 2013)



Figure 7 (Left) Jonathan with Adeboye and wife. (2) Praying for Jonathan (Google).

The opposition has not been left out of the parade. The leader of the Congress for Progressive Change, former Head of State, General Muhammadu Buhari, a northern Muslim has also visited Pastor Adeboye as the picture below shows and the Lagos State governor, Raji Fashola of the Action Congress Party, a southern Muslim has also identified with the revered pastor. Religion is a strong identity for politicians and is seen by many as key to political survival.



Figure 8 (1): Adeboye (right) with Buhari. (2): Adeboye (left) with Fashola. (Google)

A BBC poll (BBC, 2005) titled “What the world thinks of God” showed that of 10 countries (Nigeria, Indonesia, Russia, UK, India, Lebanon, Israel, Mexico, S. Korea and USA), Nigerians ranked highest on most of the questions including “I have always believed in God” and “I would die for my God/belief.” More than 90% of those surveyed in Nigeria and Indonesia would give their lives for their faith compared with just 19% in the United Kingdom. The United States however seems to tread a different path from the UK. While 95% of those polled in Nigeria said they pray regularly, 28% prayed in the UK but in the US, the figure was 67%. A total of 91% of Nigerians claimed to regularly attend religious services compared with about 54% in the US and 21% in the UK. Also while the Nigerian and US respondents ranked 9th and 8th (both 6%) respectively in agreement with the question “the world would be a more peaceful place if people didn’t believe in God,” the UK ranked first with 29% saying they agreed.

There is an obvious divergence between the two western nations, the UK and US, on the existence of God. Habermas (2006) observed that the wave of secularisation in almost all European countries since the end of the World War II contrasts with data from the US which shows a comparatively large proportion of the population made up of devout and religiously active citizens has remained constant. The European states, according to him, appear to have kept moving forward alone on that path, which ever since the two constitutional revolutions of the late 18th century, they had trodden side by side. Habermas also claims that the split with the West is perceived as if Europe were isolating itself from the rest of the world. For Christiane Amanpour, CNN’s Chief International correspondent, during the last few decades, each faith (Islam and Christianity) has exploded into powerful political forces comprising followers who share dissatisfaction with modern society, and a determination to place God and religion back into daily life and to the seats of power (CNN 2011a; Abdullah, 2006). She was speaking at the second annual Clinton Global Initiative titled: “In God’s name.” Speakers included Bill Clinton; Israel’s vice premier (now president), Shimon Peres; and, Queen Rania Al-Abdullah, wife of the King of Jordan. The gathering was to look for solutions to the growing unease between western

countries and Islam and shows how important the issue has become on the international arena. Former British Prime Minister, Tony Blair, has also set up a Faith Foundation which seeks to promote respect and understanding between the major religions. Religion, he argues, has a major part to play in shaping the values which guide the modern world and its voice should be heard (Munk debates, 2011; CNN, 2011b).

1.6 Summary

The diffusion of the GSM telephone and the Oral Polio Vaccine (OPV) are two interesting case studies. Both were launched nationally within months of each other but only the OPV was widely resisted. They show the contrast between the ease with which the public accept technology which is almost always optional and science, particularly vaccination, which is almost always enforced by legislation for 'public good'. Chen, et al. (2000) also argue that there is lower tolerance in society for reactions caused by products like vaccines given to healthy persons compared with therapy for ill persons. As the next chapter will show, resistance to vaccination in history has been partly from its enforcement by legislation seen as being against individual civil liberties in a democracy. Also, why did the public reject the OPV while accepting other medicines of western origin? This is another question which the study aims to find answers to. The OPV revolt thus provides a very interesting case study rich with data for this research to investigate how science changes common sense, how an unfamiliar scientific phenomenon becomes part of the way of life of a society.

The meaning of health and illness, according to Herzlich (1973) arises partly through individual experience and partly through the views current in society, and some authors have shown that in a given population, medical ideas and practices inherited with the culture intermingle with those of modern scientific medicine rather than disappearing. For some groups, Herzlich argues, there is no difference between medicine, magic or religion. This raises another pertinent question about the Nigerian society. What is the relationship between science and religion?

A WHO conference report notes that it is usually difficult to change pre-existing beliefs unless they are explicitly addressed (WHO, 2006). Sommer (1998) argues that if communicators have only a vague or egocentrically distorted representation of their recipients, then successful communication will be a matter of chance. Similarly, Miller (2001) was of the view that when science is being communicated, communicators need to be aware of the nature and existing knowledge of the intended audience and its implications. Pre-existing knowledge raises the question of common sense notions of science in society. How does the familiar affect the acceptance of the unfamiliar?

Specifically, the research aims to find out how the OPV controversy evolved and to compare this with others in history. It will examine the relationship between religious belief, knowledge and attitudes to science. As a pioneering effort, it is hoped that the project will contribute to public understanding of science efforts worldwide.

The specific research hypotheses to be examined are under the following headings:

1. The Oral Polio Vaccine controversy in Northern Nigeria

Null hypothesis: Media coverage of the oral polio vaccine in northern Nigeria was predominantly negative.

Alternate hypothesis: Media coverage was not predominantly negative.

Method of analysis: Content analysis of the coverage of the oral polio vaccine controversy in the Nigerian press from 2001 to 2009.

2. Media coverage of science in Nigeria

Null hypothesis: Intensity of coverage of science in the Nigerian press was low (in terms of quantity of stories) and predominantly negative.

Alternate hypothesis: Intensity of coverage of science is comparable with other contexts (United Kingdom and the United States) and not predominantly negative.

Method of analysis: Content analysis of the genres of science news in the Nigerian press form 2001 to 2009.

3. Trust in institutions and persons

Null hypothesis: Levels of trust in scientists and religious leaders in Nigeria are negatively correlated in the context of trust in other institutions.

Alternate hypothesis: Levels of trust in scientists and religious leaders are positively correlated.

Method of analysis: Factor analysis.

4. Structure of attitudes to science

Null hypothesis: 2 factors - progress and pessimism characterise the attitudes of Nigerians to science.

Alternate hypothesis: Attitudes are characterised by more than two facets.

Method of analysis: Factor analysis.

5. Knowledge and attitudes I (fundamental)

Null hypothesis: There is no interaction between knowledge and fundamental attitude to the world in the public's attitude to science.

Alternate hypothesis: There is an interaction between knowledge and fundamental attitude to the world in the public's attitude to science.

Method of analysis: ANOVA for interaction effects.

6. Knowledge and attitudes II (Religiosity)

Null hypothesis: There is no interaction between knowledge and religiosity in the public's attitude to science.

Alternate hypothesis: There is an interaction between knowledge and religiosity in the public's attitude to science.

Method of analysis: ANOVA for interaction effects.

7. Knowledge and attitudes III

Null hypothesis: Knowledge and attitudes to science are positively correlated.

Alternate hypothesis: Knowledge and attitudes to science are not positively correlated.

Method of analysis: Binary logistic regression of attitude facets on knowledge.

8. Public understanding of vaccination

Null Hypothesis: There is no association between Public Understanding of Science (knowledge, trust, attitudes) and opposition to vaccination.

Alternate Hypothesis: There is an association between Public Understanding of Science (knowledge, trust, attitudes) and opposition to vaccination.

Method of analysis: Binary logistic regression.

Chapter 2 Public resistance to vaccination programmes

2.1 Introduction

Vaccination resistance dates back to the 18th century and has persisted to present times in various forms in different countries. This chapter reviews resistance in 18th and 19th century Europe and America. Controversy resurfaced in the 20th century in the United Kingdom as well as Tanzania, Cameroon, Uganda and Kenya while in Nigeria, resistance to the OPV marked the early part of the 21st century. I examine issues in the Nigerian controversy between 2001 and 2009, the disease aetiology, choice of OPV and its limitations in controlling the disease in the North. The chapter also examines the current debate over vaccination and its continued propriety, especially in communities already free of the disease and the link with rising incidences of diseases like asthma, autism and diabetes in children.

2.2 Vaccination resistance in history: 18th, 19th and 20th centuries.

“...it is hardly the case that concepts, even when they are constructed according to all the rules of science, derive their authority only from their objective value. It is not enough for them to be true to be believed. If they are not in harmony with other beliefs, other opinions, in a word with the whole gamut of collective representations, they will be denied; minds will be closed to them; they will be as if they never were.”

- Durkheim (1912, 2001 p. 333)

Edward Jenner, a country doctor living in Berkeley, England conducted the first vaccination in 1796 by taking pus from a cowpox lesion on a milkmaid's hand and using it to inoculate an 8-year-old, James Phillips. He had overheard a milkmaid boast that since she has had cowpox, she was never going to get smallpox; a more disfiguring form of the disease. Six weeks later, Jenner variolated (person to person transfer of pus) two sites of Phillips' arm with smallpox, yet the boy was unaffected by this and subsequent exposures. His inoculation with cowpox thus became an alternative to variolation which had been in practice since the 1600s (Stern and Merkel, 2005).

However, this breach of the species barrier did not go unchallenged and made many people wary, and sometimes hostile to the idea. There was no shortage of cartoons mocking Jenner and depicting the transmogrification of the recently vaccinated into cows and beasts.

In England, criticism of public vaccination had been common ever since it was introduced in 1840, but, according to Beck (1960), an organised movement to repeal compulsory vaccination did not begin until 1871. The rise in strength of the anti-vaccination movements followed the promulgation of the compulsory act of 1853 which the public saw as the extension of the powers of the state over areas of “traditional civil liberties” and resistance to it was mobilised, not only by liberal reformers, but by members of a large and politically active working class (Potter and Potter, 1988; Durbach, 2000). A protest letter to parliament by John Gibbs, a hydropathic practitioner in 1856 captured the situation: “Are we to be leeches, bled, blistered, burned, douched, frozen, pilled, portioned, lotioned, salivated by act of parliament?” (Durbach, 2000). Vaccination then, involved the use of a scalpel to cut the arm which left a big scar and it was denounced unchristian and labelled “the mark of the beast” (Durbach, 2000). Beck (1960) also pointed out that some clergymen said children’s faces would turn into cow’s faces with horns. The scientific community was divided on vaccination and among those opposed to it were Benjamin Richardson and Edgar Crookshank. Richardson, a physician, lecturer and founder of several journals remained opposed to germ theory throughout his life. Also, Crookshank, the first Professor of Bacteriology at King’s College, London, in 1889, published a book in which he claimed that Jenner’s lymph was responsible for the secondary transmission of syphilis (Beck, 1960; Potter and Potter, 1988).

In the United States, during the last few decades of the 19th century and the early part of the 20th century, a wide range of groups and individuals also engaged the scientific elites in a battle for public opinion reflecting similar fears that scientific advances were being put to coercive uses and that the state was increasingly expanding into private realms of decision making. Their actions, according to Colgrove (2005) revealed how citizens of varied ideological persuasions

viewed scientific knowledge during a period of swift and unsettling social change when the application of biological products seemed to hold peril as well as promise. Records in this period showed that poorly performed vaccinations, ineffective vaccines and contamination by other microorganisms were sources of concern.

Sadly too for the pro-vaccination movements, an improvement in safety standards coincided with a change in the epidemiology of the disease as a milder form of smallpox (*Variola minor*) with a less debilitating effect appeared in the United States in 1897, and unlike fatality rates of 20% to 30% recorded with *Variola major* (the earlier form), *Variola minor* rarely killed. As a result of this shift vaccination came to be seen as increasingly unjustified (Colgrove, 2005).

The anti-vaccination movement, according to Colgrove comprised a heterogeneous assortment of individuals and organisations that differed in their beliefs, tactics and goals and one such was the Anti-vaccination League of America formed in 1908 by two wealthy businessmen, John Pitcairn and Charles Higgins. Pitcairn, an active member of the Swedenborgian church and whose son had earlier suffered an adverse reaction after being vaccinated, was also devoted to homeopathy, but his opposition was not based on theology and medical practice alone but also on politics. In one of his publications, Pitcairn described forcing people against their will as “medical tyranny.” “We have repudiated religious tyranny; we have rejected political tyranny; shall we now submit to medical tyranny,” Pitcairn said (Colgrove, 2005).

Other influential groups in this period were the Christian Scientists founded by Mary Eddy and premised on a belief that illness was a mental, rather than material phenomenon, and as such could be overcome through prayer. However, sensational cases of children dying, especially from diphtheria, under the care of Christian Science parents and charges of manslaughter and unlawful practice of medicine forced Eddy to issue a statement in 1901 in support of vaccination, but with prayers. There was also the Physical Culture group founded by the fitness guru Bernarr Macfadden which rejected germ theory and proffered a regime of fasting, exercise, natural foods and abstinence from alcohol, tobacco and coffee (Colgrove, 2005).

In 1905, the US Supreme Court affirmed the constitutionality of public vaccination in the case of *Jacobson vs. Massachusetts* stating that the need to protect the public outweighed individuals' right to privacy (Stern and Merkel, 2005). This did not however stop the anti-vaccination campaign. The court had to rule again in 1922 (Colgrove, 2005) that no constitutional right was infringed by excluding an unvaccinated child from school.

The anti-vaccination movement was no less rancorous in Brazil. The opposition newspaper, the *Correio da Manhã* in October, 1904 published the portrait of a man suffering from a grisly tumour that had distorted his arm and chest and accompanied this with a story describing vaccinations as "... the propagator of all means of illness, the monster that pollutes the poor and innocent blood of our children with the vile secretions expelled from sick animals..." (Needell, 1987).

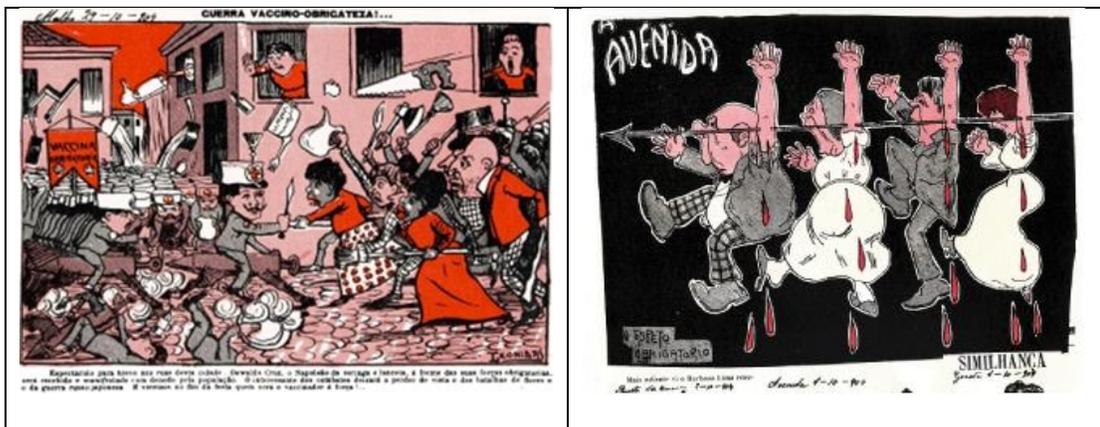


Figure 9 Cartoonists' depiction of the Brazilian revolt (Hochman, 2009)

Although the Jennerian vaccine was first introduced into Brazil in 1804, the first law making vaccination compulsory in Rio de Janeiro was promulgated in 1832 but it was ineffective. However, the new law of 1904, widely known as the "Torture Code" (Hochman, 2009) contained severe penalties including fines and the requirement of a vaccination certificate for public education, employment in public service and marriage. It was opposed by the middle class and the positivist church while opposition radicals exploited fears and ignorance of the poor. The debate eventually turned into a revolt and as crowds mobbed streets, there was an attempted coup, but this failed (Nachman, 1977; Needell, 1987).

Concerns over the safety of vaccines again emerged in the latter half of the 20th century. In January 1974, the Hospital for Sick Children at Great Ormond Street, London published a report that 36 children had suffered severe neurological complications following their DTP immunisation. The report, according to Baker (2003), generated a stream of negative publicity that led to a rapid decline in immunisation rates against whooping cough, such that by 1979, 102,500 cases had been reported throughout the United Kingdom and an estimated 36 children died. The medical profession was divided over the vaccine and Professor Gordon Stewart of the University of Glasgow published a series of 160 cases of encephalopathy that he linked to the DTP vaccine. The Joint Committee on Vaccination and Immunisation (JVCI) was compelled to conduct another study and in 1981, the investigators concluded that although the vaccine was associated with an increased risk of acute neurological illness, the risk appeared to be very low. However, the controversy continued in the courts until 1988 when Mr Justice Stuart Smith, in *Loveday vs. Renton and the Wellcome Foundation* ruled that there were better explanations than vaccine damage for all cases in question (Baker, 2003).

The DTP controversy reverberated across continents as far away as Japan where its use was suspended in 1975. This was however, followed by an epidemic which led to about 40 deaths. However the United States largely avoided a controversy until a documentary titled: "DTP: Vaccine Roulette" sparked a major wave of negative publicity. The US medical profession however, remained in support of the vaccine, but a rise in litigation led to the National Vaccine Injury Compensation Act of 1986 (Baker, 2003).

A Measles Mumps Rubella (MMR) and Autism controversy was sparked off in 1998 in the United Kingdom by Dr Andrew Wakefield and colleagues following their report of a hypothesised link between autism and the MMR vaccine in the medical journal, *The Lancet*. The controversy, according to Burgess et al. (2006) led to a significant drop in vaccine coverage. Much of the controversy however, centred on the combination of three live viruses together in one which, Wakefield and others portrayed as being harmful. Burgess et al. (2006) also pointed

out that the trustworthiness of official assurances had been undermined by an earlier controversy over the bovine spongiform encephalopathy (mad cow disease) in which constant assurances from the government that beef was safe were later disproved (see Bellaby, 2003). The United Kingdom again became the locus for exporting the MMR controversy and the effects were felt in the USA, Australia and New Zealand. The Lancet has since issued a full retraction of the paper (BBC, 2010a) but Wakefield, who has been struck off the medical register by the General Medical Council, remains unperturbed (BBC, 2010b; 2010c).

Vaccination regimes have also been linked with the onset of diabetes and asthma. According to Classen and Classen (1997), the timing of paediatric immunisations may alter the development of diabetes in humans, but DeStephano et al., (2001) disagree claiming that the results of their own investigation found no association between recommended childhood vaccines and an increased risk of Type 1 diabetes. DeStephano et al. also conclude as unfounded, suggestions that diabetic risk in humans may be altered by changes in the timing of vaccinations. Classen and Classen (2003) in another study reported an association between Type 1 diabetes and Haemophilus influenza, pertussis, MMR and BCG vaccines. Again, in another study, Hviid et al. (2004) found no evidence to support a temporal association between widespread introduction of general childhood vaccination and an increase in incidence of Type 1 diabetes. It is informative to point out at this stage that the risk of Type 1 diabetes has also been linked to older mothers. Bingley et al. (2000) at Southmead hospital looked at 1,375 families in the Oxford area and found that a mother's age at delivery was strongly related to Type 1 diabetes and the risk increased by 25% for each five year band of maternal age.

In another instance of disagreement among scientists, DeStefano et al., (2002) reviewed research findings from New Zealand, the UK and Sweden which found possible evidence in support of an association between asthma and whole cell pertussis vaccine, queried the methods and sample sizes in the study and drew attention to another longitudinal study in England which found no association between DTP and asthma. They also looked at conflicting results from the UK,

Guinea Bissau and Finland on the association between measles and asthma. They concluded that DTP, OPV and MMR did not increase a child's risk of developing asthma.

Rottem (2008) argues that although infections and vaccinations may have a potential role to play in the normal maturation of the immune system, in the development and balance of regulatory pathways, and in the development and exacerbation of asthma, the benefits far outweigh the risks of not vaccinating. Surprisingly too, a fast food diet has been linked by a global study to the rise in asthma and eczema in children (Ellwood, et al., 2013). The findings were based on data from more than 319,000 teenagers between the ages of 13 and 14. All the participants were involved in the International Study of Asthma and Allergies in Childhood (ISAAC), which is a collaborative research project involving more than 100 countries and nearly two million children. In Cameroon, Nigeria's neighbour to the east, in the early months of 1990, girls ran away from schools to avoid vaccination teams (Feldman-Savelsberg, et al., 2000). The school girls, and adults surrounding them feared the vaccines would sterilize them. It was during a period of public disagreement between the Family Life Association of Cameroon (the pro-life Catholic group) and some government establishments over the safety and administration of the Tetanus Toxoid (TT) vaccine on girls of child bearing age only. The TT vaccine was part of a global strategy to eliminate neonatal tetanus developed by the WHO in 1989 (Milistien, et al., 1995). The disagreement between the government and the anti-abortion group soon became embroiled in the politics of the era and was tagged by the opposition as a government plot to harm the unruly west and northwest provinces. The aftermath of the controversy was a sharp rise in teenage pregnancies and abortion in the northwest province as the vaccinated girls sought to confirm their ability to still have offspring (Feldman-Savelsberg, et al., 2000).

The pro-lifers continued their worldwide campaign against the TT vaccine. In 1995, an international pro-life organisation in the Philippines issued a statement, circulated worldwide, that the TT vaccine being administered to women of child bearing age in the country and Mexico contained anti-human chorionic gonadotrophin (anti-hCG) hormone, which was capable of

causing sterility in women (Miller, 1995). The hormone, hCG, is necessary for the initiation of pregnancy and is produced in large amounts throughout pregnancy. According to Milistien et al. (1995), this assertion, that WHO and UNICEF were using women as guinea pigs to test a contraceptive vaccine given to them under the guise of tetanus toxoid, though denied by WHO, also circulated in Tanzania, Nicaragua, Mexico and the Philippines.

In Tanzania, according to a UNICEF ESARO (2003) report, Dr Birgitta Schnell, the medical director of a Catholic mission hospital, St Benedict's in Ndanda, received a number of reports and newspaper articles containing anti-fertility research and shared the information at a regional meeting in 1994 where she raised the issue of TT being laced with anti-hCG and opposed vaccination until she had an independent laboratory confirm the purity of the vaccine. Though she consequently administered the vaccine, the rumour spread to other regions and religions. The report cited a Muslim leader who went around convincing followers that immunisation is un-Islamic.

The rumour about the OPV containing anti-fertility agents gained ground in Uganda around 1996 in an area of Kampala, according to the UNICEF ESARO report, and came from two sources: Mulindwa Muwonge, of Central Broadcasting Service (CBS) radio and a radical group of Buganda youths called the Bazukulu. Muwonge campaigned on his radio station that the OPV contained anti-fertility drugs designed to end the race and the youths carried this further to state it was a plot by Western countries. In addition to the conspiracy theory, rumours of expired drugs and the contamination with HIV were also circulating, and made worse by the red colour of some OPV formulations which fed stories that children were being given blood contaminated with HIV.

In Kenya, anti-vaccination campaigns, according to the report, started around 1996 in the Central Province, the heartland of political opposition, and particularly, in the diocese of Nyeri, where a militant Catholic priest, Bishop Nicodemus Kirima led a campaign from the pulpit against OPV.

Other Catholic Church leaders believed that the OPV was laced with contraceptives, citing TT and contraceptive studies.

There were indeed trials using anti-hCG vaccines partly funded by the WHO (Jones, et al., 1988; Jones, 1996) which involved two intramuscular injections and a promise of a contraceptive effective for six months. The basic principle of a contraceptive (or anti-fertility) vaccine is to use the body's own immune defence mechanisms to provide protection against an unplanned pregnancy. The development of this contraceptive however, became a weapon of choice for the pro-life campaigners who oppose all forms of contraceptives, except abstinence and it transmuted from an "anti-fertility vaccine" to a "sterilising vaccine." While the pro-lifers and the Catholic Church were vocal in their opposition to abortion and contraceptives, the conjoining of TT vaccines (or OPV) with anti-hCG (contraceptive) properties is what Knapp (1944) refers to as "syncretism."

2.3 Vaccination resistance in Northern Nigeria: 2001 to 2009

African leaders in 1996 launched the "Kick Polio Out of Africa" campaign aimed at eradicating the debilitating childhood disease from the continent. In October 2000, Nigeria launched its own version of the continent wide National Immunisation Days during which all children of vaccination age were expected to be immunised against a range of diseases. But as early as January 2001, a subtle campaign had begun by some religious leaders in the northern part of the country against the exercise. Although there were reports of a boycott in some states, turnout was still regarded as massive (Ogundipe, 2001; Vanguard, 30/01/2001). Later in the year, an Islamic sect in Niger state, declared immunisation un-Islamic and called on Muslims to shun the exercise (Atofelekun, 2001; The Guardian, 25/10/2001). A cleric in Sokoto state also declared it un-Islamic the following year, preaching to his followers that some verses in the Holy Koran can be used to cure diseases (Oyerinde, 2002; The Guardian, 28/05/02). Also in May 2002, as the nationwide immunisation drive progressed, the Kano state commissioner for health, Dr. Masur

Kabir, at a press conference, attributed the prevalence of the polio virus in 10 of the 44 local government councils in the state to rumours the vaccine is a contraceptive and the creation of western countries who do not conform with the will of Allah, to infect them with the HIV/AIDS virus, but the position of the government remained that it did not contain the virus, nor a contraceptive, and was a safe and effective vaccine to prevent polio (Abuh, 2002, *The Guardian*, 17/04/2002).

However, the rumour continued to spread. A cleric, Mohammed bin Uthman told the British Broadcasting Corporation (BBC 2002; see also Malakoff, 2001), that the infamous field trial of the drug, Trovan by Pfizer in Kano in 1996 which led to the deaths and deformities of some children, continued to shape his views. If they really love our children, Uthman also asked, “why did they watch Bosnian children killed and 500,000 Iraqi children die of starvation and disease under an economic embargo?” The cleric also told the BBC that the vaccine may have been responsible for the spread of AIDS in East Africa following a controversial book by journalist Edward Hooper, titled: “The River” which suggested that HIV was initially transmitted to humans in the late 1950s through the use of oral polio vaccine. Three independent studies have, however, cast doubt on the theory (BBC 2002). Despite the on-going rumours, some prominent Islamic leaders and Emirs were in support of the vaccine. An emissary of the Emir of Gwandu, Alhaji Mailatu Bunu Gwandu attested to the safety of the vaccine and the support of the Emir of Kazaure and the Supreme Council for Islamic Affairs (Abraham, 2003, *Tribune*, 17/10/2003).

In early 2003, rumours of the death of 300 children following their immunisation with expired vaccines spread across the country forcing the government to issue a statement denying such deaths and the use of expired drugs (Yusuf, 2003, *Vanguard*, 31/08/2003; Oke, 2003, *Vanguard*, 07/09/2003). The debate however took a dramatic turn in July 2003 when two very influential Islamic groups, the Supreme Council for Shari'ah in Nigeria (SCSN) and the Kaduna State Council of Imams and Ulamas at a news conference rejected the vaccine, warning Muslims to be wary of “its potential dangers.” Sheik T. Suleiman of the Council of Ulamas, who signed the

statement with Sheik Zubairu Sirajo of SCSN, said: “Our doctors have conducted extensive research on this. It is a plot by the Western world to reduce the population of Nigeria and other developing countries” (Madugba, 2003; This Day, 16/11/2003, IRIN News, 2003).

A major blow to the campaign followed with a ban on the use of OPV announced by Kano State in August 2003 (BBC 2003) and followed by Zamfara State in October (Sabiou and Shobayo, 2003, Tribune, 27/10/2003). Kano State in May 2003 had a change of government from a sympathetic governor Rabiu Kwankwaso of the People’s Democratic Party who lost his re-election bid, to Ibrahim Shekarau of the opposition All Nigeria People’s Party. The stage was set for a rapid spread of resistance. Another significant factor was the subsequent media campaign, at home and abroad, embarked upon by prominent Kano-based medical doctor and president of the SCSN, Dr Datti Ahmed. Ahmed, a renowned paediatrician, became the spearhead of the anti-vaccination movement. Ahmed said the vaccine was a United States led conspiracy to depopulate the developing world (BBC, 2003) and he told *The Guardian* that his opposition was based on several e-mails he received confirming the contamination of the vaccines with anti-fertility agents, HIV/AIDS and cancer (Abuh, 2004, The Guardian, 10/01/2004). Ahmed also told a South Africa online news medium that the adulteration of the vaccines was the work of “modern-day Hitlers” (News24, 2004) but his opposition was limited to the oral polio vaccine (IRIN News 2004).

Four days before the immunisation exercise was due to commence in October 2003, a group of Jama’atul Nasril Islam volunteers embarked on a campaign against the exercise, informing citizens in some areas of Kano of the plans by the United States to cut down their population. Ibrahim Babagana, a resident of Gwande in Maiduguri, Borno State capital told his wives to lock the door and even proceeded to mark it with white chalk depicting it had been visited by vaccination officials because he was informed at the mosque by some emissaries from Kano that vaccination was an indirect method to reduce the population of northern Muslims. The issue of

the controversial Trovan drug trial in Kano some years before also became part of the message as the emissaries referred to it as part of the grand plan (Murray, 2003, Punch, 29/10/2003).



Figure 10 Polio victims in Northern Nigeria (The Guardian, Sept 14, 2000)

The controversy continued to generate mixed reactions among the public. While many remained wary of the vaccine, others embraced it. “I heard about the controversy but my husband agreed that we still give our baby the polio vaccine,” Amina Abdulkadir, a 28-year-old mother in Kano city told IRIN News, but 32-year-old Aishatu Mohammed took a different line: “We will receive the other vaccines, but not the oral polio vaccine because they said it contains harmful substances,” (IRIN News 2004). The political, religious and traditional elites were also divided on the issue. A former Minister of Special Duties, Alhaji Wada Nas, took the line of Dr. Ahmed in describing the vaccine as a “secret de-fertilization” programme of the United States (Alli, 2003, Punch, 30/10/2003).

The executive director of the federal government agency saddled with the nationwide campaign, the National Programme on Immunisation (NPI), Dr (Mrs) Dere Awosika could not understand the rationale for depriving children of the vaccine since the adults took the Cerebro-Spinal Meningitis vaccine few days earlier and both were from the same source (Akintola, 2003, The Times 24/11/03). The traditional ruler and spiritual leader of the Borno emirate, the Shehu of Borno, Alhaji Mustapha Umar Ibn el Kanemi and his counterpart of the Gwandu emirate, Alhaji Mustapha Jokolo continued to support the vaccination campaign (Musa, 2003, The Guardian,

19/11/2003). Prominent Islamic scholar, Sheikh Yusuf Al-Qaradawi said the vaccine was lawful and blamed the SCSN for creating a negative image of Islam showing it to contradict medical progress (Yahaya, 2006). Social critic and university lecturer, Yusuf Bala Usman, on his part, described the ban as “sheer wickedness” (Isenyo and Timothy, 2004, Daily Times, 24/02/2004). The medical community was also not unanimous on the vaccine. A joint statement by the World Health Organisation, the Federal Ministry of Health, National Agency for Food and Drug Administration and Control (NAFDAC) and UNICEF denied the American link, pointing out that most of the vaccines were imported from Indonesia and Malaysia, both Muslim countries. They also alluded to a test carried out by a Muslim pathologist at the Ahmadu Bello University Zaria, Dr Abdulmumini Rafindadi at the request of the Katsina State branch of the SCSN which found the drug to be free of anti-fertility hormones (Murray, 2003a, Punch, 31/10/2003). The federal government also set up an independent panel of experts headed by a northerner, renowned virologist and Professor Emeritus, Umaru Shehu, and following tests conducted in South Africa, it reported in December 2003 that the vaccine was safe (Lambo, 2003, The Guardian, 30/12/2003).

On the opposing bench, Bayero University teacher and pharmacologist, Dr Lawal Hassan Bichi testified before Nigeria’s House of Representatives, that the tests his group carried out on the vaccine showed it contained some elements capable of impacting negatively on fertility as well as the causative agents of HIV/AIDS (Ogbodo and Ayeoyemikan, 2003, The Guardian, 23/12/2003). Also, a test ordered by the Jama’atu Nasril Islam (JNI) conducted in India by Dr Haruna Kaita, Dean of the Faculty of Pharmaceutical Sciences of the Ahmadu Bello University Zaria, reported “undeclared contaminants which could cause malfunctions of the testes in males and cause infertility in women” (Kazaure, 2004, Weekly Trust, 06/03/2004). In support of the vaccine, Professor F D Audu, consultant virologist at the College of Medicine, University of Ibadan wrote a widely circulated article criticising his colleague, Professor Hussein Akande Abdulkarrem of the Lagos State University, who had in a lecture described the vaccine as “a

huge virological deception”. Professor Audu described Abdulkareem’s statement as “unfortunate and backward” (Adu, 2004, Tribune, 08/01/2004; Ogbonnaya and Haruna, 2004, This Day, 01/03/2004).

Meanwhile, as the debate continued, more states joined the bandwagon. Bauchi and Niger banned the vaccine in the early part of 2004 (This day, 2004, 25/02/2004). Kano governor, Ibrahim Shekarau described the ban as “the lesser of two evils ... to sacrifice two, three, four, five even ten children to polio than allow hundreds of thousands or possibly millions of girl children likely to be rendered infertile ... tests carried out by scientists in the state last year found traces of hormones. We want explanations” (Ogundipe, 2004, Vanguard, 27/02/2004).

It was not smooth sailing for the spearhead of the anti-vaccination campaign, Dr Ahmed. Nigeria’s President, Olusegun Obasanjo tacitly accused him of spite. Obasanjo said: “I have heard that one of the people pushing this issue said I have offended him. What I was told was that he gave quotations to supply vaccines and was turned down” (Ebonugwo and Nderibe, 2004, Vanguard, 10/03/2004). Ahmed was also accused of vengeance because the contract of his daughter who had earlier worked for UNICEF was not renewed. Ahmed, in response, said his medical doctor daughter worked for BASICS, not UNICEF and resigned voluntarily due to lack of job satisfaction (Shiklam, 2004, Daily Champion, 31/03/2004).

The effects of the ban continued taking its toll on children as more and more cases of paralysis and death were recorded in the various states. Jigawa State lifted the ban claiming polio had claimed the lives of 27 children (Ibeneme and Anthony, 2004, Vanguard 25/02/2004). Niger also called it off. Niger State governor, Abdulkadir Kure said he had been assured of its safety (Adeyemi, 2004, The Guardian, 28/02/2004), Bauchi too called it off but Kano remained adamant (Ogundipe, 2004, The Vanguard, 27/02/2004). Yet, another committee was set up by the federal government, this time jointly with the state governments and the JNI and it released a report confirming the safety of the vaccine. The committee’s findings surprisingly reported trace amounts of estradiol, a sex hormone, in some samples, the presence of which had been

previously denied. The committee (Bichi and Babatunde, 2004; 27/02/2004) explained: “the trace amounts of estradiol in question is much less than what is found in recycled drinking water in several developed countries.” The Sultan of Sokoto and head of the Supreme Council for Islamic Affairs in Nigeria endorsed the report but the Kano State government declined, insisting on awaiting the result of its own independent investigation (Ozoemena, Anthony and Mamah, 2004, Vanguard, 18/03/2004; Bichi and Babatunde, 2004, Punch, 27/02/2004).

However, in June 2004, Health Minister, Professor Eytayo Lambo announced Kano had accepted the potency of the OPV produced in Indonesia (Fagbemi, 2004, Tribune, 14/06/04). Speaking on the acceptance, Abdullahi Saleh Pakistan, an Islamic preacher and one of those invited by the Kano State government to review the results of its own tests said: “from what we were told at the meeting, the polio vaccine to infertility ratio had been exaggerated.” Kano business man, Ta’ambu Abdullahi, who was also at the meeting said “even though I do not understand most of the medical jargon of the committee, I am convinced the polio vaccination should go on” (Vanguard, 2004, 16/07/2004). The state resumed the use of the vaccine on July 31, 2004 when the governor, Ibrahim Shekarau, administered it to several babies (Foulkes, 2004). While the debate ensued, 792 children were paralysed by the virus in 2004 alone in Nigeria and 1,266 globally (WHO, 2005).

Did Kano State’s acceptance of the vaccine lead to an immediate wholesale adoption by the people of northern Nigeria and the termination of the spread of polio? In August 2006, an estimated 467 new cases were reported (Peter-Omale, 2006, This Day, 16/08/2006) and in 2009, in Niger State alone, some 15 fresh cases were reported in 12 local governments (Falola and Adedeji, 2009, Punch, 12/10/2009).

Why was polio still spreading after the ban was lifted by Kano State? For Sadiya Musa, the inconsistency on the part of the politicians calls for more suspicion; “how can they say the vaccine is bad and then say it is good again” (AP, 2006). Also, some of the traditional rulers were not convinced of its compatibility with Islam. However, following a five day immunisation

tour of Egypt in 2007, the Emir of Gombe, Abubakar Alhaji Usman Shehu admitted to journalists that although he went on the trip as a “doubting Thomas” he has since been convinced of its compatibility (Fred-Adegbulugbe, 2007, Punch, 25/02/2007).

There were in addition, according to Michael Galway, head of UNICEF’s polio communications in India, implications of wider issues of poverty and local priorities (AP, 2006). Mallam Mohammed Sani said he refused to allow his children take part because they were denied free drugs for malaria and typhoid fever (Akhaine, 2008, The Guardian, 07/04/2008). Larson (UNICEF, 2005) also argues that there was some refusal and resistance to taking the vaccine because there was a perception it was not a local need but an externally imposed effort. The result of this, Da Costa (2007) states, is that the vaccine is now packaged with other goods such as insecticide treated mosquito nets and Vitamin A supplements.

Notably also, the issue of vaccine derived polio virus (VDPV) did not feature in the debate. Kano’s chief health officer, Aisha Kiru told Time Magazine that given the low level of education, it may lead to a mass rejection of the vaccine, a view supported by Claire Hajaj of UNICEF who argues that communicating medical risk to illiterate and remote populations isn’t always possible. “Usually, you have to settle for something that’s not quite as perfect,” Hajaj said (Da Costa, 2007).

This takes us to Hypothesis I and Hypothesis 8

Hypothesis 1: The Oral Polio Vaccine Controversy in Northern Nigeria

There are several theories on the effect of the mass media on public opinion (McQuail, 2005). This research focuses on positive and negative evaluations and genres of communication. We can infer, for the purpose of hypothesis testing, that if coverage of the vaccination controversy was negative, public opinion about the vaccine will be unfavorable.

Null hypothesis: Media coverage of the OPV vaccine in Nigeria was largely negative.

Alternate hypothesis: Media coverage was not predominantly negative.

Method of analysis: Content analysis of the coverage of the OPV controversy in the Nigerian press (2001 to 2009).

Hypothesis 8: Public understanding of vaccination

Null hypothesis: There is no association between Public Understanding of Science (knowledge, trust, attitudes) and opposition to vaccination.

Alternate hypothesis: There is an association between Public Understanding of Science (knowledge, trust, attitudes) and opposition to vaccination.

Method of analysis: Binary logistic regression.

2.4 Poliomyelitis: Aetiology and control

It is pertinent to dwell on the nature of the polio virus and its control measures to better understand the intricacies of the vaccination campaign and why the disease has continued to spread, despite concerted eradication efforts and the lifting of the ban. It will also examine why the WHO and its funding partners are pushing for the use of a vaccine that was discontinued in the United States more than a decade ago.

Poliomyelitis is a highly infectious disease caused by a virus which attacks the nervous system and can cause total paralysis or death in a matter of hours. It mainly affects children under five years of age and 1 in 200 infections leads to irreversible paralysis, usually in the legs (GPEI, 2012; WHO, 2012). The polio virus belongs to the enterovirus subgroup and they are transient inhabitants of the gastrointestinal tract, comprising three serotypes: PV1, PV2 and PV3 (also called wild polio virus Type 1, 2 and 3). However, immunity to one does not guarantee significant immunity against the others. The virus enters through the mouth, multiplies in the intestine and is shed through faeces from where it can spread rapidly, and there is evidence that flies can passively transfer the virus from faeces to food. Following illness, it continues to be excreted in the stool for several weeks and may penetrate and infect the central nervous system which leads to destruction of the nerve cells that activate muscles, causing the legs to become lifeless, a condition called acute flaccid paralysis (AFP). However, less than one per cent of polio infections lead to flaccid paralysis and 95% of cases often do not show symptoms, although the infected persons shed the virus in the stool. Many sufferers with paralytic poliomyelitis recover completely, but where symptoms remain after 12 months, the situation

becomes permanent. In some cases, the virus attacks the nerve cells of the brain that control seeing, hearing, smelling, tasting, and swallowing, a condition called Bulbar polio and can be fatal without respiratory support. A more severe form is the Bulbospinal polio, a combination of the two types causing paralysis of the arms and legs, and may also affect breathing, swallowing and heart function (CDC 2012; WHO, 2012; GPEI, 2012).

The inactivated polio vaccine (IPV), also called the Salk vaccine was developed in 1955 by Dr Jonas Salk and licensed the same year in the United States. Oral polio vaccine was developed in 1961 by Albert Sabin and Type 1 and Type 2 monovalent oral polio vaccine (MOPV) were licensed the same year. Further improvements led to the licensing of Type 3 MOPV in 1962 and Trivalent OPV in 1963. The trivalent OPV (tOPV) largely replaced IPV use in the US but in 1987, the enhanced potency IPV was licensed and in 2000, the use of tOPV was discontinued (CDC, 2012). The enhanced IPV (IPOL, sanofi pasteur) contains all three serotypes of polio vaccine virus weakened by mutation and inactivated with formaldehyde and is supplied as a single dose prefilled syringe administered as an injection. IPV is very effective but it produces less gastrointestinal immunity than OPV, so recipients are more readily infected with wild polio virus than OPV recipients are. The duration of immunity is also unknown. Monovalent OPV vaccine consist of live, attenuated (weakened but not inactivated) poliovirus strains of either Type 1 (mOPV1) or Type 3 (mOPV3) providing protection against only one type of virus, but much stronger immunity to Type 1 (or Type 3) poliovirus compared with OPV for the same number of doses. Bivalent oral polio vaccine (bOPV) consists of live, attenuated poliovirus strains of Type 1 and Type 3 and simultaneously targets both. Bivalent OPV is at least 30% more effective than OPV and almost as good as the respective monovalent OPVs (GPEI, 2012). The trivalent OPV contains live attenuated strains of all three serotypes of polio virus in a 10:1:3 ratio, but is most effective against Type 2. The vaccines are supplied as a 0.5ml dose in a plastic dispenser and vaccine viruses are excreted in the stool of the vaccinated person, and other people

coming in contact with this may be infected. Excellent intestinal immunity helps protect against infection from the wild polio virus and immunity is probably lifelong (GPEI, 2012).

A major setback of the trivalent OPV is vaccine-associated paralytic poliomyelitis (VAPP) which affects approximately one in every 2.7 million first doses of the vaccine. The mechanism is believed to be a mutation, or reversion, of the vaccine virus to a more neurotropic form. Reversion is believed to occur in almost all vaccine recipients, but it only rarely results in paralytic disease. Paralysis that occurs is similar to that of the wild virus and may be permanent. Another disadvantage is that very rarely the virus in the vaccine genetically changes and starts to circulate among a population. These viruses are known as circulating vaccine-derived polioviruses, cVDPV (CDC 2012; WHO, 2012; GPEI, 2012). Polio outbreaks can be caused by cVDPV that have regained their neurovirulence (Minor, 2009) and the ability to spread in human populations that have poor immunity. Another undesired consequence of OPV, Minor notes, is immunodeficient vaccine-derived polio virus (iVDPV). This condition arises when some individuals that have B-cell deficiency disorders do not mount a hormonal response to the polio virus and can become chronic long term excretors of VDPV. Some 23 cases, according to Minor, have been confirmed throughout the world and these patients can excrete VDPV for several decades. Also, circulating VDPV may be just as deadly as its wild form. Jenkins, et al. (2010) found that the attack rate and severity of disease associated with cVDPV in Nigeria is similar to those associated with WPV. Modlin (2010) is, however, of the opinion that the Nigerian case was an exception and most cVDPV outbreaks have been controlled by focused supplemental immunisation campaigns.

VAPP can be prevented by withdrawing the live attenuated OPV which causes it from use and switching to the use of IPV, as is the case in the United States. IPV however, remains prohibitively expensive for poorer nations and cannot be used easily in mass immunisation campaigns that have been very successful with OPV because it has to be injected (WHO, 2012).

2.5 Vaccines: Victim of success?

Public Health Scientists at the United States Center for Disease Control (CDC) categorise vaccine preventable diseases as one of the ten great public health achievements of the decade 2001 to 2010 (MMWR, 2011). This period, the report notes saw substantial declines in cases, hospitalisations, deaths, and health-care costs associated with vaccine-preventable diseases. Statistics show that from the art of variolation in the Ottoman Empire around 1670 to Edward Jenner's experiment 200 years ago with cowpox (Barquet and Domingo, 1997), the technique has proved to be a reliable defence against other terrible illnesses. Roush and Murphy (2007) compare eight diseases in the US for which vaccines are licensed or recommended prior to 1980 with the 2006 number of reported cases and found greater than 99% reduction in the number of cases of diphtheria, measles (99.9%), paralytic poliomyelitis (100%), rubella (99.9%), congenital rubella syndrome (99.3%) and smallpox (100%). The list of vaccine preventable diseases has now grown to 27.

Anthrax	Cervical cancer	Diphtheria
Hepatitis A	Hepatitis B	Haemophilus influenza type b
Human Papillomavirus	Influenza/swine flu	Japanese encephalitis
Lyme disease	Measles	Meningococcal
Monkey pox	Mumps	Pertussis
Pneumococcal	Polio	Rabies
Rotavirus	Rubella	Shingles
Smallpox	Tetanus	Typhoid
Tuberculosis	Varicella	Yellow fever

Table 3 Vaccine preventable diseases (MMWR, 2011)

Despite these laudable achievements, concerns over safety just won't go away. Vaccines, like some other pharmaceutical products are not entirely risk free but while most known adverse effects are minor, some vaccines have been associated with very rare but serious side effects which may not be evident until they come into widespread use (Chen, et al., 2000). Chen et al. observe that while some progress has been made in addressing some of the shortcomings, there is lower tolerance in society for reactions caused by products like vaccines given to healthy persons compared with therapy for ill persons. These increasing concerns (Poland and Jacobson,

2000) have engendered an increasing number of ‘anti-vaccine’ groups, further fuelling media and public concerns over a gamut of disorders linked to vaccines. Schwartz (1979) recalls that the problem of decision making in the face of scientific uncertainty, the disputes among experts, the controversy over the proper participants in the dispute, the debate over technical and statistical evidence and the participation of diverse interest groups in the controversy were present in the debate over smallpox vaccine which has now been successfully eradicated worldwide.

Vaccine	Potential adverse effect
Pediatric immunisations: DT, DTaP, DTP, Hepatitis B, Measles, MMR, OPV, Rubella	Asthma
Pediatric immunisations: Haemophilus influenza, whole cell Pertussis, MMR and BCG	Diabetes Type 1
Swine flu	Gullian-Barre syndrome
Anthrax	Gulf war illness
DT (Diphtheria-tetanus toxoid); DTaP (DT plus acellular pertussis); DTP; MMR (Measles, Mumps, Rubella)	Febrile seizure
DT; DTaP; DTP	Hypotonic-hypo-responsive episodes
DTP (DT plus whole cell pertussis)	Acute encephalopathy
DTP; Measles; Hepatitis B	Anaphylaxis
Measles	Thrombocytopenia
OPV	Vaccine associated paralytic polio, circulating vaccine derived polioviruses
Rubella	Acute arthropathy

Table 4 Vaccines and associated diseases

However, some members of the public resist vaccines due to other reasons aside from safety (Lyren and Leonard, 2006) and include religion, pain, cost and the question of whether to put children at risk of a disease that no longer exists. Song (2013) observes that although 50 states in the US require children to receive federally recommended vaccination before attending school, they also allow for medically based exemptions. Some state policies, in addition, allow for religious and philosophical exemptions. Salmon et al. (2006) also observe that there are objections to a compulsory vaccination regime which, having worked well in some countries, may not be acceptable in others, especially in countries where high coverage has been achieved through other approaches. According to Salmon, et al., those in support of compulsory

vaccination argue that it ensures greater equity in society while opponents argue that it diminishes the authority of parents to make decisions on behalf of their children. Lyren and Leonard (2006) however contest the authority position arguing that some children are exposed to far more dangerous issues such as smoking and watching violent television in reach of non-nutritious food. For Song (2013), the profusion of state-level policies allowing religious and philosophical exemptions may have contributed to a resurgence of some contagious diseases in the US. Using data from the United States Centers for Disease Control and Prevention, he found that 27,550 cases of whooping cough were reported in 2010, 15,216 in 2011 and 41,000 in 2012 and there were 222 cases and 17 outbreaks of measles in 2011 compared with a median of 60 cases and 4 outbreaks from 2001 to 2010.

2.6 Summary

Resistance to vaccination has traversed continents for centuries and differences in the patterns of resistance among the various countries are strong indicators of the role of local culture in the acceptance of science. Resistance has developed from concerns over safety, crossing the species barrier, civil liberties, religion, local and international policies and politics and possible links with the onset of other debilitating diseases.

Northern Nigeria is hot all year round with average temperatures in excess of 30 degrees centigrade providing stable conditions for rapid multiplication of pests and diseases. Electricity supply is unstable in Nigeria and does not cover the whole country which also makes the proper storage of vaccines a very difficult process. Some parts of the north like Kano are also densely populated with poor sanitary conditions making the use of OPV a high risk issue when coverage is not complete as viruses expelled in stool can be easily transmitted by flies to the unimmunised. IPV, which leaves no live virus in stool, is a better alternative in such conditions but is more difficult to use for mass immunisation exercises. Northern Nigeria is vast and a poor infrastructure network presents its own logistic problems for mass immunisation.

The tension between religion and science also played a role in the OPV revolt as some religious leaders saw the vaccine as eroding the authority of God. The contest for votes between the political parties also became enmeshed in the controversy with untoward consequences. Kano, the epicentre of both the resistance and the polio epidemic, is the most populous state in the north and is hotly contested by the two main political parties in the north.

Country	Year	Communication themes	Opposing groups	Vaccine
England	1840-1871	'Mark of the beast', against 'civil liberties' transmits syphilis	Working class, liberal reformers, church, scientists, etc	Smallpox
United States	1721 - 1722	Syphilis, black plague, leprosy	Clergy and scientists	Smallpox
United States	1890 to 1922	'Medical tyranny', coercion, un-Godly	Scientists, anti-vaccination League, Christian Scientists	Smallpox
Brazil	1904	'Torture code', 'vile secretions expelled from sick animals'	Middle class, elite, church, press, congress members, etc	Smallpox
United Kingdom	1974	'Neurological complications'	Scientists, public	DTP
Japan	1975	'Neurological complications'	(Fallout of UK episode)	DTP
United Kingdom	1998	Autism	Scientists, public	MMR
USA, Australia, New Zealand	1998+	Autism	Fallout of UK episode)	MMR
Cameroon	1990	Sterilising vaccine	Catholic priests and opposition politicians	Tetanus Toxoid
Tanzania	1990	Sterilising vaccine (anti-hCG)	Catholic Church Hospital, Islamic preacher	Tetanus Toxoid
Uganda	1996	Western conspiracy, anti-fertility and HIV contaminants	Private radio and youth groups	OPV
Kenya	1996	Laced with contraceptives and contaminated with HIV and anti-fertility substances	Catholic priests	OPV
Nigeria	2001 to 2009	Western conspiracy, contaminated with HIV and anti-fertility substances	Islamic groups, politicians	OPV
United States	Post 2000	Asthma, diabetes, Guillain-Barre syndrome, encephalopathy, autism and inflammatory bowel disease, mercury exposure, intussusceptions, Gulf war illness	Scientists, the public	DT, DTaP, DTP, Hepatitis B, Measles, MMR, OPV, Rubella

Table 5 Vaccination resistance across cultures

On the international scene, the successes achieved by vaccination in the eradication of communicable diseases may have also become its Achilles heels. Fading memories of the symptoms and pain associated with large scale epidemic outbreaks of smallpox, whooping cough and measles may have made many underestimate their devastating effects. Others also believe that since these diseases have been eradicated, there is no need to continue with vaccination, or they want to rely on herd immunity instead of subjecting their wards to its known and unknown risks.

The debate over the safety of injecting a virus into the human body has been with us for centuries and may continue. This is largely due to the unpredictable character of viruses, their virulence and capacity to cause highly debilitating and incurable diseases such as AIDS, and in cases like Ebola, death in a matter of weeks. These images are often mixed in common sense.

Research into the safety of vaccines and vaccination in general continues to generate mixed results further compounding the problem of the public who have to decide on an issue they know very little about and rely on experts for guidance. What constitutes an association and how should this be classified as significant? The various researchers seem to be engulfed by a methodological quagmire with different ways of assessing risk and one claiming the authenticity of his findings while discrediting the other. Scientific assessment of risk from vaccine-associated paralytic polio or circulating vaccine derived polioviruses did not play a strong role in resistance in Nigeria, rather, the OPV was believed to have been contaminated as part of ‘a western conspiracy’ symbolised in a sterilising vaccine.

3.1 Introduction

The vaccination controversy in Nigeria revolved around public perception of risk, public understanding of science, trust in actors (both local and international) as sources of science communication and conflict between science and religion as the society sought to familiarise with the oral polio vaccine. This chapter provides the theoretical perspective for this study of science in common sense. It examines the engineering approach of risk assessment and communication and the scientific establishment approach of public understanding of science. Moscovici's Social Representations Theory (SRT), which I have adopted for this study, provides a framework to examine both the risk and PUS perspectives based on how science becomes common sense; how the unfamiliar is made familiar.

3.2 Science and religion

“We want it all. We want to cheer on science's strides and still humble ourselves on the Sabbath. We want access to both MRIs and miracles. We want debates about issues like stem cells without conceding that the positions are so intrinsically inimical as to make discussion fruitless.”

- Cray (2006)

Various groups have expressed concern over the unknown effects of scientific achievements despite overwhelming evidence that they have contributed to improving our way of life. Troy Golden, a pastor from Oklahoma, was born with a genetic condition known as Marfan's Syndrome which had been slowly attacking his body tissue since birth including his heart. At the age of 41, Troy had his entire heart replaced with a device called the Total Artificial Heart (BBC, 2011). He did not wait for a miracle. 40-year-old Matthew Green also received a similar device in the UK (Telegraph, 2011). A more permanent treatment would have been the use of stem cells to regenerate both hearts. Stem cells have unlimited potential for self-renewal, are capable of

repairing damaged tissue and embryonic stem cells from the pre-implantation embryo have a higher capacity to differentiate into all the body's organ-specific cells (Sikora and Olszewski, 2004; Boer, 2002). Stem cells have shown great potential for the treatment of ailments such as cancer, spinal cord injury and Alzheimer's disease, among others (Sikora and Olszewski, 2004; Gardner, 2002; Boer, 2002, Fadel, 2010). But while experiments for their use to create body parts (therapeutic cloning) have been allowed in the United Kingdom, it remains banned in Canada, Germany and France (Fadel, 2010). Images of Dolly the Sheep, the first mammal to be cloned by Ian Wilmut and colleagues in 1996 (BBC, 1997) and other animals after it, have heightened anxiety on both sides of the debate. Jaenisch and Wilmut (2001) however, argue that the process cannot be used to make humans.

For some, stem cells present hope for loved ones like sporting legend, Mohammed Ali, who suffers from Parkinson's disease, while for others, it represents the possibility of creating a human being. The Catholic Church opposes therapeutic cloning as it violates human life (LifeSiteNews, 2007) and Moslem jurists have different views on therapeutic cloning but a cloned sheep was born at the Royan Institute in Iran in 2006 (Fadel, 2010). Researchers have now treated damaged heart tissue using stem cells from the patient's own heart (Makkar et al., 2012; Bolli et al., 2011). Japanese researchers also recently announced they have made pieces of human liver from stem cells which behave like healthy organs (Sample, 2013).

It is not just in the repair of human tissue that science has advanced; its applications in pharmaceuticals, agriculture and environmental mediation have also blossomed (Bauer and Gaskell, 2002). However, scepticism towards these advances also remains widespread, despite their potential. Nielsen, et al. (2002) split the opposing arguments into "blue" and "green". The blue argument is supported by moral and or religious values and is "Faustian" – a modern covenant with Mephistopheles. The green argument, on the other hand, is Frankensteinian and points to the uncertainties and risks.

Cray (2006) writing in TIME magazine (above), observed that we want access to both MRIs and miracles without conceding that the positions are contradictory. The TIME publication was about a debate titled: “God Versus Science” between two renowned scientists, Francis Collins and Richard Dawkins. Dawkins, in his book “The God Delusion” (Dawkins, 2006), argues that a supernatural creator almost certainly does not exist while Collins, an American physician-geneticist also published a book titled: “The Language of God: A Scientist Presents Evidence for Belief” (Collins, 2006). Collins finds absolutely nothing in conflict between agreeing with the evolutionary theorists and also embracing the possibility that there are answers that science isn’t able to provide about the natural world, such as “the questions about why, instead of the questions about how.” Dawkins, on his part, accepts that there may be things far grander and more incomprehensible than we can possibly imagine, but queries why believers invoke improbability and yet will not admit that they are shooting themselves in the foot by postulating something just as improbable: “magicking” into existence the word God.

“Did God make the world? Does it show signs of intelligent – even benevolent design? Is scientific study a natural part of religion, part of leaning to know God?” Knight (2004), who posed the above queries, observed that until about 1800, almost everyone would have answered yes to all three questions but by 1900, many would have answered no to all three and those who answered yes to the first might feel awkward about the other two. What is responsible for the dramatic change? Knight noted that between the time of the French Revolution (1789) and the outbreak of the First World War (1914), public and academic promotion of natural theology – God’s mind visible in His creation – collapsed. He however, argues that the position of organised religion was already weakening all over Europe and the blame for the shifting position cannot be solely at the door of science, nor was it all the fault of Charles Darwin. According to Sydow (2005), Charles Darwin, at the onset of his career, expressed his belief in the existence of the master designer but Darwinism later undermined his former Christian views. Isaac Newton also professed some belief in the existence of a design (Brooke and Cantor, 2000) and Michael

Faraday (Cantor, 2005) also frequently mixed science with religion and opened his 1846 series by alerting his audience to “the power(s) which the Creator has gifted ... matter.” The idea that the world cannot be accidental predates Darwin and Newton. According to Knight (2004), Plato in his last dialogue, “The Laws” argued that the orderly behaviour of the planets and of nature generally was by design but Leucippus and Democritus opposed this saying everything was composed of atoms which endured for a time and then came to bits. For Epicurus and Lucretius, the gods watched the world from the side-lines, but were powerless to intervene in the ceaseless dance of the particles, a middle of the road approach. The arguments were however, not enough and for many people, Knight noted, the world seemed chancy, but not that chancy.

Gould (1997) draws attention to the position of the Church on the philosophy of evolution. While Pope Pius XII grudgingly admitted evolution as a legitimate hypothesis only tentatively supported, John Paul II, nearly fifty years later said data and theory have placed the factuality of evolution beyond reasonable doubt. For Gould, science and religion are not separated by an extensive “no man’s land” and many of our deepest questions call upon aspects of both for different parts of the full answer. Lindberg and Numbers (2008) also oppose the widely-held view that Christianity gave birth to modern science, arguing that this misrepresents the scientific achievements of ancient Greeks and medieval Muslims. Pakistani theoretical physicist and Nobel Prize winner, Mohammad Abdus Salam (Salam, 1984) draws attention to the recognition by scientists from Galileo’s times onwards, of the limitations of their disciplines – the recognition that there are questions which are beyond the ken of present or even future sciences. He, like Gould and Collins, argue that there is no conflict between religion and modern science. This view also has the support of Midgley (1985, 2006) who argues that religion that clashes with science is bad religion and vice versa.

Religion is too important to too many people for its dismissal (Gould, 1997) and while it would be perverse (Knight, 1986) to deny that there is progress in the sciences, there seems to be no way of knowing if anything in present science will turn out to be true in the long run. Knight

(2004) also quotes Isaac Newton, "... though we are still playing on the seashore, yet the great ocean of truth lies waiting, undiscovered before us – an ocean of spiritual truth as well as scientific truth." Fuller (2010, 2011) was more pessimistic about the future of science, arguing that the fracturing of the church is the eventual fate of science, as scientific authority may not survive its democratisation and the influence of the internet.

Both science and religion (Gaskell et al., 2010) are used as the basis of statements about the truth. From the scientific perspective, scientific truths trump any other form of knowing, and some scientific authorities argue that religion is at best wishful thinking, at worst a pernicious force in society. However, there are both scientists and religious leaders who see no intrinsic conflict between these two pillars of truth. Also, the faith we had in the past in religion is no longer its exclusive privilege, as science has become just as omnipresent in our daily lives. This was recognised by Durkheim (1912; 2001) who argues that if the stamp of science is sufficient to give it a privileged credit, it is because we have faith in it, and this value we ascribe to it depends on the idea that we have collectively of its nature and its role in life. For Durkheim, just as we had faith in God, we now have faith in science. This raises another question: Is science a new religion?

The moderating influence religious belief may have on science is the focus of Hypothesis 6.

Hypothesis 6: Knowledge and attitudes II (religiosity)

Null Hypothesis: There is no interaction between knowledge and religiosity in the public's attitude to science.

Alternate Hypothesis: There is an interaction between knowledge and religiosity in the public's attitude to science.

Method of analysis: MANOVA for interaction effects

3.3 Science and risk (the engineering approach)

There is still just too much we do not know about science (Knight, 2004; Salam, 1984) to give scientists a blank cheque on all issues, and increasing concerns over ethical and environmental matters have led to the emergence of other resistance groups outside the religious sphere. At the

heart of the conflict between scientists and lay people is how the two groups view risk. Slovic (1987) offers a plausible explanation for this, that while scientists employ risk assessment, the majority of citizens rely on intuitive risk judgements typically called risk perceptions which have their origin in social and cultural factors. He argues that this conceptualisation of risk by lay people is richer than that of experts and reflects legitimate concerns that are typically omitted from expert risk assessment. For Starr (1969, in Slovic, 1987), risk means different things to different social groups and his ordering of perceived risk for thirty activities and technologies showed that while non-expert groups considered vaccination to be of lower risk, experts rated it much higher. Reviewing Slovic (1987), Thompson and Dean (1996) argue that it obscures the distinction between psychological patterns of risk perception and philosophical conceptions of risk. They proposed an alternative paradigm called the probabilistic/contextualist dichotomy, seen as opposite ends of a continuum and as you move from the probabilistic to the contextualist poles, risk assessment is increasingly value-laden. Similarly, Lidskog (1996) observed that the mainstream position in literature on risk management recognises a distinction between objective and subjective risks. He argues that what may appear as an objective risk is actually a socially-defined risk. Slovic (1999) agrees with the view that risk is socially constructed; arguing that one way in which subjectivity permeates risk assessments is the dependence of such on judgments at every stage of the process. He also identified affect and world views such as fatalism and individualism as having strong links to public perception of risks. Slovic et al. (2004) argue that all the images in people's minds are marked to varying degrees with affect, and readily-available affective impressions can be easier and more efficient than weighing the pros and cons, especially when the required decision is complex or mental resources are needed. Song (2013), in a 2010 study in the US found that cultural predispositions such as hierachism, egalitarianism, individualism and fatalism contribute to public perceptions of vaccine benefits and risks as well as trust, knowledge, demographics and prevalence of diseases.

For Lidskog, science is far from unanimous, and commonly, there exist different groups of experts, different ways of seeing things and different judgements which means that in many conflicts, it is possible for both sides to adduce scientific support for their positions. Added to this heterogeneity is the reflexivity of science, which opens up the possibility of questioning the knowledge claims of science itself as being the unquestionable eternal truth. These two, he said, combined with the reflexivity of subjects, have constituted a situation of openness in the interpretation of reality, and people today have greater possibility of ignoring scientific statements.

Risk and trust in institutions and persons

“Trust is both at the origin and the limit of social knowledge.” – Moscovici (2001)

The word risk, according to Luhmann (1998), appeared in modern times to indicate that unexpected results may be a consequence of our decisions, roughly replacing what had been known as *fortuna*. Luhmann proposed a conceptual approach which sees trust as a solution for specific problems of risk but which has to be achieved within a familiar world and remain sensitive to symbolic events which may suddenly destroy the basis for their existence. The distinction between trust and confidence, Luhmann argues, depends on perception and attribution. If you do not consider alternatives, you are in a situation of confidence, but if you have to choose, you are in a situation of trust. In the case of confidence, attribution for disappointment is external while for trust, it is internal. For Giddens (2010), it is unhelpful to connect the notion of trust to alternative courses of action, as it is much more of a continuous state than this implies. Trust, Giddens argues, is what derives from faith in the reliability of a person or system and is the link between faith and confidence.

Giddens (1999, 2002) observed that that while the concept of risk is the mobilising dynamic of capitalist societies, others, which he referred to as traditional cultures, have continued to use fate,

luck or the will of the gods as a substitute for risk. This observation does not however, explain the religious conservatism in the United States and other capitalist societies.

For Neidhardt (1993), a public that cannot really understand what science says, has to believe and whether they believe or not is a matter of trust. Trust, he argues, is on the social level, the compensation for the deficiencies on a cognitive level. Nisbet and Scheufele, (2009) similarly argue that a miserly public relies heavily on trust in science and scientists. Slovic (1993; 1999) also argues that conflicts arising from risk management are increasingly being viewed as side effects of our participatory democracy, amplified by powerful technological and social changes that systematically destroy trust, and not due to ignorance and irrationality on the part of the public.

The impact of risk communication, according to Breakwell (2000), depends on a complex interaction between the characteristics of the audience, the source of the message and its content. The risk manager can shape its meaning (Otway and Wynne, 1989; Wynne, 1992) and this meaning can be drastically affected by social experiences, which go beyond the immediate communication. For Fischhoff (1995), effective risk communication can fulfil part of the social contract between those who create risks (scientists), and those who bear them (the public). He also offered an insight into the twenty years' history of risk communication organised around identifiable developmental stages, with each stage building on its predecessor without replacing them. The stages are:

1. All we have to do is get the numbers right
2. All we have to do is tell them the numbers
3. All we have to do is explain what we mean by the numbers
4. All we have to do is show them they have accepted similar risks in the past
5. All we have to do is show them that it's a good deal for them
6. All we have to do is treat them nice
7. All we to do is make them partners

8. All of the above

The stages effectively traced the history of risk communication from an era when the scientists thought they were right on all issues to the present era where to succeed, effective risk communication has to be structured as a two way process.

As science, which continues to redefine our common sense, becomes more complex, we have to increasingly trust persons and institutions as regards possible risks and as Moscovici (above) noted, trust is both at the origin and at the limit of social knowledge. If we do not trust the source of risk communication, it is unlikely to be accepted as new knowledge. If we do not have faith in the source of a message, it is unlikely to change our common sense.

3.4 Science and the public (the scientific establishment)

“Literary intellectuals are at one pole - at the other scientists ... between the two a gulf of mutual incomprehension - sometimes ... hostility and dislike, but most of all lack of understanding.” - C P Snow (in Gregory and Miller, 1998)

Caricatures of the relationship between science and the public, according to Gregory and Miller (1998) are legion and scientists are both loved as saviours and hated as designers of weapons of mass destruction. Scientists on the one hand, they observed, believe their work is not being appreciated by society but are also aware the situation may threaten research funding, and consequently their careers. Democratic governments are also aware that increasing scepticism is not good for the advancement of society and the coalition of purpose among politicians, scientists and other interest groups led to the Public Understanding of Science (PUS) movement. The launch of Sputnik, the first satellite in orbit by the Russians in 1957 was a blow to American pride, the authors noted and prompted the government to invest several billions of dollars in science education. Attempts to gauge the effectiveness of this level of funding in 1972 led to the biennial scientific literacy surveys of people's knowledge, and their understanding of, and attitudes towards science. A similar interest in the UK led to the Sir Walter Bodmer Report of 1985, commissioned by The Royal Society and followed by a government White Paper in 1993,

titled: *Realizing Our Potential*. This aimed at achieving better communication, interaction and mutual understanding between the scientific community, industry and government departments. Geoffrey and Durant (1987) listed nine areas that benefit from the promotion of the Public Understanding of Science. The areas include science itself, national economies, national power and influence, individuals, democratic governments and society as a whole. There are also moral, intellectual and aesthetic benefits. They observed that while many commentators agree on the need to promote public understanding of science, the nine arguments reveal profound differences of orientation, outlook and aim due chiefly to the deceptive simplicity of the notion of PUS. Issues have been raised regarding the meaning of the words “public”, “understanding” and “science.” Einsiedel (2000) made a case for understanding the complexities involved in the word public arguing that there are many publics and their composition and nature vary with the circumstances under which public and science meet. Perhaps the greatest criticism of PUS has been from the interpretation of the word understanding and attempts over the decades to measure and relate it with knowledge. The gap between science and the literary world has been a cause for concern for several decades (see Snow above) but of fundamental importance is what the public really needs to understand or what the meaning of understanding is in this context. Durant et al. (1992) identified three different objects of scientific understanding: understanding the intellectual products of science; understanding the formal process of scientific inquiry; and understanding the institutional structures of science. Miller (1998) focused on three dimensions: a vocabulary of basic scientific terms and constructs sufficient for reading competing views in a newspaper or magazine; an understanding of the process or nature of scientific enquiry; and some level of knowledge of the impact of science and technology on individuals and on society. Gregory (2001) observed that public understanding has been equated with factual knowledge of the content of science and also with appreciation of the scientific enterprise and of particular innovations. The two equations, she noted, has led to a situation where knowledge equals appreciation; an interpretation which ignores research findings that the more knowledge people

have, the more critical they become about an issue; thus, the more knowledge people have about science, the more polarised their attitude becomes. Bauer et al. (1994) proposed that the concept of PUS be seen on the one hand as an activity which comprises practical efforts to popularise science, and on the other hand as a field for research and reflection on such activities and their intended and unintended effect.

Science indicators or social surveys aimed at measuring literacy levels have been carried out since the late 70's on both sides of the Atlantic. Such surveys have however become a euphemism for a knowledge-deficient public, hence the term "cognitive deficit model". Joffe (2002) credited the origin of the term deficit model to Wynne (1982) who used it to denote how objective scientists are juxtaposed with irrational lay people in many theories of human response to risk. Ziman (1991), while acknowledging the depressing degree of public ignorance about science, argues that such survey responses attach great weight to the weaknesses in people's formal scientific knowledge without making allowance for the difference between respondents' tacit understanding of the state of affairs and their ability to state verbally what they know. Durant et al. (1992) observed that critics raised three principal objections: the model misrepresents science itself by portraying it as an unproblematic body of knowledge; the model overlooks the fact that a great deal of scientific knowledge is both remote from and largely irrelevant to daily life; and that it is either explicitly or implicitly normative, suggesting that scientific understanding is inherently good. However, Durant et al., while conceding that a great deal of science is problematic, argue that vast areas of scientific knowledge are relatively unproblematic, giving a reasonable stable body of knowledge on which levels of public understanding can be measured just as the IQ test. Einsiedel (2000) similarly in support argues that that the public can at times be inattentive, unmotivated and ignorant and in such situations the deficit model has proved very useful. Citing the example of AIDS, he observed that the identification of the levels and nature of public knowledge became a critical first step in public education.

Miller (2001) in a contextual approach model sees the generation of new public knowledge about science as a dialogue in which, while scientists may have scientific facts at their disposal, the members of the public have local knowledge and an understanding of, and personal interest in the problems to be solved. He said it is important that citizens get used to scientists arguing about controversial facts, theories and issues. Sturgis and Allum (2004), also argue that there is no reason to assume that scientific knowledge does not have an additional and independent effect if culture, economic factors, social and political values, trust, risk perception, and worldviews are all important in influencing the public's attitude towards science. For Gauchat (2011), future survey research should explore the idea that textbook knowledge, general attitudes, formal experience with organised science and certain beliefs about the nature of science in society are components of a general cultural disposition or worldview. But for Bauer et al. (2007) while the polemic over the deficit model voiced a valid critique of a common sense concept among experts, it confused the issue with methodological protocol.

Period	Attribution problems	Proposals Research
Science literacy 1960 onwards	Public deficit Knowledge	Literacy measures Education
Public understanding After 1985	Public deficit Attitudes Education	Knowledge-attitude Attitude change Image marketing
Science and society 1990's to present	Trust deficit Expert deficit Notions of public Crisis of confidence	Participation Deliberation Angels mediators Impact evaluation

Table 6 Paradigms, problems and proposals (Bauer et al., 2007)

Outlining the three paradigms of research in the field, they argue that the link between research protocol and the deficit model needs to be severed to liberate and expand the research agenda. They suggested a liberated agenda that might include, among other things: contextualising survey results through a reframing of the knowledge-attitude problem; recognising that

information matters as well as the ability and motivation to process it; and searching for cultural indicators which indicate the context for action.

The findings of surveys have, however, provided useful insights into the relationship between knowledge and attitude. Allum et al. (2008) found that that people who are more scientifically literate have a more positive attitude to science in general, but are not necessarily more positive about specific technological applications or specialised areas of scientific research. The authors also reviewed 193 PUS surveys carried out in 40 countries in the past 15 years and found a small but positive correlation between general attitudes towards science and general knowledge of scientific facts after controlling for a range of variables.

Science and democracy

Wolpert (1992) argues that people accept the ideas of science not because they understand the evidence and argument but because they have been told that these are true, and this dependence on others accounts for why science is viewed with a mixture of admiration and fear, hope and despair. For Asimov (1983) the choice between science and technology being either a destroyer or saviour is ours; it resides in society. Science, Cobern (1999) also observed, is an aspect of several meaning systems that people construct for making sense of their world and while science has powerful ideas, there are also other powerful ideas such as freedom, democracy, rule of law, social solidarity, etc. Miller (2001) sees what eventually emerges as true (acceptable) scientific knowledge as a product of negotiation between scientists and the public. This process of negotiation is the subject of a group of essays edited by Jasanoff (2004) titled: "States of Knowledge." Co-production, according to Jasanoff, is the shorthand for the proposition that the way we know and represent the world (both nature and society) are inseparable from the ways in which we choose to live in it. Society, she argues, cannot function without knowledge any more than knowledge can exist without appropriate social support.

Shapin (2008) however observed that while it is scientists we turn to when we want an account of how matters stand in the natural world, they are not the ones who decide what ought to be

done for many of those potentially life-changing decisions. Politics and politicians decide. Also, Wynne (1991) argues that while lack of understanding of science can be seen as an obstacle to democracy, an impoverished democracy may also be an obstacle to public understanding. The role of politics in life-changing scientific decisions was exemplified in Mooney's (2005) book titled: "The Republican War on Science" wherein the author took to task, among others, President George W Bush's policies on evolution, climate change and stem cells, which he described as at the very least not scientifically informed and at worst, anti-science. Bush's position, he contended, was similar to President Ronald Reagan, also a Republican, who was reluctant to acknowledge the AIDS epidemic and educate school children about safe sex and condoms. Reagan also showed his preference for creationism over evolution and often misused the science of acid rain, he writes. That Bush's successor, President Barack Obama, a Democrat, reversed the order placed on stem cell funding shows the impact of the political system on science and its advancement. Succeeding presidents of the most powerful country in the world do not agree on the direction and pace at which science should progress, not for lack of scientific evidence, argues Mooney (2005) but for political exigencies: where the votes swing.

The intervention of the Supreme Council for Shari'ah in Nigeria (SCSN) and the Kaduna State Council of Imams and Ulama in an ongoing vaccination programme also shows the very strong influence of religious groups in the acceptance and promotion of science in the society. The reversal of policy following the change of government in Kano State, from the more religiously liberal People's Democratic Party to the more conservative All Nigeria's People's Party, further corroborates Mooney's observation.

As Hilgartner (1990) argues, people make different judgements depending on their social location, interests and appraisal of the circumstance. Now, since scientists themselves are divided on so many issues, what gets labelled distortion and what gets accepted as appropriate, who deploys these labels, and when and how are they used during controversies? The

relationship between scientists, the public, democracy, religion, and trust in institutions and persons takes us to another hypothesis.

Hypothesis 3: Trust in institutions (science, religion, etc.)

Null Hypothesis: Levels of trust in scientists and religious leaders in Nigeria are negatively correlated in the context of trust in other institutions.

Alternate Hypothesis: Levels of trust in scientists and religious leaders are positively correlated.

Method of analysis: Factor analysis

3.5 Science and Social Representations

“Social thinking owes more to convention and memory than to reason; to traditional structures rather than to current intellectual or perceptive structures.”

-Moscovici (1984)

Science in society has been examined from two major perspectives, on which I elaborated earlier on in this chapter: risk perception and public understanding of science. These two fields have grown apart over the years as the PUS resonated among scientists and the risk perception more with engineers (Bauer, 2014 in press). While the two approaches, according to Bauer, are functionally equivalent, scientists, while dealing with public opinion, prefer the terms literacy, public understanding and attitudes while engineers prefer the terms risk perception, risk assessment and risk management. The problem of PUS hinges on understanding common sense, which takes inspiration from many sources, including science, which has become a very important component (Bauer, 2009). The vaccination controversy in northern Nigeria raises several questions about the transformation in a society of a scientific phenomenon into common sense knowledge. These questions were adequately captured by Jovchelovitch (2008) when she asked the following questions: What are the relations between science and common sense; how does social knowledge evolve as it moves between different social contexts and is appropriated by different social actors; and how do emotional and social forces shape different forms of knowing? These questions were the focus of the book, ‘La Psychanalyse: son image et son public’ (Moscovici, 1961; 1976) which examined the ways in which Freud’s psychoanalysis

permeated the French public and according to Jovchelovitch, remains central to social scientific enquiry.

Moscovici's Social Representations Theory (SRT) examines the way in which a scientific language becomes common dialect, pervades judgement and directs behaviour (Moscovici, 1963). The interest with this paradigm (Joffe, 2002) is not whether a response is right or wrong but why and how society creates social representations and the common sense that evolves from this process. The theory, according to Farr (1993; 1993a) draws a sharp distinction between a scientific theory and its social representations corresponding to the contrasting worlds of science and common sense, and provides a framework for research into the public understanding of science. In contrast with a risk perception paradigm, Joffe (2003) argues that representations better facilitate the understanding of social rationality and the shared interpretive resources which it reflects and cultivates. Gaskell (2001) said it assumes that social phenomena occur within a dynamic process of interaction and communication. For Bauer and Gaskell, (1999) the conceptual richness of the theory is suited to characterising the evolution of content, structure and functions of the voices and images of public concern. For Joffe, (1999), it proposes that the motivations which underpin risk perception are not based upon a need for accurate information but rather, a want in people to protect from threat, themselves and the groups with which they identify. Jodelet (1989) sees it as providing the means for theorising representations without contradictions expressive of the subjects who constructed them, in terms of their relationship to symbolic and ideological processes, and to social dynamics.

Sergei Moscovici's (1961; 1976; 2008) study was undertaken when France was still living through the consequences of the Second World War, and psychoanalysis and Marxism had been diffused widely in French culture. Society was divided in its acceptance of both, and for this, Moscovici, according to Farr (1993) thought the adjective "social" more appropriate than "collective" (as used by Durkheim) to qualify representations. It was indeed surprising, Duveen

(2008) noted, that the ideological conflict over the Cold War could powerfully influence the framing of the social representations of psychoanalysis.

The theory remains relevant today, 50 years on, and is particularly applicable for my research, as the cold war between the western world and Islam strongly influenced the debate over a scientific product, the OPV, in a society sharply divided by religious and ethnic orientations and political party affiliations. It provides for me a conceptual framework to also incorporate both the risk and PUS paradigms. I am also convinced of its primacy for this type of research, which includes longitudinal studies to map content and changes in common sense.

Common sense and science

Discussing science and common sense, or scientific and lay epistemology raises the spectre of a very old opposition of two worlds of thinking: the professional and the casual, each with its own logic, limits and attributes (Moscovici and Hewstone, 1983). The issue in contemporary social psychology, they argue, is whether the scientific and lay epistemologies are opposites or complimentary. Moscovici and Hewstone observed that common sense comprises the images, mental connections, and metaphors that are used and talked about by everyone and is a corpus of knowledge based on shared traditions and enriched by thousands of well-practiced experiments and observations. Wagner and Hayes (2005) agree with this definition, arguing that our present day thinking is based on a succession of historically-evolved mentalities, and past events are thus compressed in images and metaphors which determine our present thinking. Gregoric (2007) describes common sense as the ability of human beings to follow their experience in discerning some obvious things, making elementary connections among them and avoiding patent contradictions. He observed that while our notion of common sense has been traced back to Greek philosophers, especially the Stoics, the germs have been found in Aristotle himself. But in Aristotle's psychology, he noted, the expression, common sense, refers to a distinct perceptual capacity in which the five senses are integrated. My concern is with the everyday use of the expression, similar to what Latin classical writers such as Cicero, Horace and Seneca referred to

as *sensus communis* (Gregoric 2007) and the power in the phrase could not have been better exemplified than by Thomas Paine in his pamphlets (Paine, 1976) titled: “Common Sense” which was credited with galvanising the citizens of what is now United States of America towards freedom from the British monarchy.

Markova (2003) observed that common sense knowledge has historically been treated as inferior and associated with lack of rationality or even irrationality, while natural science has become associated with the power of reason and rationality. Similarly, Bangerter (1995) observed that western scholarly discourse holds that the history of science is not much more than the progressive correction or elimination of erroneous folk theories. However, Jesuino (2008), noting the role of common sense in daily life, observed that at times it is insufficient and people may become intrigued or anxious about the new challenges which often come from science, whose recent revolutionary path constitutes the main source for social change. The outstanding progress of science, he argues, does not reduce the sphere of common sense but leads to a reinforcement of both forms of knowledge – we are all scientists just as we are all laypersons, and this was what Moscovici had in mind when he said we have entered the era of social representations. Jovchelovitch (2008) argues that science and common sense are entangled in and indebted to each other, and citing Habermas (2003), she said science cannot relieve common sense, even if scientifically informed, of the task of forming a judgement.

Common sense, under the social representation paradigm, according to Bauer and Gaskell, (2008) is neither a distorted vulgarisation nor a simple diffusion of dignified knowledge, but takes the middle ground and presents a third way that offers a more sophisticated theoretical and empirical heuristic. However, the idea of a new common sense, they observed is hotly debated among scientists and while it means substitution to some, to others it is pluralisation. For me, the local culture and issue are very important and it is possible for both to exist side by side (pluralisation). For some phenomena however, as one image, one way of looking at an object proves more reliable and acceptable than the other over time, it becomes treated as a fact, while the other

degenerates into folklore (substitution). As Moscovici (1984) argues, they become fossilised in tradition and taken for granted in social practice.

Moscovici, in his study, sought to understand how a scientific phenomenon inflects a society's behaviour, way of thinking and language, and is thus transformed, through its very circulation, into a social representation (Moscovici, 1963). Or, how and why countless new ideas, strange images, esoteric names relating to the universe, economy, the body, the mind, and history have become accepted ideas by leaving the labs and publications of a small scientific community to penetrate the conversation, the relationships or the behaviour of large communities and to be diffused throughout its dictionaries and current reading matter (Moscovici, 2001).

The study showed how three distinct subcultures of French society in the fifties responded to the challenge of psychoanalytic ideas. For the communist-controlled press, the communication strategy was that of propaganda seeking to enforce a stereotypical rejection by the group of psychoanalysis as an instrument of western imperialism. The communists described psychoanalysis as an invasion of French culture and morals, a tool for political intervention and an ideological rearmament of American imperialism. The Catholic press adopted the strategy of propagation seeking to influence attitudes. For them, while the theory and practice derived from it are dangerous, spiritual advisers can work together with therapists while the church must adopt its concrete findings. The newspapers catering for the amorphous urban elite diffused information from specialist sources to their readers with the aim of influencing opinions. The study, according to Jovchelovitch, (2001) showed that psychoanalysis became a different phenomenon as it penetrated the life worlds of the urban liberal professionals, the communists and the Catholics.

Now, if we consider the variety of functions served by social representations, we can extend the term to term link of propaganda, propagation and diffusion to stereotypes, attitudes and opinion (Moscovici, 1984, Doise, et al., 1993, Markova 2003) to the vaccination literature.

Propaganda	Propagation	Diffusion
Stereotypes	Attitudes	Opinion
Anti-vaccination	Pro vaccination	Pro and anti-vaccination

Table 7 Vaccination resistance: Communication styles

Castro and Gomes (2005) also proposed four logical options derivable from belief A and non A (more in the next chapter) which gives rise to highly negative, highly positive and both positive and negative.

Moscovici drew inspiration from Durkheim's concept of collective representations. Explaining his departure from Durkheim (Moscovici, 1973), he said that with collective representations, individuals and groups are envisaged in a static way as they make use of information circulating in a society, and not as they create such information. He contrasted this with social representations which do not represent simply "opinions about", "images of" or "attitudes towards" but "theories" or "branches of knowledge" in their own right for the discovery and organisation of reality. Farr (1998) said Moscovici distinguished social from individual representations with the same intent as Durkheim, to ensure that one cannot be explained in terms of the other, and as strong an anti-reductionist as Wundt, that social psychology cannot be reduced to experimental psychology. Representations, Moscovici and Vignaux (2000) argue are the object of a permanent social work, in and through discourse, so that every new phenomenon can always be reincorporated within explanatory or justificatory models which are familiar and therefore acceptable. Representations, they argue further, are inscribed within the framework of pre-existing thought, hence are always dependent on systems of belief anchored in values, traditions and images of the world and of existence, and always play a triple role of illumination (giving sense to realities), integration (incorporating new ideas or facts into familiar frameworks) and partition (ensuring the common sense through which a given collectivity is recognised). They argue that such systems for interpreting the world and events are essential vectors of opinions, judgements and beliefs directed at ensuring the relevance and regularity of our bonds and of our conduct as a community.

Science, common sense and social representations

Moscovici (1984) separates science and common sense into ‘consensual’ and ‘reified’ universes. In his consensual universe, society is seen as a group of individuals who are equal and free and this is where he locates common sense. In his reified universe, society is segregated and members are not equal, each participating only in his area of acquired competence, this is where he locates science. Markova (2003) said Moscovici saw science and common sense as two essentially different yet complimentary kinds of knowledge based on different kinds of rationalities. For Jovchelovitch (2008), it brings to the fore the continuum between life and knowledge, between a psychology of rationality and cognition and a psychology of experience, emotion and society.

The question Moscovici next sought to answer is how the ‘man in the street’ (now man in front of the television and or computer), familiarises himself with the opinions which relate to the reified universes. How do we make the unfamiliar words, ideas, or beings familiar? Moscovici (1984) argues the images, ideas and languages shared by a group always seem to dictate the initial direction by which the group tries to come to terms with the unfamiliar. Social thinking, he argues further, owes more to convention and memory than to reason; to traditional structures rather than to current intellectual or perceptive structures. He suggested two mechanisms of thought process: anchoring and objectification. He described anchoring as a process which draws something foreign and disturbing into our system of categories and compares it to the paradigm of a category which we think to be suitable, while objectification identifies the iconic quality of an imprecise or abstract idea and reproduces it in an image. Objectification, Moscovici said, is about filling something empty with substance, like comparing God to father which makes things to be known out of things already known.

Moscovici’s SRT met with resolute critics, but the amount of research it has influenced today is a testimony to its versatility and acceptability among social scientists. Jahoda, (1988), had

accused Moscovici of attempting to resuscitate the notion of group mind determination of individual thought where the ideas of an elite corps dominate individual minds. There were also criticisms from the British school of discourse theorists who viewed the notion of consensus or sharedness as flawed and suggested that social representations be described as 'linguistic repertoires' (Potter and Litton, 1985; McKinlay and Potter, 1987; Potter and Edwards, 1999).

Voelklein and Howarth (2005) summarised the criticisms into four categories: theoretical ambiguity; social determinism; cognitive reductionism; and failing to address issues of power and ideology. While Rose et al. (1995) argue that consensus is already the outcome of power struggles occurring in the social fabric, Raty and Snellman (1992) observed the tendency by the critics to translate Moscovici's ideas into the language of each commentators own theory and preferred methodology. Purkhardt (1993), in her contribution said the initial vagueness had been a virtue because it has allowed a variety of theorists and researchers to expose its usefulness and possible applications. What is required, according to Bauer and Gaskell (1999), is an elaboration and clarification of the key conceptual distinctions and their implications for the conduct of research. Moscovici (1988) argues that the theory has adopted to a large degree the perspective of the consensual universe, which means that the reified universe is also taken into account and both universes act simultaneously to shape our reality.

In their work on the urban rehabilitation of a Lisbon neighbourhood, Batel and Castro (2009) found that reification and consensualisation can be used by both lay people and expert spheres and concluded that the two notions are good descriptors of two very distinct 'ideal type' communicative formats with different consequences, instead of static notions referring to sharply differentiated universes. They also argue that conceptualising reification and consensualisation as communicative formats has implications for theory and practice; it provides the theory with analytical tools capable of diagnosing how communication unrolls in practice. Also, just as Batel and Castro found that discursive strategies based on reification were used by both the expert and lay spheres, I similarly found that in the northern Nigeria vaccination controversy and others

before, both pro and anti-vaccination campaigner's deployed 'reified' arguments to support their positions.

Moscovici (2001) also reacted to two broad criticisms: that the theory is European and that it is neither experimental nor predictive. Noting that there is a diversity of theories wherein some explain and predict (such as quantum theory) and others explain without predicting (for instance natural selection) he observed that mainstream social psychology has lately opted for the former, while his theory belongs to the latter kind. Moscovici argues that it is illusory to want to make a prediction where a relatively complex theory is required to explain, in a meaningful way, phenomena which are also relatively complex, noting that economics, linguistics, anthropology and child psychology develop theories that explain without predicting.

For me, the richness of the social representations paradigm is its robustness and I agree with Moscovici's position that when a theory is out there in the public domain, it can no longer be tied to its origin (American or European) as it becomes universal, although there may be differences in style of applying the theory. However, I disagree with him on the issue of prediction. While with some types of research, we can be content with just explaining why a phenomenon is what it is, for others, we need to go a step further and predict the probability of occurrence of certain issues given a combination of factors. This has far-reaching implications for the design, implementation and success of scientific interventions and communication. Targeting groups predicted as vulnerable has contributed to the success of the HIV/AIDS campaign in many societies. For this research therefore, while the social representations paradigm explains resistance, the PUS paradigm (and risk perception) offers conceptual approaches to prediction based on factors such as trust in institutions and persons, beliefs, knowledge, interest, etc.

The social representations theory has been used with insightful results for the study of the representations of madness in France (Jodelet 1989, 1991) and India (Wagner, et al., 1999; Wagner, et al., 2000). It was used for the study of intelligence by Mugny and Carugati (1998);

health among the Chinese community in England (Gervais and Jovechelovitch, 1998) and Ebola in the UK by Joffe and Haarhoff (2002). Wagner (1994) documents a host of research efforts guided by the theory.

Cognitive *polyphasia* versus cognitive dissonance

Moscovici (2008) in *La Psychoanalyse* also observed that a plurality of modes of thought can often coexist within the same individual. He argues that this dynamic coexistence of distinct modalities of knowledge determines a state of cognitive *polyphasia*. For Moscovici (Moscovici and Makova, 1998), just as language is polyphasic, thinking is polyphasic, meaning we can combine and use our intellectual capacities in different ways just as we can use words in different ways. Jovchelovitch (2002) observed that while Moscovici presented the concept as a hypothesis, the data provided ample evidence that different rationalities were involved in the constructions of representations about psychoanalysis. The striking finding, she observed, was that contrary to well established interpretations of cognitive phenomena, the different forms did not appear in different groups or different contexts but were found capable of coexisting side by side in the same context, social group or individual. I shall take this further and argue that when it comes to science and religiosity, my data showed it is not just co-occurrence, which may connote parallel thoughts, but also co-influence, which denotes complimentary thought processes. Science is not enough (Provencher, 2011), the data showed.

The opposite hypothesis is Festinger's theory of cognitive dissonance, which implies that if a person holds two cognitions that are psychologically (not necessary logically) discrepant, the discrepancy is uncomfortable and the person is motivated to reduce the dissonance by changing either or both cognitions or introducing a new one (Augoustinos, et al., 2010). This argument, the authors observed, has been contested by critics who argue that the desire to achieve and maintain consistency is a peculiar western cultural construction and people are more tolerant of cognitive and interpersonal inconsistencies than the cognitive dissonance theory assumes. Cognitive dissonance was also contested by Wynne (1992) who argues that in the real world,

people have to reconcile or adapt to living with contradictions which are not necessarily within their control to dissolve. He said people may opt for a more flexible and adaptive relationship with their physical and social worlds where ambiguity and contradiction are not so much of a threat.

3.6 Social representations, public opinion, media and rumours

“There is no public opinion without different representations.” – Bauer and Gaskell, (2008)

Tracing the history of public opinion as a construct, Lazarsfeld (1957) said it is generally agreed that it was the rise of the middle class, the spread of democratic institutions, the expansion of literacy, and the growth of mass media of communication which gave rise to concerns about what was loosely called public opinion. By this term, he said, many authors of the classical school referred to people who did not belong to the ruling classes from which the government personnel was recruited and yet claimed a voice in public affairs. The term public opinion, Lazarsfeld observed, came into use because ‘no appropriate logical categories existed to cope with it’. Authors in modern era have, however, raised issues with the appropriate definition of the construct, asking if the terms public and opinion can indeed be merged. Price (1992) argues that connecting the two concepts represents a liberal philosophical attempt to unite the one and the many. Is it a simple aggregation of individual views as stated by Childs (1939) or a collective-level, emergent product of debate and discussion that cannot be reduced to individuals as proffered by Blumer (1948), Price wondered? Childs (1939), a political scientist, had described public opinion as any collection of individual opinions regardless of the degree of agreement or uniformity, while for Blumer (1948), a sociologist, it is a function of a structured society, differentiated into a network of different kinds of groups and individuals having differential weights and influence and occupying different strategic positions. The debate between Childs and Blumer re-enacts the preference of social representations by Moscovici to

collective representations as theorised by Durkheim. Noting that Childs (1965) documented about 50 definitions of public opinion in the mid-60s, Noelle-Newmann (1984: 1993) separated the definitions into two concepts: public opinion as rationality and public opinion as social control. The rationality view, she argues, is based on the notion of well-informed citizens and focuses on political life and political controversies (democratic participation) while as social control, it is not concerned with the quality of the arguments but which of the two camps in a controversy is strong enough to threaten the other with isolation. Noelle-Newmann (1979) draws attention to John Locke's law of fashion. Locke had argued that the law of fashion is heeded more than any divine law or any law of the state because the individual will be made to suffer for any violation of this law by losing the sympathy and esteem of his social environment. Noelle-Newmann (1984: 1993) said: "To run with the pack is a relatively happy state of affairs but if you can't, because you won't share publicly in what seems to be a universally acclaimed conviction, you can at least remain silent as a second choice so that others can put up with you." Noelle-Newmann locates her theory of the spiral of silence in public opinion as social control. Reviewing 25 years of the spiral of science, Scheufele and Moy (2000) said it presents an approach some critics have called a fractured concept of public opinion. They however, called for a return to a more macroscopic focus, which is likely to address the societal level processes which the spiral of silence theory predicts.

Moscovici was not satisfied with the construct opinion, arguing that the broader structure which integrates its content must also be taken into account (Moscovici, 1963). He argues that "the concepts of image, opinion and attitude do not include the associations and anticipations to which they give rise" and since the concept of social representation continually go beyond what is immediately given, the construct could easily replace those of opinion or image (Moscovici, 1973). Farr (1990; 1993) argues while the techniques of opinion poll can identify just how widespread a particular belief might be within a given population, we need the theory of social representations to account for the dynamics of the change and why the distribution takes the

particular form it does. Farr (1996) observed that the contrast between French research on social representations and American and British research on attitudes and opinions is a specific instance of the difference between sociological and psychological forms of social psychology. French research on social psychology is often classified as a sociological form of social psychology in contrast to the psychological form that is dominant in the United States. This argument may, however, become unnecessary as methodological triangulation gains momentum as a process for the production of knowledge (Denin, 2010), an approach this research has adopted.

At this point, it is pertinent to dwell on the role of the media in creating representations or public opinion. Now, knowledge in its most elementary form reaches the public in the form of news (Park, 1940) and the clash of opinions and sentiments which the ensuing discussion on the issue invariably evokes, terminates usually in some form of consensus or collective opinion. Noelle-Newmann (1974) also sees the mass media as creating public opinion by providing the environmental pressure to which people respond with alacrity, or with acquiescence or with silence. McCombs (2004) for his part, was of the opinion Lippmann's (1922) thesis about the "pictures in our heads" is that the news media, determines our cognitive map of the world. The question which has engaged researchers since Lippmann's era has been how the media influence this cognitive map, our common sense. McQuail (1994) argues that the entire study of mass communication is based on the premise that the media have significant effects on people's perception of the world. At first, it was the so called "magic bullet" or "hypodermic needle model" where media were said to exert strong effects, this was however, superseded, observed Scheufele (1999), by a period when personal influence was considered to be the main influence on attitude change and the media only reinforced existing attitudes, but this lasted for a while as research again shifted to the search for strong effects. The present stage, according to Scheufele, is characterised by social constructivism which combines elements of both strong and limited media effects. Petty, et al. (2002) observed that most current analyses of attitude change hold

that it is not the information per se that produces persuasion, but rather people's idiosyncratic reactions to this information. Riffe et al., (1998) also argue that the audience chose what parts of messages, if any, to attend, and rejected much that was inconsistent with their existing attitudes, beliefs, and values. Notwithstanding the non-passive nature of the audience, Gamson and Modigliani (1989) argue that they still use media messages to construct meaning. Mass media effect theories include; agenda setting (McCombs and Shaw, 1972); quantity of coverage theory (Marzur and Lee, 1993); cultivation analysis (Gerbner, 1969; Gerbner et al., 1978); spiral of silence (Noelle Newman, 1974); and framing (Entman, 1991, 1993). Summarising research in the field, McQuail, (2005) proposed a typology of media effects on two dimensions: time and intentionality. He located all media effects research on a two-dimensional plane on which are spread a series of hypothesis such as propaganda, agenda setting, framing, policy effects, diffusion of innovation, social control and social integration.

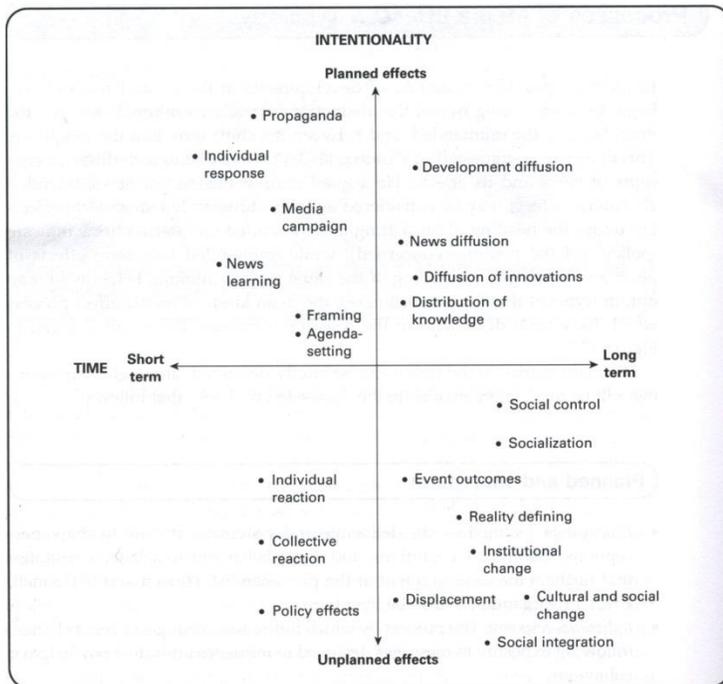


Figure 11 Typology of mass media effects (McQuail, 2005)

The results of these efforts to pin down media effects on audiences remain inconclusive, in particular with the direction of causality (Bauer, 2005).

The agenda setting theory (McCombs and Shaw, 1972) is about the transfer of salience from the mass media to the public. Traditional (or first level) agenda setting effects, according to McCombs (2004; 2005) emphasise the salience of objects, but these objects have their own attributes: central themes which define a dominant perspective on an object and aspects which are a general category of attributes. This is similar to the structural approach of Abric (2001) and Wagner and Hayes (2005). The quantity of coverage theory, (Marzur and Lee, 1993) is an elaboration of the agenda setting theory. From their work on environmental and technological risks, Mazur and Lee argue that most people don't read the entire news and as the quantity of stories increases, so do public opposition and concern and as the quantity decreases, so do audience worries. For Gerbner, (1969; 1978), what the media do is the cultivation of common perspectives, rather than achieving any preconceived goals, effects or impact. McCombs linked the theory of dominant perspectives with the concept of framing (Entman, 1993). Frames, according to Entman (1991, 1993) help establish the common sense interpretation of events and its essence is sizing: magnifying or shrinking elements of the depicted reality to make them more or less salient. Bauer et al. (2006) describe framing, at its most basic, as one way an issue is written or talked about, indicating other frames are always possible. For Gamson et al. (1992), frame as a concept plays the same role in analysing media discourse that schema does in cognitive psychology, but there is an inherent ambiguity in the concept as frame can refer to a picture or part of a building. Scheufele (1999) also argues that research on framing is characterised by theoretical and empirical vagueness. For Scheufele the conceptual definition of framing needs to be developed and split it into media and individual frames; one for presenting, the other for comprehending the news. His separation showed that like social representations, frames can be found both in cognition and in culture. The works of Entman and Rojecki (1993) on the US anti-Freeze movement and Joffe, (2002) on Ebola in the UK also show that media and audience frames can be far apart. The effect of the media on representations takes us to hypothesis I and II which examine the media coverage of science and the OPV controversy.

Hypothesis 1: The Oral Polio Vaccine Controversy in Northern Nigeria

Null Hypothesis: Media coverage of the oral polio vaccine in northern Nigeria was largely negative.

Alternate Hypothesis: Media coverage was not predominantly negative.

Method of analysis: Content analysis of the coverage of the oral polio vaccine controversy in the Nigerian press from 2001 to 2009.

Hypothesis 2: Media Coverage of Science in Nigeria

Null Hypothesis: Intensity of coverage of science in the Nigerian press was low (in terms of quantity of stories) and predominantly negative.

Alternate Hypothesis: Intensity of coverage of science is comparable with United Kingdom and the United States and not predominantly negative.

Method of analysis: Content analysis of the genres of science news in the Nigerian press form 2001 to 2009.

One other concept of relevance here is rumour and its link with social representations. Rumours are said to arise from popular culture to defend group identity and rely on emotional states in periods of social duress to make sense of change or novelty (Franks and Attia, 2011; Caplow, 1947; Benerjee, 1993; Di Fonzo and Bordia, 2000; Rosnow, 1988; Knof, 1975; Rosnow and Foster, 2005; Smith, 2001; Gewald, 2001; Johnson, 1998; Das, 1998). The concept is thus similar to the theory of social representations which proposes that that the initial direction people will look at the unfamiliar will be from the images, ideas and languages shared by the group (Moscovici, 1984); “pre-existing thoughts” (Moscovici and Vignaux, 2000) and group identity (Joffe, 1999). Also relating rumours to social representations, Lorenzi-Cioldi and Clemence (2001) describe it as an anchoring process. The concept, according to Moscovici (2008), shows that in conversations, nothing is completely forbidden. He argues: “verbosity is the price to be paid for having conversation, as well as an obstacle to conversation. It is an indicator that nothing is completely forbidden and nothing is really deviant ... Perhaps this is what is misnamed as rumour or social noise.”

3.7 Summary

For Durkheim (1912), because everything in social life, even science itself rests on opinion, it is not enough to be true to be believed. The vaccination controversy is a case in point. It was characterised by a public disagreement among scientists, politicians and religious leaders. All sides deployed reification arguments alluding to results of scientific experiments but the anti-OPV camp, in addition, deployed consensual arguments by referring to earlier episodes with Pfizer and the wars in Iraq and Afghanistan which made the conspiracy theory of a grand design against Muslims more likely to be true. The vaccination controversy bore all the hallmarks of science in society (PUS): a trust and expert deficit and crisis of confidence. The western conspiracy theme was an anchoring process, and this abductive reasoning has also been described as rumours. It originated from common sense, from pre-existing thoughts and is comparable with the development of representations related to HIV/AIDS which are no longer the same today. My research will combine both the engineering and science in society perspectives for a bird's eye view of the controversy, the place of science in Nigerian society and its relationship with religiosity. The overarching research objective is how science is transformed into common sense and Moscovici's SRT as a research framework, is robust enough for the PUS paradigm, which for most part has agreed with the risk perspective in terms of the social nature of common sense. Specific research hypotheses are listed below.

Hypothesis 3: Trust in institutions (science, religion, etc.)

Null Hypothesis: Levels of trust in scientists and religious leaders in Nigeria are negatively correlated in the context of trust in other institutions.

Alternate Hypothesis: Levels of trust in scientists and religious leaders are positively correlated.

Method of analysis: Factor analysis

Hypothesis 4: Structure of attitudes to science

Null Hypothesis: 2 factors: progress and pessimism characterize the attitudes of Nigerians to science and technology.

Alternate Hypothesis: Attitudes are characterized by more than two facets.

Method of analysis: Factor analysis.

Hypothesis 5: Knowledge and attitudes I (Fundamental Attitudes)

Null Hypothesis: There is no interaction between knowledge and fundamental attitude to the world in the public's attitude to science.

Alternate Hypothesis: There is an interaction between knowledge and fundamental attitude to the world in the public's attitude to science.

Method of analysis: MANOVA for interaction effects.

Hypothesis 6: Knowledge and attitudes II (religiosity)

Null Hypothesis: There is no interaction between knowledge and religiosity in the public's attitude to science.

Alternate Hypothesis: There is an interaction between knowledge and religiosity in the public's attitude to science.

Method of analysis: MANOVA for interaction effects.

Hypothesis 7: Knowledge and attitudes III

Null Hypothesis: Knowledge and attitudes to science are positively correlated.

Alternate Hypothesis: Knowledge and attitude to science are not positively correlated.

Method of analysis: Binary logistic regression of attitude facets on knowledge.

Hypothesis 8: Public understanding of vaccination (pages 65, 125)

Null Hypothesis: There is no association between Public Understanding of Science (knowledge, trust, attitudes) and opposition to vaccination.

Alternate Hypothesis: There is an association between Public Understanding of Science (knowledge, trust, attitudes) and opposition to vaccination.

Method of analysis: Binary logistic regression.

4.1 Introduction

This chapter sets out the methodological approach conscious of the essence of good practice and involves a triangulation of various sources of data: media archives, surveys and interviews. Using content analyses, I examine the coverage of science in the press and how the newspapers reported the oral polio vaccine (OPV) controversy. Both analyses span 2001 to 2009, covering the period before and after the revolt against the OPV. An online survey was conducted with respondents from Nigeria and abroad. The main survey was conducted in Lagos, South West of Nigeria. Interviews were also conducted with Nigerians from various tribes and faiths to contextualise the other findings. The study also gained information from past and contemporary history through books and films of local culture.

4.2 Triangulation for social representations

“From the epistemological point of view, what is in question here is the analysis of all those modes of thought which everyday life sustains and which are historically maintained over more or less *longues durees*; modes of thought applied to directly socialized ‘objects’, but which, cognitively and discursively, collectivities are continuously driven to reconstruct in the relations of meaning applied to reality and to themselves.” - Moscovici and Vignaux, (2000)

Moscovici’s SRT, according to Doise (1993) is about a meta-system of social regulations intervening in the system of cognitive functioning, and it is incumbent upon social psychologists in particular to study the links between the two in order to answer the question: which social regulations engage which cognitive functions in which specific contexts? According to Doise, it is the analysis of the relations between the social meta-system and the cognitive system which constitutes the study of social representations. Representations, according to Farr (1998) are part of culture and cognition and must be studied in both directions. The theory, according to Moscovici and Vignaux (2000) recognises the deep link between cognition and communication

and only on this condition has it been able to explain at one and the same time, in a non-reductive way, both the formation and evolution of practical knowledge and of what is called popular knowledge, as well as their social functions.

Gaskell (2001) identified two traditions within the program of research into social representations. One tradition focuses on the production of knowledge, the other on the structure of knowledge. In the production of knowledge approach there is an interest in the content of common sense as well as the process by which it is generated. Abric (2001) described the structural approach as a direct extension of the social representations theory, but proposed a hypothesis which sees the organization of social representations around a central core, constituting one or several elements that give the representation its meaning, and peripheral elements which constitute the essence of the context of the representation. Wagner and Hayes (2005) said this approach distinguishes the stable core area from the interchangeable and dynamic peripheral area.

Moscovici did not dictate any particular methodological orthodoxy to follow and this encouragement of methodological eclecticism has caused considerable confusion and some conflict; however, this diversity has also exposed its usefulness and possible applications (Purkhardt, 1993; Breakwell and Canter, 1993). Urging researchers within the framework to consider employing multi-methodological approaches, Sotirakopoulou and Breakwell (1992) said the nature of social representations implies that we do not have a single construct that could be successfully investigated through a simple method but leads researchers to ask different questions that require different methods to solve. The methods, they further argued, must consider the role of verbal expression and communications. In their study of the social representations of the European Unification, they used a combination of questionnaires, interviews, attribute check lists and media analyses. The authors also used statistical techniques such as content analysis, correspondence analysis and multi-dimensional scaling to enumerate factors within constructs. Wagner, et al. (1999a) examined six empirical studies in this field and

the methods used were ethnography, interviews, focus groups, content analysis, statistical analysis of word associations, questionnaires and experiments.

For this research, I have adopted the production of knowledge approach, focussing on the contents of common sense. It has involved content analysis of media articles, questionnaires, interviews, analysis of historical texts and field observations. Statistical methods deployed include correspondence analysis and factor analysis. Questionnaires, according to Sotirakopoulou and Breakwell, enable an investigation of ideas, beliefs, opinion, attitude and knowledge; interviews tackle feelings, understanding and explanations; while media analysis is used to provide images of the target representation, which for this research is science. Historical texts, in my view, are useful in examining the origin of common sense and observations allow the researcher to match words with activity. These processes will enable a triangulation of the data (Gaskell and Bauer, 2000; Bauer and Gaskell, 1999) to map contradictions and consistencies.

To triangulate methods is a way of institutionalising reflection in a research process and the strategies are to validate empirical procedures and or results and not an additional epistemological source (Flick, 1992; 1992a). Denzin (1978) conceived of four basic types of triangulation: data, investigator, theory and methods. Methods triangulation can be within or between. Of concern to this research is between methods, which according to Denin, recognises that the flaws of one method are the strengths of the other and when combined, you can achieve the best of each while overcoming their unique deficiencies. Flick (1992, 1992a) said triangulation recognises that subjective knowledge and social interactions should be understood as parts of social, local and institutional contexts and against the historical backgrounds of those contexts. However, he acknowledged in a later writing (Flick, 2002) that the problem of developing a really integrated quantitative/qualitative method of data collection or data analysis remains largely unresolved. Also, Denin (2010) in an article which reviewed the paradigm wars, argues that we are in a free fall space concerning the politics of evidence, as there are no iron

clad criteria regulating the production of knowledge or validation of enquiry findings. He called for a community of researchers that honour and celebrate paradigms and methodological diversity.

Diversified methodological approaches were deployed in this study to examine representations in cognition and in culture. For cognition, an online pilot survey based on the Icelandic Omnibus version was first conducted and followed later by the main survey modelled after Eurobarometer and National Science Foundation surveys. The pilot provided valuable insight into the drafting of the questions for the main survey and the interviews.

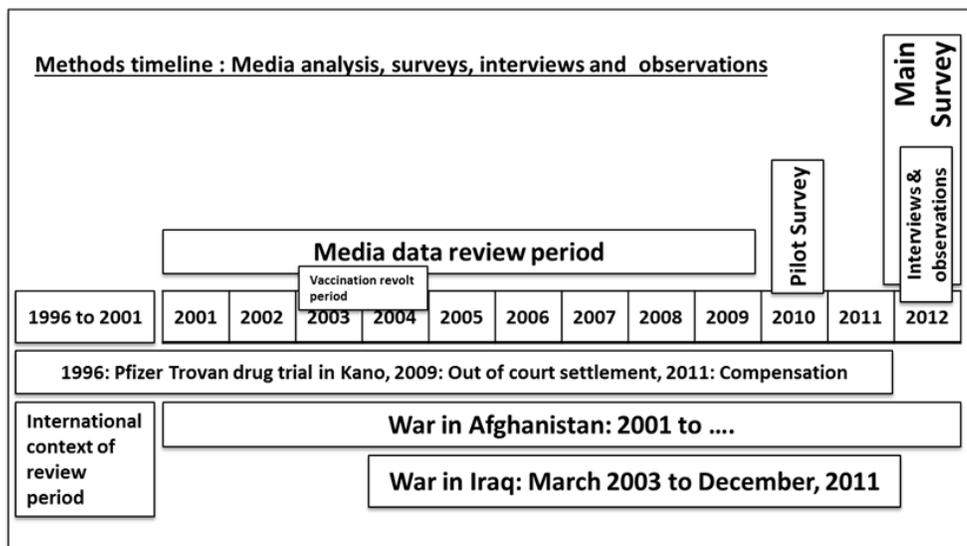


Figure 12 Methods outlay showing time line for data gathering and analysis

16 interviews were conducted in Lagos, South West Nigeria, deliberating on some of the issues that arose in the surveys and with participants drawn from various parts of the country and different religious orientations. Two media data were gathered, one about immunisation in the Nigerian media which involved data from several newspapers and another on science in the Nigerian press which was drawn from one newspaper, *The Guardian*, referred to as the flagship of the Nigerian press. Both newspaper cuttings were from the decade 2001 to 2009.

Relevant to our construction of contemporary culture is a film produced by Tunde Kelani titled “Thunderbolt” which captures the relationship between traditional African beliefs and practices,

Christianity, tribal differences and science. It also shows how one individual can be scientifically literate, a Christian and a believer in African traditional religion.

Books by acclaimed Nigerian authors also provide historical backgrounds for social, local and institutional contexts and understanding the variety and variability of the common sense of the Nigerian public. Nobel Prize for Literature winner, Professor Wole Soyinka’s book titled “Ake: The years of childhood” (Soyinka, 1989) gives a historical account of Yoruba culture and beliefs pre- and post- colonisation. Chinua Achebe’s “Things Fall apart” (Achebe, 1958, 2010) reconstructs life in Igbo land before and during colonialism, while Alhaji Abubakar’s book, “Rawan Bagaja: The Water of Cure” (Iman, 1934, 1978) provides an account of the culture and beliefs of the people of Northern Nigeria and the relationship between Islam and Judaism. The International Crisis Group report titled ‘Northern Nigeria: Background to Conflict’ (ICG, 2010) and Paden’s ‘Muslim civic cultures and conflict resolution (Paden, 2005) also provide compelling narratives of Islam and democratic federalism in Northern Nigeria. Existing statistical data from the Nigeria Bureau of Statistics and the Nigeria Population Commission also offer insight into contemporary issues. The books were featured in Chapter 1 and the movie in Chapter 7.

Representations	Cognition	Survey Interview	
	Culture	Contemporary	Immunisation controversy
			Science in the press
			Film review
	Historical	Archival research, book reviews	
Activity		Observations in the field	

Table 8 Methods of data elicitation

Gaskell and Bauer (2000) suggested some criteria for quality assessment. They identified confidence and relevance as two broad categories for providing the basis for quality assurance and they apply to both qualitative and quantitative research. Confidence and relevance markers for qualitative research are indicated by triangulation and reflexive understanding; transparency and procedural clarity; corpus construction; thick description, surprise value and communicative validation. For quantitative research, important considerations are reliability of measures,

internal validity, sample size, representative sampling, external validity and validity of measure. The authors also argue that a marker of any relevant research must be its surprise value and urged the documentation of evidence with an account of confirmed and disconfirmed expectations. On validation, they argue that confronting sources with results of analysis is consistent with knowledge interest of empowerment but cannot be a *sine qua non* for the relevance of research. This research is guided by these suggestions.

4.3 Analysis of science news

The media provide an archive of common sense and Laswell (1941) argues that we can gain an insight into the lives of others when we look into this archive, a view echoed by Bauer et al. (2006). To Silverstone (1999), the media offer a route to the hidden territories of the mind and meaning and to Joffe (1999) it makes events penetrate the consciousness of people who are quite remote from them. Its role in spreading news (Sommer, 1998) has turned it into some kind of “external memory” for knowledge, what Lippmann (1922) calls “the pictures in our heads”, an encyclopaedia of events, views, concerns and aspirations of the people of a particular milieu during a period. Studying the media allow us to look into this “external memory” as a proxy for common sense both in the long and short term and for contextualising other data.

Nigeria’s estimated population of 162 million has over 250 ethnic groups speaking about six major languages and 527 listed ones (Ethnologue, 2010) but the official language is English, inherited from the colonial administration. The print media carries out its trade mostly in English with some local language publications catering for defined language groups, while the television and radio stations all have substantial content broadcast in local dialects. Two newspapers, *The Daily Times* and *New Nigerian*, both established by the federal government, dominated the newsstands in the 1970s. *The Daily Times* was produced in Lagos in the south while the *New Nigerian* was produced in Kaduna in the north. Both have now been sold to private owners. Privately-owned English language newspapers include *The Guardian*, *The Punch*, *Nigeria*

Tribune, Vanguard, This Day, Daily Trust and *Champion*. Most of the newspaper head offices and printing presses are in Lagos. There are other special interest weeklies such as Alaroye, produced in the Yoruba language and celebrity gossip newspapers such as *City People* and *FAME*.

The Nigeria Demographic and Health Survey report (NPC 2009) shows that 29.2% and 11.9% of male and female respondents respectively read newspapers at least once a week. Nigerian newspapers are not categorised as broadsheet or tabloid, but there are those who lean more towards business and finance such as *The Guardian* and *This Day* and those who publish more general interest news such as *The Punch, Vanguard* and *The Sun*. Circulation figures of Nigerian newspapers are hotly contested but comparatively low (with western media) and often blamed on inadequate transportation infrastructure. A group of advertisers commissioned a research in 2008 to generate media audience data (Brandwork, 2009) but it was not based on actual print runs. In the report, *The Punch* was rated number one with 18% share of the market, *The Nation* with 16%; *The Sun*, 13.5%; *Vanguard*, 13.3%; *The Guardian*, 13.3%; *This Day*, 11.4%; and *Daily Trust* 6.2%. *Tribune, Champion* and *Compass* are placed in the eighth, ninth and tenth positions. A newspaper's print run does not, however, coincide with its influence (Moscovici, 2008).

The media analyses are longitudinal in design. Longitudinal research, according to Menard (2002) describes patterns and direction of change and data is collected for each item or variable for two or more distinct time periods. He contrasts this with cross sectional research in which measurements occur in a single time interval for all variables and for all cases.

Content analysis

Content analysis (Mayring, 2004) was developed in the early twentieth century and the principal focus then was the systematic analysis of large quantities of textual data from the growing mass media and only quantitative procedures were developed. These procedures, Mayring noted, attracted criticism for neglecting latent meaning structures and ignoring textual content that

defined and modified the particular textual units. Bernard Berelson, (1952) credited with the first methodological monograph on the technique, defines content analysis as a research technique for the objective systematic and quantitative description of the ‘manifest content’ of communication. More than fifty years later, Krippendorff (2004) disagreed with Berelson’s approach and defines it as a research technique for making replicable and valid inferences from texts (or other meaningful matter) to the contexts of their use.

Content analysis, according to Bauer (2000), can among other things, be used to monitor trends and changing patterns, construct indicators of worldviews and compare this across communities. Content analysis is public opinion research by other means. For Hansen et al. (1998), the issue with content analysis is how far quantification is taken and to what degree the quantitative indicators are read or interpreted but it can provide some indication of the relative prominences and absences of key characteristics and the inferences to be drawn depend entirely on the context and framework of interpretation.

Representations of immunisation in the press

Hypothesis 1: The Oral Polio Vaccine Controversy in Northern Nigeria

Null Hypothesis: Media coverage of the oral polio vaccine in northern Nigeria was largely negative.

Alternate Hypothesis: Media coverage was not predominantly negative.

Method of analysis: Content analysis of the coverage of the oral polio vaccine controversy in the Nigerian press from 2001 to 2009.

From the library of *The Guardian* newspaper in Lagos Nigeria was obtained a corpus of 701 newspaper clippings of articles from all major newspapers on immunisation from 2001 to 2009 arranged by date of publication. The corpus contained articles from *The Guardian*, *The Punch*, *This Day*, *Champion*, *Tribune*, *Vanguard*, *New Nigerian* and *Daily Times*. The corpus was examined for consistency and 54 *Daily Times* and two *New Nigerian* articles were removed because they featured only in the years 2003 to 2005. The remaining 643 articles were retained. While the entire corpus was used to identify the themes after a thorough reading of most of the

articles, every third article was then selected and this made up a sample size of 212 articles used for the content analysis.

	Guardian	Punch	This Day	Tribune	Vanguard	Champion	Total
Sample %	25.9	22.2	18.9	10.4	16.0	6.6	100%
Corpus %	27.5	21.2	18.2	7.6	16.2	9.3	100%

Table 9 Newspapers number of stories: entire corpus (643) sample (212)

The selected articles were then coded using a coding frame which examined, among other things, the intensity of coverage as well as the themes and the actors. I also made an evaluation of the articles on a positive and negative scale (see Appendix 1 for code book).

For Breakwell (2000), the impact of risk communication (or indeed any communicative effort) depends on a complex interaction between the characteristics of the audience, the source of the message and its content. The coding of the vaccination controversy looks at the content as themes, the source as actors and evaluation as projected impact on audience. The classifications should be judged on their usefulness and not whether they are true or false (Everitt, et al., 2001).

A theme (content) as used in this study is a prominent and or recurring issue in the debate or as Moscovici (2008) proposed, "a single content that is formulated in various ways." Themes as used here can also be described loosely as 'interpretive packages' (Gamson and Modigliani, 1989). McCombs (2005) also argues that not all themes can be classified as frames as defined by Entamnn (1991; 1993). McCombs proposed delimiting dominant or central attributes that can be categorised as frames from other attributes he called 'aspects', which can also be referred to as peripheral elements. The various themes also encompass what Abric (2001) and Wagner and Hayes (2005) described as core and peripheral elements.

The themes used in coding the articles were religious/un-Islamic; western conspiracy; effective vaccine; coverage and logistics; risk from the vaccine and the 'others' (comprising other important issues). While some of the identified themes were social representations of the vaccine identifiable as reified and consensual arguments, others were contextual issues with impact on the uptake of the vaccine. The un-Islamic and western conspiracy themes can be categorised as

the anti-vaccination frame, while the effective vaccine is the pro-vaccination frame. Coverage and logistics, risk from the vaccine as well as the “others” themes are systemic issues which can impact both anti- and pro-vaccination frames. Themes were preferred for this study because of the preference for the content of knowledge approach which allows you to map the presence and importance of all issues in the controversy over the long term. Of note here is coverage and logistics in the spread of the disease, and as the data will show, this theme can also be viewed as a dominant perspective, particularly in the post-revolt stage of the study. Themes were also categorised as primary and secondary to capture stories with competing major themes and to delineate as much as possible the primary issues.

The actors were categorised as federal government and its agencies such as Ministries of Health, National Programme on Immunisation, Agency for Food Drug Administration and Control (NAFDAC) and the States and local governments. Other actors were: religious and traditional leaders such as the JNI, SCSN; world bodies such as WHO, GPEI, UNICEF, Rotary and other international agencies; and the “others” actors which included local non-governmental organisations, private persons, and those who did not fit into earlier defined categories. There were also primary and secondary actors to capture stories where you have two major actors featuring in an article stating different or common positions. Notably, the actors were integrated into the main survey for evaluations of public trust as part of the triangulation process.

The evaluation of the articles was based on a contextualised scale of the alarming nature and possible impact of the event.

Positive valuation of story	Negative valuation of story
0 (no value)	0 (no value)
1 local positive issues	-1 Local negative issues
2 local positive issues	-2 Local negative issues
3 strategy and plans	-3 negative events, funding gaps, strikes
4 funding, media reviews	-4 negative events, funding gaps, strikes
5 endorsement by religious leaders	-5 Religious dissent, corruption
6 (state immunization campaign events)	-6 state ban
7 (national immunization campaign events)	-7 northern ban and deaths from vaccines

Table 10 Positive and negative evaluation criteria

It involved a thorough reading of the article to determine the appropriate magnitude. “+7” would refer to very positive national events, while “-7” would refer to very negative national issues and the zero mid-point would be a neutral article.

The role of the actors was also part of the evaluation and the researcher’s familiarity with the context allows a reading of the text beyond the manifest content, taking into account the impact of the messages from such actors on their audience and how it propels them to act: reject or support.

Using Castro and Gomes’s (2005) argument that about a relevant social issue there is belief A and non-A which gives rise to four logical options, I propose four categories of evaluations to characterise the systems of communication based on options P (positive) in favour and N (negative) not in favour which will give rise to N2, N1, P1, P2. The evaluation was recoded accordingly from -7 to +7 to N2, N1, P1 and P2 (see appendix 1 for syntax of recoded variables).

Representations of science in the press

Hypothesis 2: Media Coverage of Science in Nigeria

Null Hypothesis: Intensity of coverage of science in the Nigerian press was low (in terms of quantity of stories) and predominantly negative.

Alternate Hypothesis: Intensity of coverage of science is comparable with other contexts (United Kingdom and the United States) and not predominantly negative.

Method of analysis: Content analysis of the genres of science news in the Nigerian press form 2001 to 2009.

For this analysis, the newspaper of choice was *The Guardian*, established in 1983 and regarded by most as the flagship of the Nigerian press. Although it was at the onset described as the paper of the elite, it is now read by virtually all sectors due to the popularity of some of its sections (Computers, Business, Property, Vacancies and Alternative Medicine), as well as its moderate political views and a merging price regime in the industry. The paper has also been relatively consistent over the decades in its editorial policy as regards its layout, which makes it appropriate for longitudinal analysis. Also, for science and technology news, the paper has stood

out over the decades as a first choice newspaper while the others have focused more on politics, crime and everyday news. The corpus for the vaccination controversy provides more evidence as *The Guardian* featured more stories than all the other newspapers.

What sample size is ideal for a study of science in the press? Krippendorf (2004) was of the view that the ideal sample size is a “cost-benefit question” but Stempel (1952 in Bauer and Arts, 2000) had earlier found that increasing the sample size beyond twelve in the sampling of a full year of daily newspapers did not produce marked differences in findings. Also, Riffe et al. (1993) compared simple random sampling, stratified or constructed-week sampling, and consecutive-day sampling of a local daily and found that two constructed weeks could adequately and effectively represent the population, and that daily-stratified sampling was far more efficient than simple random sampling. For the analysis of science in *The Guardian* newspaper, 822 articles were selected over a nine year period. In each year, every 25th edition was picked starting from an arbitrarily chosen date and examined for science-based articles; this produced 14 editions of two constructed weeks for each year in the sample. Every article in each edition was read to ensure they actually include science in at least two paragraphs. Thus, an article about oil giant, Shell’s profitability would not have been selected while one about Mobil’s profitability tied to discovering more oil fields and environmental degradation would have been included.

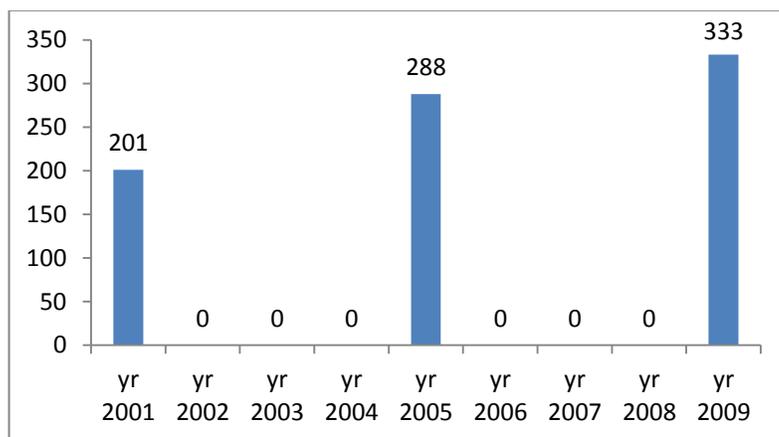


Figure 13 Sample year and size (N822)

The study covered the whole field of science and the analysis was painstakingly carried out by me in Nigeria in the summer of 2010 at the library of Punch Nigeria Ltd, publishers of Punch group of newspapers, using the hard copies. It took about six weeks to complete. Each newspaper was read by the researcher and coded using a coding frame (Appendix 2) adapted from a similar study of the British press (Bauer et al., 1995).

Valuation tone of article, positive	Valuation tone of article, negative
0 (No positive consequence)	0 (no negative consequence)
1 Benefit limited to individuals	1 Long term damage to individuals
2 Benefit is to groups	2 Long term damage to groups
3 Benefit is localised within nation state	3 Damage is localised within nation states
4 Long term benefit across nation states	4 Long term damage to nation states
5 Long term benefit across continents	5 Long term damage across continents
6 Long term benefit to this generation	6 Long term damage to this generation

Table 11 Evaluation criteria for science in the media

The evaluation was based on a scale of perceived benefits and projected risk/damage of the technology involved in the article. It involved reading of the article to determine the appropriate magnitude; +7 being long term benefits to this and future generations and -7 referring to long term damage to this and future generations. The zero mid-point would be a neutral article.

Reliability of content analysis involves some doubling of effort. The same person may make a second interpretation after a time interval (to determine intrapersonal reliability) or two or more may interpret simultaneously (Bauer, 2000). Reliability of content analysis, Perreault and Leigh (1989) argued, can conceptually be thought of as the percentage of the total responses (observations) that a typical judge could code consistently given the nature of the observations, the coding scheme, the category definitions and the judge's ability. It can be easily achieved, (Riffe et al., 1998) when a concept is more rather than less manifest but the most manifest content is not always the most interesting or significant. Simple percentage agreement is one of the most popular coefficients but the consensus is that percentage agreements do not take into account and correct for chance agreement between raters especially with two coders and few coding categories (Neuendorf, 2002; Cohen, 1960; Hughes and Garret, 1990 and Grayson, 2001). If two raters have to decide yes or no, chance means they will agree 50% of the time. Neuendorf

listed measures to control for chance agreement for nominal data to include Scott's pi, Cohen's kappa and Krippendorff's alpha, while Spearman's rho and Pearson's correlation coefficient are for measures that are metric. Riffe et al. (1998) and Perreault and Leigh (1989) observed that Scott's pi and Cohen's kappa were the most widely-used measures to overcome the shortcomings of the simple proportion and formed the basis on which most other approaches have been developed.

This research will use simple agreement and Scott's pi or kappa for reliability tests of nominal variables and Spearman rho for metric data. Scotts pi and Cohen's kappa, according to Neuendorf, are derived from the same conceptual formula but have been criticised for being overly conservative, while Krippendorff's alpha, though attractive, is rarely used because of the tedium of its calculation. Neuendorf said authors agree that a kappa of 0.80 or greater would be acceptable. Banerjee et al. (1999) were of the view that above 0.40 is good agreement beyond chance while below is poor.

Reliability tests for polio vaccine controversy articles were conducted for the frames, actors and evaluation. A sub-sample of 21, made up of every tenth article of the 212 selected for the analysis, was re-coded by me one year after the first coding was done in July 2011.

	% agreement	Scott's pi
Main theme	81	0.72
Actor one	86	0.76
Evaluation (+/-)		
	Spearman rho	0.99
	Exact agreement	38%
	Plus/minus 1 point range	86%
	Plus/minus 2 points range	100%

Table 12 Reliability test for OPV content analysis

High levels of reliability were expected for main actor and main theme but this may be influenced by the number of main actors in a particular article. Also, agreeing on secondary actors and themes was more difficult, since there were more than five major actors in the debate and more than three often featured in one article as journalists sought to balance their reporting. The results show agreement beyond chance for primary frames and primary actors.

	% agreement	Scott's pi
Source of news	78	0.67
Main news value	66	0.51
Second news value	44	0.25
Controversy	93	0.81
What's story about	76	0.66
Who is telling story	95	0.91
Academic field	95	0.92
Strategic technology	98	0.97
Location in cycle	73	0.60
Stereotype	73	0.49
Consequences I	68	0.53
Consequences II	61	0.27
Benefits and risk	80	0.66
Evaluation (+/-)		
	Spearman rho	0.997
	Exact agreement	61%
	Plus/minus 1 point range	93%
	Plus/minus 2 points range	98%

Table 13 Reliability test for *The Guardian* content analysis

For the reliability test for science in the media (*The Guardian* newspaper analysis), 41 articles representing a sub-sample of the 822 articles for the content analysis were re-coded by me in August 2011 at the library of Punch Newspapers in Nigeria; one year after the first coding was done. Intrapersonal reliability (Bauer, 2000) was chosen for practical and cost reasons as the coding involved traveling to and from Lagos, Nigeria on both occasions. Different levels of agreement were expected due to the varying number of categories for the variables and often overlapping functions of the journalists' beats in the media. There is also what the media practitioners often refer to as double lead, wherein two or three major actors or issues are involved in one story and either can be the main actor or issue. This often creates reliability problems for coders. Distinguishing between primary and secondary actors and location of consequences about a major Shell oil spill in the Niger Delta is a case in point. Both Shell and Niger Delta are strong newsmakers and the spill has ramifications for the sociocultural factors, the finances of the firm involved and the environment. What is more important here is for the coding to capture as many of the issues or actors as possible. Everitt, et al. (2001) argued that classification should be judged largely by its usefulness, rather than whether it is true or false, and Neuendorf (2002) noted that what constitutes an acceptable level of reliability for each

variable is open to debate. For most variables, I would argue, the level of reliability is often increased when recoded into smaller categories for analysis. For me, Bernejee et al's (1999) position on the issue is good enough. From 0.40 and above is good agreement beyond chance when there are several categories, fewer ones necessitating higher values of Scott's pi.

Correspondence analysis

Correspondence analysis (Greenacre and Blasius, 1994) is a multivariate method for exploring cross tabular data by converting such tables into graphical displays called maps and related numerical characteristics. It is an exploratory technique primarily intended to reveal features of the data rather than to confirm or reject hypothesis about the underlying processes which generated the data. This, according to Blasius (1994) means that one can find clusters of categories which are connected in an equal manner with other clusters of categories. Greenacre (2010) said CA is based on what the French call a triplet of information for a data set: the objects in a multidimensional space, their weights and the distances between them.

In CA (Greenacre and Blasius, 1994) there are no assumptions *per se*, the usual process of checking the assumptions is replaced by a substantive justification of the graphical elements, which form the basis of the correspondence analysis map. This view of being model-free is, however, not accepted by all authors in the field. Van der Heijden, Mooijaart and Takane (1994) argue that CA is not model-free, since an explicit choice is made to emphasise certain aspects of the data. For Clausen (1998), the method represents a methodological philosophy based on inductive reasoning and can be employed to describe graphically almost any contingency table on the assumption there exists an association to be described.

Purkhardt and Stockdale (1993) said multidimensional scaling is suitable for exploring and describing social representations, as it provides a geometric or spatial representation of relations among stimulus objects, which allows meaningful interpretation of distances. For this research, I have used correspondence analysis to examine associations between objects.

Genres of science news

Noting that rhetorical criticisms have not provided firm guidance on what constitutes a genre, Miller (1984) observed that they have been defined by similarities in strategies or forms in the discourse, similarities in audience, in modes of thinking and in rhetorical situations. Yates and Orlikowski (1992) describe genres as being characterised by substance and form. Substance, they argue, refers to the social motives, themes, and topics being expressed in communication while form refers to the observable physical and linguistic features of the communication. For Luzon (2005), texts belonging to a genre share some communicative purpose, textual features and content while Bazerman (1997), see genres as "frames for social action" which shape the thoughts we form and the communications by which we interact. Genre, he argues, are "guideposts we use to explore the unfamiliar." Bazerman (2010) also describes genres as being at the central nexus of human sense-making, where typification meets utterance in pursuit of human action. Also arguing that there are no undisputed maps of the system of genres, Chandler (1977) describes them as textual schemata, a framework within which to make sense of related events. Genre, Chandler argues, often overlap just as there are mixed genres. Franzosi (2010) adopted the term to denote a class of texts with distinctive and invariant qualities and suggested the inclusion of evaluation. Roberts (1989) had also made a case for evaluation in the analysis of text, describing them as judgements about the goodness or badness of a state of affairs as a manifestation of a category in comparison with ideals.

Media genre is a practical device for consistency and efficiency and is pre-recognised by the journalists and their audience (McQuail, 2005). According to McQuail, it is a collective identity which relates to purpose, form, meaning, is established over time and allows the separation of newspapers and magazines into classes based on content, space allocation and importance accorded different sections such as business, economy, banking, fashion, etc. Newspaper genres, McQuail observed, vary from the prestige or broadsheets to the tabloids (sensational) with

several locating themselves in between the two extremes and at this level, they can be recognised by their audience and news focus, which gives them their distinguishing characteristics.

The second level genre, which I propose for this study, examines the attributes of science articles in the newspaper. For the purpose of this study, genres of science news are a cluster of variables around some evaluation which forms a collective identity relating to meaning and sense making. The objective is to identify those clusters which will approximate the common sense notions of science in the Nigerian culture. This will involve looking at how the variables position themselves in geometric space using correspondence analysis. The concept of genre, I argue, is richer than frames, as it avoids the ambiguity in definition, particularly between core and peripheral elements, and also embraces evaluation of the themes which makes much clearer distinction between favourable and unfavourable representations. Content analysis turns words into numbers (Franzosi, 2004). Using multivariate statistical analysis, numbers can also be turned into geometric or graphical presentations (Greenacre and Blasius (1994; Greenacre, 2010; Bartholomew et al., 2008) for ease of interpretation or comprehension of associations. The geometric associations, I propose, can also be used to map genres of science news.

4.4 Public understanding of science survey

Two surveys were conducted in the process of the research, a pilot online survey held in 2010 and an expanded survey held in 2012.

	Pilot survey	Expanded survey
Time conducted	May, 2010	November, 2012
Procedure	Online	Field administration
Sample size	168	377
Number of questions	14	74

Table 14 Pilot and main survey procedures

4.4.1 Pilot online survey

A pilot online survey of public understanding of science was conducted by me from the 27th of May, 2010 for three weeks on a website produced by Steve Bennett of the Institute of Social

Psychology (see Appendix 4 for questionnaire). The online survey for this research was modelled after the “Icelandic Omnibus Short version.” The design ensured all respondents responded to all the items before moving to the next page and the questions were simple enough to reduce measurement errors. The main objective was to prepare for the main survey by testing the relationship between certain variables and for input into the question guide for the interviews. The survey was conducted online using Facebook, the social networking site and e-mail lists from willing associates and respondents. There were in all 168 responses at the end of the three week study, which included Nigerians at home and abroad. The main variables in the survey were knowledge, attitude, religiosity and socio-demographics.

With the Nigerian online survey, 64.3% of the respondents agree “It’s the father’s gene that decides whether the baby is boy or girl but a higher 79% also agree it is not the mother’s gene. This pattern likewise occurred in the US survey in 2008, where 62% of respondents agree the father’s gene decides sex and a higher 71% agree it is not the mother’s gene (NSF, 2012). 67% of the Nigerian respondents also agree that God determines the sex of a child while 62% said it is not pure luck that determines sex. A cross tabulation shows that only 19 (N=168) of the respondents who agree that fathers gene decides sex also agree it is not God compared with 72 that agree it is both God and the father’s gene. This observation is what Moscovici refers to as cognitive *polyphasia* (more in chapter 7). Where the respondent lives is also significantly associated with the answer to whether God determines sex (Chi sq = 9.0; P<0.01). A cross tabulation shows that those who reside abroad are more likely to disagree that God determines sex than those who live in Nigeria. But the number in agreement was still high at 59%. Is this an indication of more exposure to science or the role of the new culture they have imbibed?

The response to the question “Humans developed from earlier species of animals” was also quite interesting. Only 34% of the respondents agree the statement is true, with 51% saying it is false, disagreeing with the Darwinian concept of evolution. Regression analysis in Model 3 (Appendix 3) shows it is significantly associated with “God determines sex”, “luck determines sex”,

“mother’s gene” and ages 35 to 44. Also, Model 4 (Appendix 3) shows that compared with a highly religious person, a mid-religious person is 176.6% more likely, and a low religious person is 199% more likely to provide the correct answer though the low religiosity is not significant. In other words, the less religious you are, the more likely you are to agree that humans developed from animals.

The online survey shows that how the public relates with a scientific artefact may be influenced by social and cultural factors.

4.4.2 The expanded survey

The main survey was modelled after the Euro-barometer, National Science Foundation, Taiwan, India and other PUS surveys with input from the pilot survey and additional questions to localise. The plan for the main survey was to set the questions and contract out the nationwide questionnaire administration to a reputable opinion poll firm in the same manner the Euro-barometer is conducted and seek sponsors to finance the project. The firms were contacted and invoices were received but financing the project proved more difficult than anticipated with letters turning up more promises than funds. After a few months, attempts were also made to conduct the survey online, but all the survey companies contacted could not guarantee respondents from the northern part of the country. On my limited budget, I opted to administer the questionnaires in paper form in November 2012 using a network of volunteers mostly in Lagos. Lagos state’s population was estimated by the 2006 census to be 9.1 million (NPC, 2013) but this was disputed by state government officials who conducted a parallel census alongside the national one and came up with an estimate of 17.5 million and is projected to date to be about 21 million (Lagos, 2013). The Lagos figures for the 2006 national census have recently been invalidated by the census tribunal citing “inaccurate counting” (Akoni, 2013; 31/08/2013). Population figures are hotly contested in Nigeria due to its importance for political structures and revenue allocation. The return of questionnaires sent to Kano was zero out of 50

questionnaires delivered to a volunteer, despite all pressures including financial inducements. The return from Abuja and Enugu were also minimal from 50 questionnaires each sent to those stations. The response from Lagos was good. In all, about 480 questionnaires were returned. Some were however too poor to be included, too many questions having been left out. 377 returned questionnaires were classified fit for the survey and used for the analysis. Unanswered questions were coded as missing. See Appendix 4 for questionnaire and 5 for table of frequencies and syntax for recoded variables. Some comparisons of frequencies were made with the findings of Special Eurobarometer 224/Wave 63.1, henceforth referred to as EU (2005)

Interest, Informed and engagement

Interest and informed	Main survey		EU 2005	
	Interest	Informed	Interest	Informed
Religion	92.6	89.4	N/A	N/A
Current affairs	91.2	84.9	N/A	N/A
Entertainment	89.7	82.2	N/A	N/A
Sports	86.7	81.2	68	69
Culture and arts	81.2	72.1	N/A	N/A
New medical discoveries	74.5	58.4	88	70
New scientific discoveries	72.7	63.4	78	61
Politics	69	74.3	71	75

Table 15 Ranking of interest and being informed (N=377) compared with EU (2005)

The first section of the questionnaire is about how interested and informed the respondents feel they are about certain issues in the news. Table 15 shows the respondents feel less interested in new medical discoveries and new scientific discoveries than in religion and current affairs. Also, while respondents feel less interested in politics than medical and scientific discoveries, they feel more informed about politics than science and medicine. The table also shows the respondents generally feel more interested than they feel informed on all measured items except politics where it is the reverse. EU (2005) shows a similar pattern. Respondents are more interested in new medical and scientific discoveries than they feel informed and it was also the reverse with politics. Levels of interest in new science and new medicine are however higher in EU but interest in sports is lower.

Respondents in the Nigeria survey were also asked how regularly they engage with science and religion as part of the narrative about the relationship between both. The table below shows that while 70% read and watch science, the figure drops to less than 20% when it was about science activities and donating to science.

Engagement science and religion	Science %	Religion %
Reading and watching	70.6	84.1
Attend activities	18.6	91
Donate	11.9	74.5

Table 16 Ranking of engagement with science and religion (N=377)

Cronbach's Alpha (Cronbach, 1951) for all six engagement items is 0.614 and all 15 interest and feeling informed items is 0.790.

Knowledge of science

Literacy: Textbook knowledge	Correct %
Electrons are smaller than atoms	35
The center of the earth is very hot	45.9
The oxygen we breathe comes from plants	68.7
Antibiotics kills viruses as well as bacteria	25.2
Father's gene determines sex	69.5
All radioactivity is man made	41.6
Continents have been moving for millions of years	57.8
The universe began with a big explosion	19.9
Scientists will never understand the human mind	23.3
Human beings developed from earlier animals	37.4
God determines baby is boy or girl	13

Table 17 Ranking of textbook knowledge of science for main survey (N=377)

The table above shows that the variable "father's gene determines sex" has the highest number of correct answers while the most poorly-answered questions were "the universe began with a big explosion" and the attribution of sex to God. These variables, along with "humans developed from earlier species of animals" have both scientific and religious answers. Pardo and Calvo, (2004) observe that some population segments may be influenced in their appropriation of a scientific proposition by values or beliefs in their society's culture. Citing Germany, they argue that it is plausible the simultaneous mention of radioactivity and the role of humans in its genesis may activate anti-nuclear values, while in The Netherlands the response to the question "Human beings as we know them today developed from earlier species of animals" may have interfered

with some cultural values (see also Miller et al., 2006). In the Nigerian sample, about 70% agree that the father's gene decides sex but an even higher 74.5% attribute it to God's making. These findings lend credence to Pardo and Calvo's (2004) observation that while contemporary science is the most universal of cultural constructs, certain parts of it conflict with religious beliefs, worldviews on nature, ideas about identify of and separations between the species and about the beginning of human life. But is it a conflict in the Nigerian culture?

Cronbach alpha for all 11 items is 0.55. As is standard with PUS surveys, I computed an index of knowledge based on a summary of the first set of seven questions (Table 18) by excluding those linked with creationism, to reduce bias in the results. Cronbach alpha for the seven items is 0.47. The statistics are: mean = 3.67, standard deviation = 1.60, skewness = -0.01, median = 4 and the mode = 3.

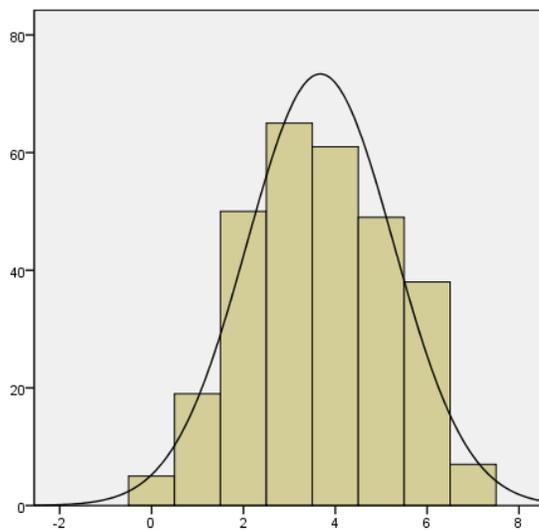


Figure 14 Histogram of knowledge index

The Kolmogorov-Smirnov test for normality of distribution is significant at $P < 0.01$ indicating a deviation from normality, but the sample is large and Fields (2005) argues that with large samples, it is quite easy to get significant deviations from normality and the test does not tell us if the deviation is large enough to bias any statistical procedures we may apply to the data.

As well as the aggregate or average of items, another index of aptitude tests is the item difficulty (Pardo and Calvo, 2004). The standard measure of item difficulty, according to the authors, is

the percentage, usually represented by *P*, of test takers who answer a specific item correctly and the higher the *P* of an item, the easier it is. The expectation, they argue, is that the difficulty index will vary in each society across sub populations and also across societies. It thus provides a tool for comparing groups within a society and comparing countries. An item difficulty analysis was also conducted on the knowledge questions. Issues where God and science meet were more difficult to resolve but surprisingly, more were willing to accept humans developed from animals than that the universe began with a big explosion or that the sex of child is not determined by God. A comparison was made with EU (2005).

Scientific literacy	Survey (N377)	EU 2005
Fathers gene decides sex (EU mothers gene)	69.5	64
Oxygen we breathe comes from plants	68.7	82
Continents have been moving for years	57.8	87
Understanding scientific investigation	50.1	N/A
Centre of earth is hot	45.9	86
All radioactivity is man made	41.6	59
Humans developed from animals (Scientifically correct)	37.4	70
Electrons smaller than atoms	35.0	46
Understanding genetics	35.0	N/A
Antibiotics kill viruses as well as bacteria	25.2	46
Science never understand human mind (positive)	23.3	N/A
Universe began with big explosion (Scientifically Correct)	19.9	N/A
God decides sex (Scientifically correct)	13.0	N/A

Table 18 Scientific literacy test by item difficulty (N=377) compared with EU (2005)

On the mode of scientific investigation, 50% of the respondents answered correctly but the surprise was the low level of correct responses (35%) to the “understanding genetics” question given the prevalence of sickle cell anaemia in the Nigerian society and the high correct response to “father’s gene.” Can this result be attributed to poor knowledge of genetics? Another plausible alternative is that the high scores on “father’s gene” may have been due to interest which arise from the importance of a male child in the African society. Remarkably, EU respondents scored higher on all questions. The question of whose genes determine sex was differently worded.

General attitude to science

The attitude variables were recoded into increasingly positive image of science on a one to five scale with the “don’t know” option merged with “neither nor.” This merger disregards, for

convenience, a possible difference between the two but it is sufficient for this research to merge them into a mid-point. A factor analysis was conducted on the recoded variables to identify common themes and see if they are all driven by the same underlying variable or are multidimensional in nature

Key facets of attitude to science	PSEUDONYM	% agree
Science making our lives easier and more comfortable (Rec)	EASIER, COMFORT	80.6
Science makes our way of life change too fast	TOO FAST	73.7
Scientists want life better for the average person (Rec)	SCIENTISTS BETTER	73.5
The benefits of science are greater than harmful effects (Rec)	BENEFITS > HARM	61.3
Science will create more job opportunities (Rec)	MORE JOBS	59.7
Science and technology are making our lives healthier (Rec)	LIVES HEALTHIER	55.7
New inventions will be found to counter harmful ones (Rec)	NEW INVENTIONS	45.6
Science will give a complete picture of the universe (Rec)	UNIVERSE PICTURE	45.1
Science responsible for most environmental problems	ENVIRONMENT	44.3
The more I know about science the more worried I am	WORRIED SCIENCE	40.6
Knowledge makes scientific researchers dangerous	SCIENTISTS DANGEROUS	35.5
Growth of science means that few control our lives	FEW CONTROL	34.5
Science and technology can sort out any problem (Rec)	SORT ANY PROBLEM	23.9

Table 19 Ranked statistics of attitude variables (N=377)

The pseudonyms indicated in bold in the table will be used interchangeably with the full title.

No items	Alpha	Item deleted
13	0.5	
12	0.56	Growth of science means few could control our lives
11	0.58	Because of knowledge, scientific researchers are dangerous
10	0.62	Science makes our way of lives change too fast
9	0.65	The more I know the more worried I am
8	0.70	Science and technology responsible for environmental problems

Table 20 Cronbach's Alpha for 13 attitude questions

Cronbach's Alpha for all 13 items is 0.5 but when progressively reduced using 'Cronbach's Alpha if item deleted', the value increases. Cronbach alpha remains 0.5 after the variables were re-coded in increasingly positive images of science. The value may be an indication the variables measure more than one construct.

I also examine the percentages of the non-response option "don't know" in the survey results.

The variables "dangerous", "control", "invention" and "benefits" had the greatest number of "don't know" responses and total non-responses. "Don't know" responses present a dilemma for the researcher: should these variables be regarded as those in which the society is more

ambivalent (no opinion) than the rest or do they show that the response options are inappropriate or too restrictive (Pardo and Calvo, 2002)?

	Don't know	Missing	total
Scientists dangerous	9	2.9	11.9
Few control	8	4.2	12.2
New invention	8	3.4	11.4
Benefits greater than harm	7.7	2.7	10.4
Scientists better	4.8	3.2	8
Universe picture	4.8	2.9	7.7
Lives healthier	3.2	4.2	7.4
Environment	2.9	1.9	4.8
More jobs	2.4	1.3	3.7
Worry science	2.4	1.9	4.3
Sort and problem	1.6	5.3	6.9
Too fast	1.6	2.7	4.3
Easier, comfort	0.5	1.6	2.1

Table 21 Percentage of Don't Know responses to attitude questions (N=377)

Trust in leaders and worldview

Trust, according to Moscovici (2001) is both at the origin and at the limit of social knowledge and in the OPV controversy, it was apparent that there were trust issues with some actors and this informed the addition of this section to the survey. The table below shows the highest levels of trust on foreign non-governmental organisations (NGO's), followed by religious leaders and surprisingly, more consider military more trustworthy than politicians.

Trust in leaders (%)	Low (0-2)	Mid (3&4)	High (5&6)
Recoded trust in foreign NGOs	22.5	30.9	46.6
Recoded trust in religious leaders	25.9	38.8	35.3
Recoded trust in scientists and professors	23.0	42.4	34.6
Recoded trust in local NGO's	34.7	41.4	23.9
Recoded trust in Judiciary	49.1	40.8	10.1
Recoded trust in military leaders	62.6	29.5	7.9
Recoded trust in politicians	91.9	5.1	3.0

Table 22 Summaries of trust in leaders and scientists (N=377)

Cronbach alpha for all seven items is 0.699.

The trust variables were analysed in the framework of Hypothesis 3.

<p>Null Hypothesis: Levels of trust in scientists and religious leaders in Nigeria are negatively correlated.</p> <p>Alternate Hypothesis: Levels of trust in scientists and religious leaders are positively correlated in the context of trust in other institutions.</p> <p>Method of analysis: Factor analysis</p>

Trust takes us to the next part of the survey, which comprises different aspects of worldviews and includes levels of religious guidance (religiosity), belief in destiny and a fundamental attitude to the world.

The fundamental attitude to the world variable follows a very interesting concept from Hans Blumenberg's (1959) essay that the fundamental attitude to the world is not a choice between technology and nature but relationship to the world. Fundamental orientation splits the world into those who believe in the preservation of nature and those who believe in its exploitation. Blumenberg, in *The legitimacy of the modern age* (see Brient, 1964) also argues that the fundamental 'existential attitude' of the modern age is a radically active and reconstructive orientation to the world in which the world appears now as something to be mastered: constructed or reconstructed according to human order as opposed to an aesthetic view of the world where nature is to be preserved. Jager (1996) suggested two metaphors: the threshold and barrier. He argues that the barrier represents a never-ending struggle with resistant nature and is allied to engineering and technology, while the metaphor of the threshold addresses the question "who are you"? Brient (2001) also drew attention to the delineation between *viva contemplativa* (spectators and admirers of divine creation) and *viva activa* (the lords and masters of nature). The relevance is the possible interaction with knowledge as spelt out in hypothesis 5.

Hypothesis 5: Knowledge and attitudes I (Fundamental Attitudes)

Null Hypothesis: There is no interaction between knowledge and fundamental attitudes to the world in the public's attitude to science

Alternate Hypothesis: There is an interaction between knowledge and fundamental attitudes to the world in the public's attitude to science

Method of analysis: MANOVA for interaction effects

The variable was part of the questions in the Icelandic Omnibus Survey of PUS (2010); question D12 in the Taiwanese 2012 survey of Understanding, Interest and Concerns in Science and Technology and question Q35 in the United Kingdom Public Attitudes to Science (PAS, 2014). Participants in the Icelandic and Taiwanese surveys were shown a picture of the Niagara Falls

(Appendix 9) and asked five questions to choose one: two each measuring the engineering and aesthetic attitudes. The concept was adopted for this survey but both the picture and the four questions were localised. The Niagara Falls picture was replaced by a picture of Zuma rock in Abuja, Central Nigeria.



Figure 15 Zuma Rock with what looks like a human face (CRIENGLISH.com)

Participants were then asked to pick one of four options:

- a. You are fascinated by the beauty of this natural spectacle
- b. You are thinking of how much granite the rock could produce for construction
- c. You are thinking of how unimportant you are in the natural order of things
- d. You are thinking of how to set up a tourist centre for people to enjoy nature, and to generate income for yourself and others

Answers A and C were grouped to form an aesthetic view of the world while questions B and D were categorised as an engineering or existential view of the world. The objective was to see if this mediates other variables in the survey. 54.6% and 10.9% of respondents respectively chose the first and third options (total of 65.5%). The rest chose the engineering perspective.

For health and wellbeing, when respondents were asked which of several options they have considered as first and second for a health and wellbeing issue, western medicine and prayers featured prominently. Prayers were a very strong second option, as well as traditional medicine. Common sense views of health and wellbeing revolve around the three.

On religiosity, when respondents were asked the question “on a scale of zero to six, how much guidance does religion play in your daily life?” About 48% chose the maximum six points, while

another 25% chose 5, both adding up to 72.6%. Only 7% scored themselves below three points on a seven point scale. This takes us to hypothesis 6.

Hypothesis 6: Knowledge and attitudes II (religiosity)

Null Hypothesis: There is no interaction between knowledge and religiosity in the public's attitude to science.

Alternate Hypothesis: There is an interaction between knowledge and religiosity in the public's attitude to science.

Method of analysis: MANOVA for interaction effects.

The other worldview is belief that man has a destiny which is beyond his control. The world, some have argued, is not accidental (Knight, 2004) but by design. This worldview, notably, is often seen as separate from religiosity as some of the Abrahamic faiths disagree with the concept. This concept of destiny is what the Yoruba call 'Ori' and the Igbo call 'Chi'. In the Nigerian sample, it was a view widely held by many of the respondents, as 78% agree with the statement "everyone has his own destiny."

Structural Analysis

Factor analysis belongs to a family of methods which involve what are called latent variables (Bartholomew et al. (2008). Latent variables arise because quite often, concepts used regularly by social scientists cannot be directly observed and we rely on several direct and indirect questions. Using several questions may result in many latent variables, called factors, within each concept we are measuring, but at times, it may result in one or two.

Factor analysis, however, unlike CA, is a model-based technique (Bartholomew et al) and involves assumptions about the joint distribution over some relevant populations of the variables involved. The essence of the problem that factor analysis has to solve is that of inverting the regression relationship to tell us about the latent variables when the manifest variables are given. Factor Analysis, according to Field (2005), strives to reduce the correlation matrix (*R*-matrix) to its underlying dimensions by looking at which variables correlate highly with a group of other variables. By this method, factor analysis achieves parsimony by explaining the maximum

amount of common variance in a correlation matrix using the smallest number of explanatory concepts. Factor analysis also presents the prospects of assigning an average to each individual on each factor, a kind of composite score (Field, 2005).

Also, by rotating the axes, we can maximise loadings on one factor while minimising the other to produce better interpretation. There are two types of rotation; orthogonal rotation keeps factors independent (uncorrelated) while oblique rotation allows the axes to take any position in the factor space (Kieffer, 1998; Fields, 2005; Abdi, 2003). Abdi (2003) notes that because rotations, whose *raison d'être* is to facilitate interpretation, are always performed in a factor space, the new axes will always explain less variance than the original factors which are computed to be optimal but the part of the variance explained by the total subspace is still the same as before rotation. Kieffer, however, argues that orthogonal solutions, while easier to interpret, do not honour a researcher's view of reality as he (the researcher) may believe that two or more of the extracted and retained factors may be correlated. An oblique rotation on the other hand more closely honours the researcher's view of reality but may be more difficult to interpret and is less parsimonious. The choice of rotation method Kieffer argues, is not arbitrary and if it is to generate results that best fit the data then oblique is preferred, but as the factor to variable ratio and factor correlation decrease, the results from both tend to be similar.

Factor analysis was used to identify the underlying factors in the attitude and trust variables of the main survey, which had 377 respondents. Field (2005) said a sample size of 300 will provide a stable enough factor solution. The principal component analysis extraction method was also used as it restricts conclusions to the sample in contrast to the Maximum Likelihood Method or the Kaiser's Alpha Factoring, which assumes participants are randomly selected and from which results can be generalised to the larger population (Field, 2005).

Hypothesis 4, and 7 were used to analyse the results of the survey for structures of attitudes and relationship with knowledge.

Hypothesis 4: Structure of attitudes to science.

Null Hypothesis: 2 facets: progress and pessimism characterise the attitudes of Nigerians to science and technology.

Alternate Hypothesis: Attitudes are characterised by more than two facets.

Method of analysis: Factor analysis.

Hypothesis 7: Knowledge and attitudes III

Null Hypothesis: Knowledge and attitudes to science are positively correlated.

Alternate Hypothesis: Knowledge and attitude to science are not positively correlated.

Method of analysis: Binary logistic regression of attitude facets on knowledge.

Hypothesis 8 examines the relationship between PUS and opposition to vaccination.

Hypothesis 8: Public understanding of vaccination

Null Hypothesis: There is no positive association between Public Understanding of Science (knowledge, trust, attitudes) and opposition to vaccination

Alternate Hypothesis: There is an association between Public Understanding of Science (knowledge, trust, attitudes) and opposition to vaccination.

Method of analysis: Binary logistic regression.

4.5 Living with science: Interviews, film reviews and field observations

Germane to this section designed to capture how citizens live their everyday life is how science, gods and God coexist in a multi-ethnic society, and this is captured very well in local cinema. A movie directed by Tunde Kelani titled: “Thunderbolt” is situated in modern Nigeria and shows the relationship between the Igbo, Yoruba, orthodox medicine, African traditional practices and Christianity. Sixteen interviews were conducted by me in Lagos in September 2012, most of them at the Ikeja Military cantonment which offered an opportunity to interview Nigerians from across the country. One interview was conducted in my house while Participants 1 and 2 were interviewed in Participants 1’s office in a church. Only twelve were used in the analysis as some of the participants were not very forthcoming with answers.

The questions were worded to see how science and religion coexist among the various tribes and to confront interviewees with some of the findings of the pilot survey. The episodic interview

format adopted for this study aims at contextualising experiences and events and focuses not only on the problematic but also on positive, surprising, satisfying situations (Flick, 2000a).

	Sex	Age bracket	origin	religion	Status	profession
P1	Male	Above 50	South west	Christian	Married	Church PR
P2	Male	30 to 49	South West	Christian	Married	advertising
P3	Male	Above 50	South West	Christian	Married	General business
P4	Female	20 to 29	North central	Christian	Single	Student
P5	Female	20 to 29	North East	Christian	Single	Soldier rating
P6	Female	20 to 29	South South	Christian	Single	Student nurse
P7	Male	30 to 49	South West	Christian	Single	Office manager IT
P8	Male	20 to 29	South South	Christian	Single	Computer operator
P9	Male	30 to 49	South East	Christian	Married	Banker
P10	Male	30 to 49	South East	Christian	Married	IT sales
P11	Male	30 to 49	North Central	Moslem	Married	Business
P12	Male	30 to 49	North Central	Moslem	Married	Imam/trad healer

Table 23 List of interview participants (N=12 conducted September, 2012)

Episodic interviews, according to Fick, facilitate the presentation of experience in a general comparative form and include a combination of narratives and argumentation. Episodic interviews, for me, allow participants to narrate personal experiences and how this has shaped their views and actions, particularly common sense experiences with science and religiosity. Interviewees were chosen randomly around the cantonment and asked if they wanted to participate in the interview, following which they had to come to an office located in a business centre. They were shown the questions and had to sign the consent forms before the interview commenced. The approach employed in the analysis of the interviews was thematic. Thematic analysis, (Braun and Clarke, 2006) is independent of theory and can be applied across a wide range of theoretical approaches, providing a rich and detailed yet complex account of data. Themes here were to capture the essence of the data in an inductive approach and could be semantic or latent. Specifically, the Attride-Stirling, (2001) procedure for thematic analysis was adopted.

4.6 Summary

Methodological triangulation allows the researcher to have a broader perspective of the social phenomenon in observation by building on the strengths of each method. My research utilises a

combination of historical texts, media analyses, surveys, interviews and field observations. Media analyses provides a historical and contemporary context for the research, as well as an inroad into the culture of science. It was used to analyse the coverage of science in the media and daily accounts of how the controversy over the OPV unfolded and was “resolved,” at least, among the public actors. The PUS survey enables an analysis of public opinion about science, specific scientific issues and the scientific establishment in the population. Some of the findings informed the set of questions for face-to-face interviews and an ethnographic study. This multi-method approach enables an integration of the results of the individual methods, which collectively form a body of evidence for a conclusion that is more revealing than either method alone.

5.1 Introduction

This chapter looks at science in the Nigerian media from two perspectives: the general and the particular. The purpose is to categorise issues, actors and themes. Content analysis turns words to numbers and correspondence analysis turns the numbers into a geometrical representation for easy identification of the genres of science news. The overarching objective is to construct a map of what is in the public's mind about science, what the newspapers draw attention to, what they tell the public to think about its value as a loss or gain and the likely consequences for science and society.

5.2 The Oral Polio Vaccine controversy in the press (2001 to 2009)

Null Hypothesis: Media coverage of the oral polio vaccine in Nigeria was largely negative.
Alternate Hypothesis: Media coverage was not predominantly negative.
Method of analysis: Content analysis of the coverage of the oral polio vaccine controversy in the Nigerian press from 2001 to 2009.

In 1988, the World Health Assembly launched the "Global Polio Eradication Initiative" and in 1996 African leaders followed with "Kick Polio Out of Africa." Both campaigns were aimed at ridding the world of the polio virus following the successful eradication of smallpox. In October 2000, Nigeria took a step further by designating National Immunisation Days, during which all children of vaccination age were expected to be immunised against a range of diseases. Some religious leaders in the northern part of the country, however, declared vaccination as un-Islamic and by early 2001, there were reports of a boycott of the exercise in some northern states. A revolt followed in 2003, when two very influential Islamic groups said the vaccine had been contaminated as part of a Western conspiracy against Muslims. The end of the boycott did not however lead to wholesale acceptance and eradication of the disease and this section examines

the coverage of immunisation in the Nigerian media from 2001 to 2009, a period which includes the years of the oral polio vaccine controversy.

Nelkin (1995) argues that the reality of science for most people is what they read in the newspapers and consequently, how the media present a news item is important, as the metaphors and catchphrases deployed guide public perception. Nelkin asks: "Was Chernobyl a disaster or an event? Is research into embryos a means to enhance fertility or a way to manipulate persons?"

Also, Einsiedel (1992) notes that there are dimensions to scientific literacy or the public understanding of science that touch directly on the quality of information available to the public.

LaFollette (1990) too argues that what people believe about science (here the vaccine) - how it was made, who made it and why - affects their political response: "In each person's mind, the images formed over a lifetime blend together, complex and multifaceted, based on both facts and fancy, these ideas are continually revised through education and experience as well as exposure to images produced by the media." A longitudinal study of the media is therefore necessary to unravel how these images are formed and by who, and how they have changed over the years.

Also, McCombs and Shaw's (1972) agenda-setting theory proposes that what the media prioritise as important coincides with what is uppermost in people's minds, thus a study of the coverage of immunisation will show aspects of public anxiety about the vaccine and the who and the what that informed it. It is also perhaps equally important to estimate the plausible effects of the increased coverage of the controversy on the public (Marzur and Lee, 1993).

5.2.1 Methods

Using content analysis, this chapter looks at how six major Nigerian newspapers (The Guardian, The Punch, Tribune, The Vanguard, This Day and The Champion) covered the immunisation saga between the years 2001 and 2009. Franzosi (2004: 2010) enumerated the history and advantages of content analysis for large volumes of text, particularly with longitudinal data

involving newspapers. Sufficient to say it is a systemic, logical and replicable method for making valid inferences as to the explicit and implicit information contained in narratives.

The content analysis was approached with the following research questions:

1. What was the intensity of coverage?
2. What were the various themes of the controversy?
3. Who were the actors?
4. How did actors and themes relate?
5. How positive or negative was the media coverage?

643 articles were used for the intensity of coverage and disease incidence while 212 articles, made up of every third, were selected and used for the content analysis (see Chapter 4 for more details). The selected articles were coded using a coding frame (Appendix 1) which examined among others, the themes and the actors. I also made an evaluation of the story on a positive and negative scale. The evaluation involved a thorough reading of the article and +7 would be very positive national events while -7 would refer to very negative national issues and the zero mid-point would be a neutral article. The role of the actors was also part of the evaluation and the researcher's familiarity with the context allows a reading of the text beyond the manifest content (Berelson, 1952) to replicable and valid inferences (Krippendorf, 2004). 7 was code for national Immunization events; 6 for state events; 5 for endorsement by religious leaders; 4 for funding, media reviews; 3 for strategy and plans; 2 and 1 are local positive issues or comments in the dailies; 0 has no relative value; -1 and -2 are local negative issues and comments; -3 and -4 are negative events, funding gaps, strikes; -5 includes religious dissent, corruption; -6 state ban; -7 Northern ban or agglomeration of states ban and reported deaths from vaccinations. Articles were allocated categories by re-coding the sum of the positive and negative valuations which gave the overall tone of the story. Values between -7 and -5 were coded N2 (High negative); -4 to -1 coded N1 (Low negative); 0 to 4 coded P1 (Low positive); and 5 to 7 coded P2 (High Positive).

5.2.2 Intensity of coverage and disease incidence

In Chapter Two, I narrated how Islamic preachers had been campaigning in public against the vaccine for some years before the actual ban in 2003. The ban, however, may have heightened concerns in the public and this was reflected in a flurry of media activities.

	2001	2002	2003	2004	2005	2006	2007	2008	2009
Polio cases	4.9	17.7	31.1	68.4	72.7	100	30.9	75.3	47.3
News Coverage	33.5	40.0	65.2	100	46.5	59.4	18.7	29.7	21.9

Table 24 WPV cases and news coverage index (Polio N=4818; media coverage N=643)

An analysis of all the 643 articles on immunisation published by the seven selected newspapers in the review period show a steady rise from 2001 to a major peak in 2004, then a steep decline in 2005 only to rise to another peak in 2006 and to rise again in 2008.

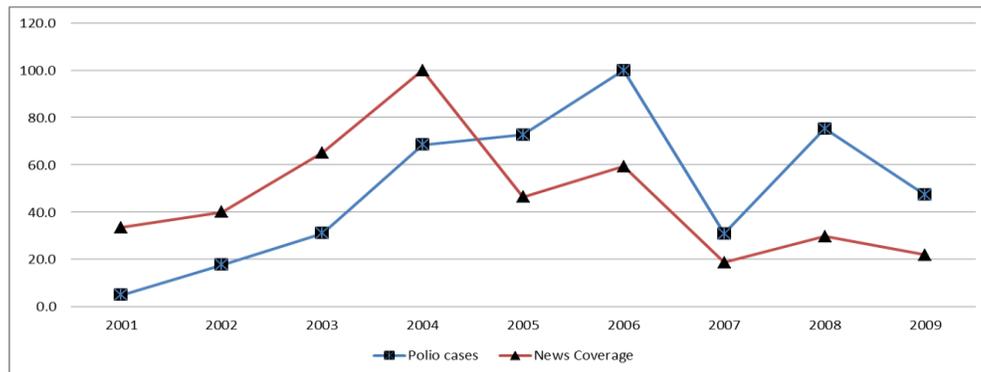


Figure 16 WPV cases and news coverage

Compared with the number of Wild Polio Virus (WPV) cases reported by WHO (2011) in the same review period, it is both interesting and surprising, to see the similarities in the patterns of both coverage and disease incidence.

While newspaper reports show a marked decline in 2005 following the lift of the ban on the vaccine by all the northern states, disease incidence continued to rise, albeit with a slight decrease in gradient. Both show two more peaks in 2006 and 2008. Was the drop in media coverage in 2005 an indication the media thought the issue had been resolved and the vaccine accepted? Rising cases revealed by the publication of fresh data on new infections (Peter-Omale, 2006; 16/08/2006) may have led to another wave of public anxiety and increase in media coverage to a second peak in 2006.

The sample of 212 selected for the analysis shows that 80% of the newspaper articles (see code book in Appendix 1) were in the news form and in terms of size were mainly medium sized (53%) and small (27.8%). There were also five editorial comments in the sample as well as features or long reviews and interviews with selected actors.

Guardian	Punch	This Day	Tribune	Vanguard	Champion
25.9	22.2	18.9	10.4	16.0	6.6

Table 25 Newspapers and percentage coverage of vaccination (N=212)

We can identify three phases in the life of the controversy: pre revolt, revolt and post-revolt. As in Ungar’s (1998; 2008) studies of Ebola and Global bird flu, the three stages are not demarcated by firm dates, as “the shift from one to the other is an emergent process that strengthens over time but is never absolute”.

What could be interpreted as the pre-revolt stage with “alarming packages” emerged early in the review period with reports of the vaccine being un-Islamic and tainted with the HIV/AIDS virus. The un-Islamic and conspiracy theory continued in 2002, buoyed by conflicting tests results from scientists and the involvement of elite religious leaders, till the debate climaxed in the revolt of 2003. Following the resolution of the conspiracy theory, the number of themes declined, but the un-Islamic theme was not resolved until sometime in 2007. After this, a single meaning emerged, albeit in the press, and the issue of coverage which had been in the debate all along became the focus of attention. The revolt period may thus be located between 2003 and 2007.

The post-revolt stage followed the resolution of both un-Islamic and conspiracy theories and the acceptance of the vaccine as effective by elite actors, or those who did not accept chose to stay out of public debate.

	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total
Un-Islamic	5.6	9.5	2.9	2	0	0	0	0	0	2.4
Conspiracy	0	4.8	11.8	23.5	8.7	0	0	6.7	0	9.4
Effective	77.8	66.7	47.1	68.6	87	40	11.1	33.3	27.3	56.6
risk issue	5.6	0	5.9	0	0	0	0	0	0	1.4
coverage	0	9.5	29.4	3.9	0	53.3	88.9	60	72.7	25.9
others	11.1	9.5	2.9	2	4.3	6.7	0	0	0	4.2
	10	10	100	100	100	100	100	100	100	100

Table 26 Themes and year of occurrence in column percentages (N=212)

The table above shows that while the effective vaccine theme was dominant (56.6%) throughout the review period, there were concurrent concerns about logistics affecting the coverage (25.9%) of the immunisation programme. Most surprising, too, was the low frequency (1.4%) of debates about risk from the vaccine. The risk covered by the media had to do with expired drugs and not the scientific risks which are vaccine associated paralytic polio (VAPP), circulating vaccine derived polio virus (cVDPV) and immuno-deficient vaccine derived polio virus (iVDPV). Coverage and the effective vaccine campaign became the dominant issues after 2005 (see <http://www.youtube.com/watch?v=uxA6-9MapMw>; <http://www.youtube.com/watch?v=7mfTpz6CW5g> for an online video of the media coverage of the OPV controversy produced in cooperation with the London College of Communication.

5.2.3 The themes in the controversy

This section describes the various themes and how they were presented and debated by the actors. The entire corpus of 643 articles was read several times and sets of issues in the debate separated into six categories. The manageable number of six was chosen for analytical purposes: not too many to be repetitive but enough to convey the messages.

The un-Islamic theme (2.4%)

This theme emerged at the onset of the NID's when Islamic preachers began to publicly campaign against the exercise, raising the issue of its compatibility with the Quran and the teaching of the prophet in the Hadith. The theme may however, have been present in discourse in the north before the period covered by this study. It was present in the vaccination debate between 2001 and 2004 and came up again in 2007 as a secondary theme.

"Cleric declares immunisation un-Islamic" (Atofelekun, 2001; Guardian, 25/10/2001).

"Immunisation is un-Islamic - cleric" (Oyerinde, 2002; This Day, 28/05/02).

The Guardian article said a cleric in Niger state had declared the immunisation exercise to be against Islamic injunctions and urged his followers not to participate. The *This Day* news story went further to urge Islamic scholars to show those verses in the Holy Quran and the Hadith of the prophet that justify the exercise of preventing a disease.

The western conspiracy theme (9.4%)

This theme was about a grand design by Western countries against Islam and the developing world. It likely entered discourse around 2002, rose rapidly in 2004 only to drop in 2005 and did not show much presence again until 2008.

"North rejects polio vaccine because of US" (Abraham, 2003, Tribune, 17/10/2003).

In this article, Alhaji Mailatu Bunu Gwandu was reported to have declared that

"America had no good intentions towards Muslims and whatever emanated from the US stood dubious for any Muslim notwithstanding the value."

Ibrahim Babangana, a resident of Gwange in Maiduguri, Borno State (Murray, 2003; Punch, 29/10/2003) did not allow his children be immunised. He said:

"Our brothers who came from Kano warned us at the mosque that the vaccine was an indirect family planning method intended to reduce the population of northern Muslims.

"They told us that one American company had done a similar thing in Kano some years back (reference to Pfizer's infamous Trovan drug trial in 1996) during which some Moslem children were killed and others paralysed and so we were warned not to allow it happen to our children again."

In an interview in Kano (Ogundipe, 2004, Vanguard, 27/02/2004), the state governor, Ibrahim Shekarau insisted on the anti-fertility hypothesis.

"... it is a lesser of two evils, to sacrifice two, three, four, five even 10 children than allow hundreds of thousands or possibly millions of girl child likely to be rendered infertile ... tests carried out by scientists in the state last year found traces of hormones. We want explanations."

In an interview with *The Guardian*, (Abuh, 2004 in *The Guardian*, 11/01/2004) renowned paediatrician, Dr. Datti Ahmed, said polio incidence in the country was very small and the "common sense" thing to do was to stop the campaign until necessary tests are conducted.

"It is not something that is widespread. The total infection is about 146 per annum which is a small figure when you imagine the hundreds of thousands that are being vaccinated. If it turns out the allegation is true, it means damage would have been done to hundreds of thousands of children."

Ahmed said it was too early to find evidence for sterilisation and HIV/AIDS because the children had not reached child-bearing age and cancers and HIV/AIDS take several years to develop. Testifying at the Nigeria House of Representatives session on the vaccine, Bayero University teacher, Dr Lawan Bichi said his first grouse was against the unethical omission of some components of the vaccine from the label. He said tests carried out on some randomly-selected vaccine samples showed they contained elements not reflected in their labels and among which were substances capable of impacting negatively on fertility and the causative agents of AIDS (Ogbodo, and Ayeoyemikan (2003, *The Guardian*, 23/12/2003) .

The effective vaccine theme (56.6%)

This was the most dominant in the news coverage. The campaign was for the public to accept the vaccine as effective against polio and quite often too, to dispel rumours and reaffirm its efficacy. Professor, Idris Muhammed (Adoba, 2001, *This Day*, 09/02/2001) emphasised the impossibility of the vaccine being tainted with the HIV virus and dispelled the Pfizer link. He said:

"No medical or scientific basis can justify their coexistence, it is simply not possible.

"It is ironical that the Pfizer trial could be used to militate against immunisation when in fact if we had immunized our people against meningitis disease in the first place there would have been no opportunity for any Pfizer or any other drug company to conduct a clinical trial."

Dr Masur Kabir Commissioner for Health, Kano state in 2002 under governor Rabiun Kwankwaso of the People's Democratic Party (Abuh 2002; Guardian, 17/04/2002) said

"We are already enlightening our people that it is safe and harmless ... The vaccine does not contain HIV, neither is it a contraceptive. It has no complications or side effects."

WHO, UNICEF and The Federal Ministry of Health officials (Murray, 2003a; Punch, 31/10/2003) also refuted claims of OPV being contaminated with anti-fertility substances and HIV/AIDS virus.

"The oral polio vaccine is safe and effective. ... The vaccine is neither contaminated with HIV/AIDS nor cancerous microbes and is free of any anti-fertility hormones."

Tests conducted by a Moslem pathologist at the Ahmadu Bello University Zaria, Dr Abdulmumini Rafindadi at the request of the Katsina State branch of the SCSN also found the drug to be free of anti-fertility hormones (Murray, 2003, The Punch, 29/10/2003). He said in Kaduna:

"The finding of a series of tests which we carried out in October, 2002 on the polio vaccine at the instance of the Katsina state branch of SCSN has proved that the vaccine is free of any anti-fertility agents or dangerous diseases like HIV/AIDS" (Akhaine, et al 2003: The Guardian 18/11/2003).

The federal government set up an independent panel of experts headed by a northerner, renowned virologist and Professor Emeritus, Umaru Shehu, and following tests conducted in South Africa, it reported in December 2003 that the vaccine was safe (Lambo, 2003: the Guardian 30/12/2003).

The report said among other things:

"All tests were conclusive that none of the samples had been contaminated by HIV-1 and HIV-2; no anti-fertility agents were detected in the sample as interpreted by

prominent national and international experts present at this meeting as well as those confirmed by the laboratory consultant in South Africa."

Yet another committee of all stakeholders set up in February 2004 declared the vaccine safe for use but now found trace amounts of estradiol in some samples but no progesterone (estradiol is a sex hormone). The committee (Bichi and Babatunde, 2004; 27/02/2004) however noted that

"The trace amounts of estradiol in question was much smaller than what is found in recycled drinking water in several developed countries."

It explained that the estradiol may have resulted from calf blood used in the production process to grow the virus.

After a tour of Egypt, some prominent Islamic leaders finally accepted vaccination.

"Immunisation is Halal in Islam based on the teaching of the Quaran and the Hadith," the forum of traditional rulers said in a statement (Fred-Adegbulugbe (2007; 25/02/2007)

The risk theme (1.4%)

This was designed to capture risks from vaccine-derived polio or other sources of risk that may be attributed to taking the vaccine (apart from those linked to western conspiracy). It appeared as 1.4% of the sample and was prominent as a primary theme between 2001 and 2003 and again in 2008, but as secondary theme.

What is very interesting here is the relative absence of the risk of contracting vaccine-derived polio virus in the debate and the focus on expired vaccines, which may be related to distribution. The explanation came in an article in TIME magazine as Kano's chief health officer, Aisha Kiru said given the low level of education, informing them of the risk may lead to a mass rejection of the vaccine (Da Costa, 2007).

The risk theme was well captured by an alarming report which appeared in one of the dailies. The report (Yusuf, 2003, Vanguard, 31/08/2003) was titled, "300 children die after vaccination" and the report said:

"More than 300 children between the ages of one and six have been killed by expired vaccines ... apart from the death toll; many more were paralysed with scores of others infected as a result of the use of expired vaccines."

The report was denied by both the Adamawa State Commissioner for Health, Dr Saidu Morupa and the Ministry's permanent secretary, Dr J Kwaje:

"No child died as a result of the immunisation exercise ... No polio immunisation mass campaigns (NIDS) have been conducted in Adamawa state this year ... No incidence of paralysis due to wild polio virus have been reported from Adamawa state for the past two years contrary to claims by the reporter that scores were paralyzed" (Oke, 2003; Vanguard, 07/09/2003).

There were other headlines in the same alarming risk frame:

"Govt agency distributes expired typhoid vaccines" (Owuamanam, 2003; Punch, 01/09/2003);

"Plateau health ministry stops dispensing of NPI expired vaccines" (Obateru, 2003; Vanguard, 04/09/2003).

Coverage and Finance (25.9%)

A major surprise was the amount of articles that featured issues concerning inadequate coverage and finance; 25.9% of the articles appeared as primary and 29.7% as secondary themes (Appendix 1). This shows how strong the issue was in the controversy. In terms of number of articles, it was the dominant secondary theme between 2001 and 2006 and it became the main issue in the debate from 2006 to 2009. The focus on the conspiracy theory at the beginning of the review period may have dampened its importance in the continued spread of the disease. It was the silent obstacle to the eradication process.

A medical worker in Lagos State (Anaele, 2003; Punch, 27/02/2003) said:

"It is true, we don't have the vaccine. The supply is irregular."

Commissioner for Health, Lagos State, Dr Leke Pitan attributed the shortage to the federal government and coming from Lagos, one of the richest states in the federation, is a good indication of a failure of policy.

"We are waiting for the federal government to supply us because there is a policy that the vaccine must be solely supplied by it. So there is nothing we can do."

A United States Agency for International development (USAID) report (Akpe, 2003; Punch, 12/03/2003) said coverage dropped by 11% between 2000 and 2002 and describing the decline as 'alarming' the organisation attributed it to persistent unavailability of vaccines for routine immunisation and non-availability of immunisation cards.

The report was denied by the authorities, the headline of *The Guardian* article said:

"Agency refutes report of drop in immunisation coverage" (Anyikwa, 2003; Guardian, 21/03/2003).

There were also issues concerning the adequacy of population figures. The Sokoto state director of primary health care regretted that they were working with wrong population estimates (Olyinka, 2006; 03/07/2006)

"Most of the time, whenever we are on vaccination, we often find we exceed the projected number of children. But on careful scrutiny, we find that not even half of the children have been immunized".

Issues of adequate funding also continued to mar the success of the campaign. In 2007 and several years into the campaign, the director-general of the National Programme on Immunisation, Dr Edugie Abebe, solicited the assistance of Rotary International to bridge a \$30.7 million funding gap for the 2007 immunisation target (Isine, 2007; 25/01/2007)

The Others Theme (4.2%)

This category contained stories related to vaccination but not belonging to any of the themes above and was about 4.2% of the primary themes.

There were reports of unrelated events having direct impact on the campaign. A Punch story (Bolarinwa, 2001; Punch, 02/12/2001) reported a Nigeria Union of Local Government Employees (NULGE) strike disrupting the third national immunisation exercise. There were also several newspaper headlines reporting allegations of corruption:

“Ibori warns LG’s against diversion of immunisation facilities” (Adebayo, 2002; Vanguard, 14/01/2002).

“FG investigates Banks handling of immunisation programme funds” (Ojeme, 2002; Guardian, 10/04/2002).

In a *Champion* newspaper article titled: “Unanswered questions about NPI’s N2billion gift” (Uzendu, 2002; Champion, 15/04/2002), Health Minister Alphonsos Nwosu said the government was investigating how a grant of EU20 million was converted to Nigerian currency without “express permission” of the NPI.

An article also canvassed for the inclusion of other tests with routine immunisation (Ndubusi, 2001; This Day, 21/08/2001):

"Compulsory hearing screening is already embedded in the health policies of many counties of the world such that antenatal hearing tests are carried out on new babies."

The national coordinator of the National Programme on immunisation, Dr Dere Awosika, also said an act to make immunisation compulsory was being considered by government. She said compulsory vaccination existed in law before the 1979 constitution reversed it (Akintola, 2003; Daily Times 24/11/2003).

5.2.4 Actors, themes and evaluation

The actors identified in the debate were grouped into the federal government and its agencies, such as the ministries and the National Programme on Immunisation, etc.; the state governments and their ministries and parastatals; religious leaders and groups, emirs and other elite voices in the debate; there were also the World Health Organisation, UNICEF, Rotary International, other

members of the GAVI alliance and other foreign NGOs; the others category included local NGO's, private persons and others who did not fit into the previous classes. Sectional leaders and religious groups were responsible for the un-Islamic theme with voices from states and some other individuals and groups, while the western conspiracy debate featured almost all actors.

	Un-Islamic	Conspiracy	Effective	Risk	Coverage	Others
Federal government	0	30	46.7	0	50.9	22.2
States and local govt.	20	30	22.5	66.7	30.9	33.3
Religious/sec leaders	60	15	0.8	0	0	0
World bodies	0	0	10.8	0	10.9	0
Others	20	25	19.2	33.3	7.3	44.4
	100	100	100	100	100	100

Table 27 Tabulation of primary themes and primary actors in percentages (N=212)

A cross tabulation of the actors and themes shows a high level of significance with Chi sq. = 83.03, P<0.01 and a Cramer's V of 0.313.

Anti-vaccination	Mixed messages		Pro-vaccination
N2	N1	P1	P2

Table 28 Systems of communication adapted from Castro and Gomez (2005)

The evaluations were recoded using Castro and Gomez (2005) four logical options for systems of communication (see Appendix 1 for syntax of recoded variables) to N2; N1; P1 and P2.

	N2	N1	P1	P2
Un-Islamic	10	12.5	0	0
western conspiracy	60	6.3	8.1	2.9
effective vaccine	10	9.4	65.9	77.1
risk issue	10	3.1	0.7	0
coverage	0	59.4	21.5	20
others	10	9.4	3.7	0
Total	100	100	100	100
Total number of articles	10	31	135	35

Table 29 Tabulation of primary themes and evaluation in percentages (N=212)

Both P1 and P2 formed 80.18% (135+35) of the articles and thus media coverage may be considered generally positive.

Correspondence analysis was used to explore the relationship between the evaluation and the themes for the period 2001 to 2009. The chi sq value of 99.9; P value of 0.01 and Cramer's V value of 0.4 show there is enough variation in the data for correspondence analysis.

The bi-plot shows the relative strengths of the association between the themes and the evaluations. Those which appear closer together are relatively more associated than those far apart. The western conspiracy and risk themes are more closely associated with high negative values than coverage and others categories.

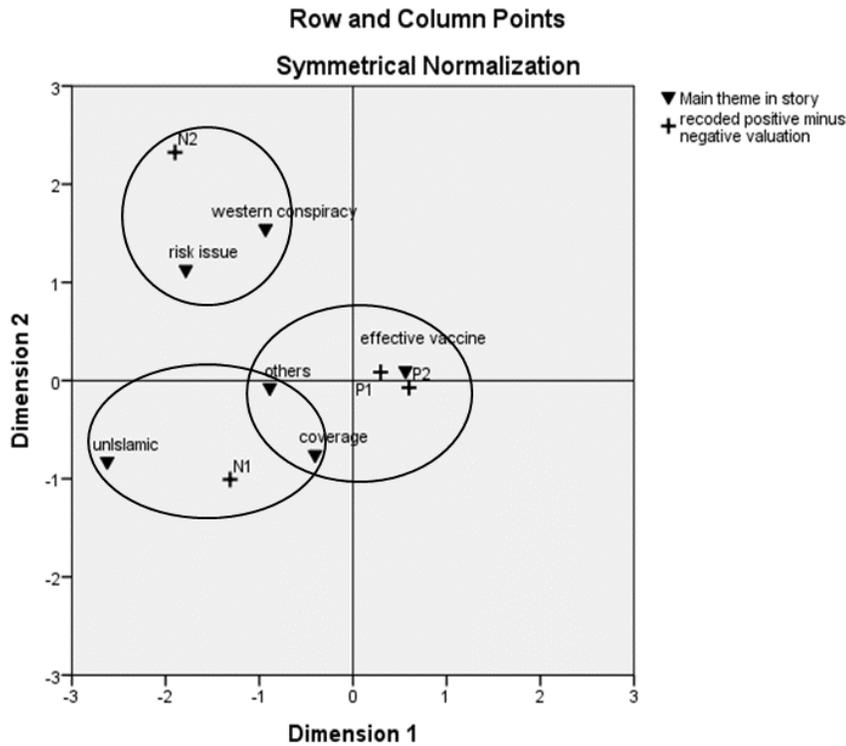


Figure 17 Bi-plot of evaluation and main theme (2001 to 2009) N=212

Three genres (clusters of collective identity for meaning and sense making) based on these associations with evaluation are visible in the bi-plot. The concept of genre is richer than frames as it avoids the ambiguity in definition, particularly between core and peripheral elements. It also embraces evaluation of the themes which makes a much clearer distinction between anti- and pro-vaccination representations as well as the mixed.

Dimension	Inertia
One	62.9%
Two	36.3%
Total inertia	99.2%

Table 30 Inertia accounted for evaluation and themes 2001 to 2009

Western conspiracy and risk tend to be close to high negative values, forming a genre at the top left of the geometric space; effective vaccine forms another genre with both positive values on

the right side of graph. The genre on the bottom left comprises un-Islamic, coverage and others category. Dimension one (from left to right) separates the negative evaluation from the positive. It also separates the effective vaccine theme (right) which promotes acceptance from other themes which may inhibit acceptance of the vaccine (left).

	Mass	Coordinates		Inert	CONTR		CORR2		Quality F1+F2
		F1	F2		F1	F2	F1	F2	
Un-Islamic	0.02	-2.62	-0.83	0.10	0.30	0.04	0.92	0.07	0.99
West/Conspiracy	0.09	-0.93	1.55	0.14	0.15	0.55	0.32	0.68	1.00
Eff/ vaccine	0.57	0.56	0.10	0.10	0.33	0.01	0.98	0.02	1.00
Risk /vaccine	0.01	-1.78	1.13	0.03	0.08	0.04	0.77	0.23	1.00
Coverage	0.26	-0.41	-0.76	0.08	0.08	0.36	0.27	0.73	1.00
Other themes	0.04	-0.89	-0.07	0.02	0.06	0.00	0.89	0.01	0.89
N2	0.05	-1.90	2.33	0.20	0.31	0.62	0.47	0.53	1.00
N1	0.15	-1.31	-1.01	0.20	0.48	0.37	0.69	0.31	1.00
P1	0.64	0.30	0.09	0.03	0.10	0.01	0.91	0.06	0.97
P2	0.17	0.60	-0.07	0.04	0.11	0.00	0.91	0.01	0.92

Table 31 Numerical solution for evaluation and themes 2001 to 2009

The masses, a measure of the importance of a particular profile in the analysis, show that the effective vaccine theme has the highest value (0.57) followed by coverage; denoting their level of importance in the analysis. The low positive evaluation (0.64) also dominates the analysis. The effective vaccine and un-Islamic themes have the highest contribution of points to inertia (CONTR) of dimension one (the extent to which the point has contributed to determine the direction of the dimension). The low and high negative evaluations also show strong influence on the dimension. Western conspiracy, coverage and high and low negative define dimension two. The values of the squared correlations (CORR2 - how well a point is described by the dimension) show that the first dimension explains 92% of the inertia for un-Islamic frame, 98% for effective vaccine and 91% each for single positive and double positive evaluations. The second dimension explains 72% of the inertia for the coverage frame and 68% for the western conspiracy frame. The values of the quality of description (F1+F2) show that all the points in both sets are well described in the two dimensional solution.

Also interesting are the associations between themes and evaluation (Chi sq 79.83; $P < 0.01$; Cramer's $V=0.5$) and actors and evaluation (Chi sq 39.74; $P < 0.01$; Cramer's $V= 0.4$) before the

ban was lifted in 2004, involving about 107 articles from 2001 to 2004. These very strong relationships show there is enough variation in the data for correspondence analysis to describe geometrically the associations between the variables.

The analysis below is between themes and evaluation. The bi-plot also shows three genres and is quite similar in appearance to the geometric projections of the full data from 2001 to 2009.

Dimension	Inertia
One	66.6%
Two	31.5%
Total inertia	98.1%

Table 32 Inertia accounted for evaluation and themes 2001 to 2004

The analysis shows a slightly more dominating first dimension compared with 2001 to 2009 and a good two dimensional solution accounts for at 98% of the inertia.

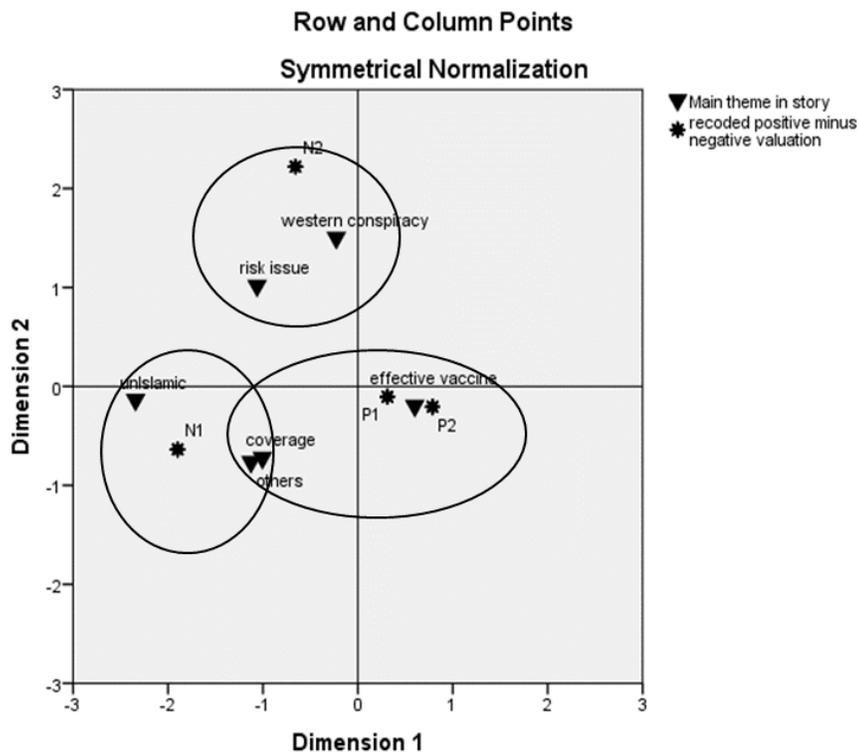


Figure 18 Bi-plot of evaluation and themes (2001 to 2004) N=107

The masses, a measure of the importance of a particular profile in the analysis, show that the low positive evaluation has the highest value (0.61) followed by the effective vaccine theme (0.6) denoting their level of importance in the analysis. Risk and western conspiracy form a cluster with high negative while effective vaccine also forms a cluster with both positive evaluations.

Main theme	Mass	Coordinates			CONTR		CORR2		Quality F1+F2
		F1	F2	Inertia	F1	F2	F1	F2	
Un-Islamic	0.05	-2.34	-0.14	0.19	0.36	0.00	0.96	0.00	0.96
Western conspiracy	0.15	-0.23	1.50	0.17	0.01	0.70	0.03	0.96	1.00
Effective vaccine	0.60	0.60	-0.19	0.16	0.31	0.05	0.93	0.07	1.00
Risk issue	0.03	-1.06	1.02	0.04	0.05	0.06	0.61	0.39	1.00
Coverage	0.12	-1.01	-0.72	0.12	0.17	0.13	0.72	0.25	0.97
Other themes	0.06	-1.13	-0.76	0.07	0.10	0.07	0.75	0.24	0.98
N2	0.08	-0.66	2.22	0.23	0.05	0.86	0.11	0.89	1.00
N1	0.14	-1.90	-0.64	0.38	0.72	0.12	0.93	0.07	1.00
P1	0.61	0.31	-0.10	0.05	0.08	0.01	0.85	0.06	0.91
P2	0.17	0.79	-0.21	0.09	0.15	0.02	0.85	0.04	0.89

Table 33 Numerical solution for evaluation and themes (2001 to 2004)

The values of the squared correlations show that the first dimension explains 96% of the inertia for un-Islamic frame, 93% for effective vaccine, 93% for the single negative evaluation and 85% each for single positive and double positive evaluations. The second dimension explains 96% of the inertia for the western conspiracy theme and 89% for the high negative theme. The values of the quality of description (F1+F2) show that all the points in both sets are well described in the two dimensional solution.

Concatenated table for genres

The evaluations, themes and actors can be combined into one table to visualise the geometric representations of the three. This is achieved by merging the cross tabulation of actors and evaluations and themes and evaluations into a table referred to as concatenated (or staked) table (Greenacre, 2010; Greenacre and Blasius, 1994). This is an intermediate between simple and multiple correspondence analysis.

The analysis, carried out using the **R** software, shows the close association between the sectional leaders, the high negative evaluation, conspiracy theories and risk from the vaccine. They form a distinct genre. World bodies, other actors, federal government, high and low positive and effective vaccine all cluster around the centroid forming another cluster while coverage and other themes are between N1 and P1 but closer to low negative. The Un-Islamic theme is also closer to low negative than high negative.

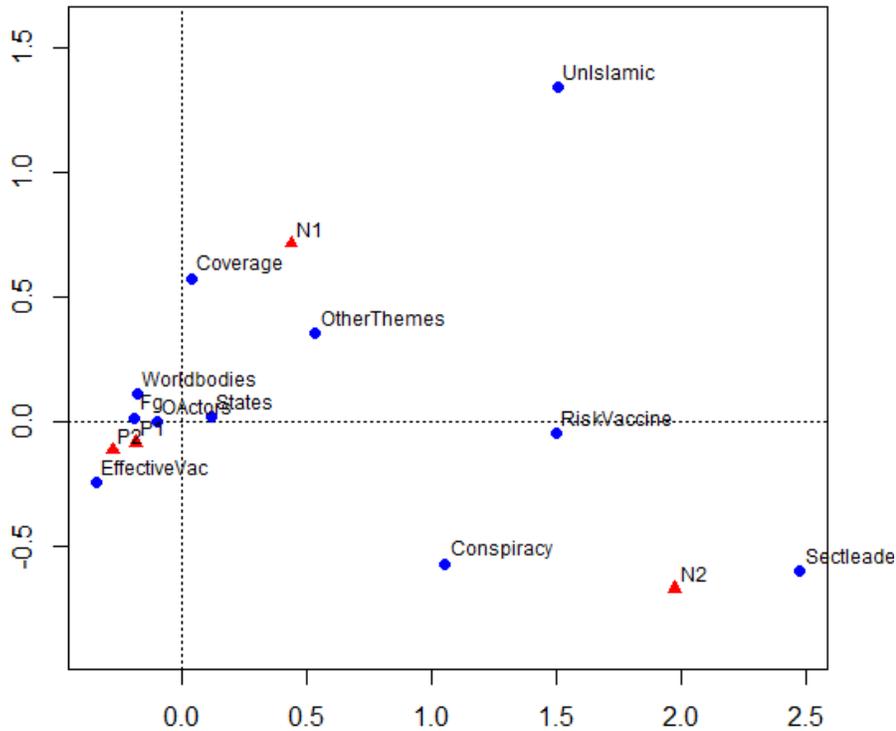


Figure 19 R output of evaluation, actors and themes (2001 and 2004) N=107

	N2	N1	P1	P2
Federal government	1	12	62	17
States and Local govts	4	10	27	15
Sectional leaders	4	2	1	0
World Bodies	0	3	15	1
Other Actors	1	5	30	2
Un-Islamic	1	4	0	0
Western Conspiracy	6	2	11	1
Effective vaccine	1	3	89	27
Risk issue	1	1	1	0
Coverage	0	19	29	7
Other themes	1	3	5	0

Table 34 Concatenated table of evaluation, actors and themes (2001 to 2009) N=212

Dimension	Inertia
One	64.2%
Two	27.2%
Three	8.6%

Table 35 Inertia accounted for evaluation, actors and themes 2001 to 2009

The masses show that the federal government and effective vaccine theme had the highest values followed by states and coverage; denoting their level of importance in the analysis. The masses also show the dominance of the low positive evaluation.

	Federal govt	States	Sect leaders	World bodies	Other Actors	Un-Islamic	Conspiracy	Effective	Risk	Coverage	Other themes
Mass	0.22	0.13	0.02	0.04	0.09	0.01	0.05	0.28	0.01	0.13	0.02
ChiDist	0.19	0.35	2.55	0.40	0.35	2.02	1.21	0.42	1.51	0.57	0.69
Inertia	0.01	0.02	0.11	0.01	0.01	0.05	0.07	0.05	0.02	0.04	0.01
Dim. 1	-0.38	0.24	4.98	-0.35	-0.19	3.03	2.13	-0.68	3.02	0.09	1.08
Dim. 2	0.04	0.05	-1.85	0.35	0.00	4.14	-1.76	-0.76	-0.16	1.76	1.08
	N2	N1	P1	P2							
Mass	0.05	0.15	0.64	0.17							
ChiDist	2.09	0.84	0.23	0.49							
Inertia	0.21	0.11	0.03	0.04							
Dim. 1	3.98	0.89	-0.36	-0.55							
Dim. 2	-2.08	2.20	-0.27	-0.37							

Table 36 R output of numerical solution for actors, themes and evaluation

The media and the OPV controversy

The content analysis of articles on the coverage of immunisation by the Nigerian media provides a longitudinal map of the representations of the OPV in the decade 2001 to 2009. It shows a breakdown of the debate into specific themes and the actors behind those themes. It has also enabled an evaluation of the themes and with the aid of correspondence analysis; we can see graphically who is responsible for what and the likely positive or negative impact.

Longitudinal analysis also shows a concise picture of how the themes changed over the span of the survey which allows a demarcation into pre-revolt, revolt and post-revolt stage and the themes predominant at each stage. It identified three major themes as crucial to the poor uptake of the vaccine and the eradication of the disease: the conspiracy theory, the un-Islamic theme and coverage (poor distribution system and fund shortages, among others). After the conspiracy theory was put to rest in 2004, the disease continued to spread indicating there were still some underlying issues yet to be resolved and one of this was the issue of compatibility with Islam and the religious leaders were still in doubt about if it was Godly to immunise. After this was addressed, it now became very obvious that there were attendant issues of logistics all along which were critical to the success of the immunisation programme but were overshadowed by the other themes. One cannot also rule out the non-conversion of many in the public still sceptical of the new way of looking at disease following the heated political and scientific

disagreements. For Sadiya Musa, the change on the part of the politicians calls for more suspicion; 'how can they say the vaccine is bad and then say it is good again' (AP, 2006).

Content analysis however, has limitations on how the figures that emerged from its statistical components can be interpreted. As regards frequency of occurrence of themes, its statistical value may not always tally with societal impact but the reported cases of polio infections (WHO, 2011), which were a separate statistical output, shows an interesting comparison with media coverage. This is not entirely unexpected given several theories about mass media effects, particularly agenda setting (McCombs and Shaw, 1972), which argues that what is uppermost in the news is also uppermost in the minds of the public: in this case, public concern over rising infection cases. If infection cases are rising, then media coverage will increase alongside public anxiety over the disease. The differences observed in the lines of the graphs in the trend analysis also shows that the media and what is uppermost in people's minds can at times resonate and at times be at variance (see Bauer, 2005; Joffe, 2002; Entman and Rojecki, 1993).

It is also surprising that despite the overwhelming positive coverage by the media, the disease continued to spread. Could this be a validation of Mazur and Lee's (1993) hypothesis about increased media coverage driving public opinion in the negative direction? One would have expected that such overwhelming positive media coverage would lead to a positive response but the study showed the limitations of media-mind link. The media may indeed tell us what we should think about (Cohen, 1963), but not necessarily how we should think about it. There was also the issue of coverage of the entire northern population and its impact on what was seen as resistance, which may in fact be inadequate coverage in some areas. It would be interesting to extend the study beyond 2009 to see how the vaccine coverage issue plays out in the following years alongside the effective vaccine theme.

5.3 Science news in the press (Guardian newspaper: 2001 – 2009)

Null Hypothesis: Intensity of coverage of science in the Nigerian press was low (in terms of quantity of stories) and predominantly negative.

Alternate Hypothesis: Intensity of coverage of science is comparable with other contexts (United Kingdom and the United States) and not predominantly negative.

Method of analysis: Content analysis of the genres of science news in the Nigerian press from 2001 to 2009.

McQail, (1979) argues that as an instrument of social power, the media can attract and direct attention to problems, solutions or people, can confirm status and legitimacy, can be a channel for persuasion and mobilisation and can bring certain public into existence and maintain them. This study of science in the Nigerian press was therefore designed to capture these dynamics: to construct a map of what the media draw the attention of the public to about science, what they tell the public to think about its value as a loss or gain and its likely consequences for science, the society and also the public. Of relevance here is the hypothesis of agenda setting (McCombs and Shaw, 1972; McCombs, 2004; 2005), which proposes that what is prominent in the news is what is also salient in people's minds. Also, going by the hypothesis of 'quantity of coverage theory' an elaboration of agenda-setting theory, many in the public are not likely to read science news in detail, scanning the headline and looking at pictures and on issues of risk, persistent coverage may actually drive opinion in a negative direction (Marzur and Lee, 1993). It is also a fact that much of what is headline news in newspapers is bad news and the dramatic and the more of it you have in the news, the more anxious the public becomes. Science is not exempt from this and what is news may be the unfamiliar, at times a novelty with its attendant public anxiety. News has also been described as the expected but unpredictable (Park, 1940) with the same consequences of public anxiety. We expect a hurricane in its season but the pattern is unpredictable. Another hypothesis of relevance to this study is cultivation analysis. Gerbner (1969) and Gerbner et al. (1978) argue that what the media do is cultivation of common perspectives rather than achieving any preconceived goals, effects or impact.

5.3.1 Methods

The newspaper of choice was *The Guardian*, regarded as the flagship of the Nigerian press. *The Guardian* newspaper has been relatively consistent in terms of its focus and sections over the decades, thus lending itself to longitudinal analysis. In longitudinal analysis, comparisons span the same context over a longer period, which allows the detection of fluctuations in content (Bauer, 2000a). Answers to the specific questions listed below will be sourced from the frequencies of the different categories in the coding frame set out in the code book (appendix 2) on a corpus of 822 articles selected from *The Guardian* newspaper over a ten year period.

Concept	Specific questions
Intensity of coverage	a. Page type b. Section story is found c. Space allocated d. Benchmarking with other countries.
Journalistic practice	a. News value b. Main agent in narrative c. Event life cycle for new and recurring issues.
What is present and what is propagated	a. Academic field b. Strategic technologies
How were the news sourced?	a. Local sources b. Foreign origin c. Type of journalist, specialist in science reporting and others.
How were they presented?	a. Risk or gain b. Location of consequences c. Evaluation and genres

In each year, every 25th edition was picked starting from an arbitrarily chosen date and examined for science based articles and these produced 14 editions of two constructed weeks for each year in the sample (see figure 13) and a total of 42 editions. Every article in each edition was read to ensure they actually include science in at least two paragraphs. The evaluation was based on a scale of perceived benefits and projected risk/damage of the technology involved in the article. It involved reading of the article to determine the appropriate magnitude; +7 being

long term benefits to this and future generations and -7 referring to long term damage to this and future generations. The zero mid-point would be a neutral article (See Chapter 4 for more details). The artificial week (Stempel, 1952) constructed for the corpus construction is also in appendix 2.

5.3.2 Intensity of coverage

The space allocated to science coverage by *The Guardian* in terms of column inches was about 6.8% of the total available space in 2001, 7.7% in 2004 rising to 8.3% in 2009

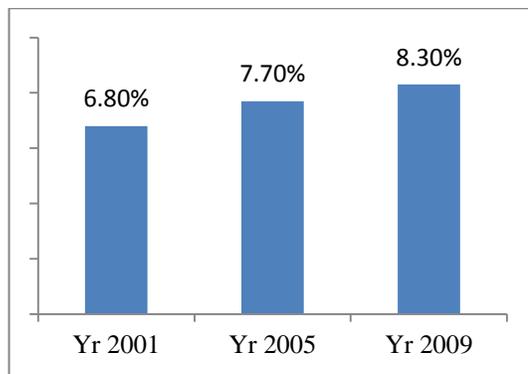


Table 37 Percentage of column inches for science news (N=822)

This compares well with the 5-6% devoted to science by the British press (Bauer et al., 1995), both data are however, separated in time. The PEW research centre's annual report (PRCP, 2011) on American journalism also shows the number of science stories at cumulative 9.2% (Science and technology at 1.7%; environment at 1.8% and health and medicine at 5.7%) but with a different methodological approach. PEW's focus is mainly on number of stories on cover pages. The interest here is in the direction of the movement and since the Nigerian data shows is it is on the increase, it can be related to increasing interest and widening topics in science reporting.

The front page is the most visible of all news pages and is seen by even those who do not buy the newspaper on the newsstand and those who listen to newspaper reviews on radio and television. It also features the most important news of the day and in *The Guardian*, it spills onto page two, while the other topical news items follow on pages three to five. The back page of *The*

Guardian is also part of its main news and is not devoted to sports as in most dailies. Thus, the most important issues of the day are likely to be found on pages one to five and the back page.

Day of week	Day of month	Column ins	Edition ins	Percentage	Yr av %	3yr av
YR 2001						
Monday	01/01/2001	587	14112	4.2%		
Friday	26/01/2001	409	14112	2.9%		
Thursday	15/02/2001	1856	20160	9.2%		
Friday	02/03/2001	1178	14112	8.3%		
Tuesday	27/03/2001	1228	20160	6.1%		
Saturday	21/04/2001	883	12096	7.3%		
Wednesday	16/05/2001	868	16128	5.4%		
Sunday	10/06/2001	1002	14112	7.1%		
Thursday	05/07/2001	1659	14112	11.8%		
Monday	30/07/201	954	20160	4.7%		
Saturday	25/08/2001	707	12096	5.8%		
Tuesday	18/09/2001	762	20160	3.8%		
Sunday	14/10/2001	1073	12096	8.9%		
Wednesday	07/11/2001	1967	20160	9.8%		
			223776		6.8%	
YR 2005						
Saturday	08/01/2005	1949	16128	12.1%		
Wednesday	02/02/2005	1469	16128	9.1%		
Sunday	27/02/2005	1977	16128	12.3%		
Thursday	24/03/2005	1125	20160	5.6%		
Tuesday	18/04/2005	425	20160	2.1%		
Friday	13/05/2005	1053	16128	6.5%		
Tuesday	07/06/2005	598	24192	2.5%		
Saturday	02/07/2005	1715	16128	10.6%		
Wednesday	27/07/2005	1595	20160	7.9%		
Sunday	21/08/2005	2239	20160	11.1%		
Thursday	15/09/2005	2205	20160	10.9%		
Monday	10/10/2005	1442	20160	7.2%		
Friday	04/11/2005	1478	16128	9.2%		
Monday	28/11/2005	849	20160	4.2%		
			262080		7.7%	
YR 2009						
Sunday	25/01/2009	2002	24192	8.3%		
Thursday	19/02/2009	1982	20160	9.8%		
Monday	16/03/2009	2755	27972	9.8%		
Friday	10/04/2009	1708	16128	10.6%		
Tuesday	05/05/2009	1108	20160	5.5%		
Saturday	30/05/2009	1509	16128	9.4%		
Wednesday	24/06/2009	1345	16128	8.3%		
Saturday	18/07/2009	1630	16128	10.1%		
Wednesday	12/08/2009	2306	18144	12.7%		
Sunday	06/09/2009	1827	24192	7.6%		
Thursday	01/10/2009	1233	24192	5.1%		
Monday	26/10/2009	1738	20160	8.6%		
Friday	20/11/2009	1540	18144	8.5%		
Tuesday	15/12/2009	786	20160	3.9%		
			281988		8.3%	7.4%

Table 38 Column inches per publication sample (N=822)

The science articles found on these pages are among the most important news items of the day. The content analysis shows that 3.4% of the sample was on the front cover, 3.8% on the back page and in all 22.2% were on the main news pages (front, back and pages 2 to 5). A cross tabulation of recoded academic field and page type shows that most of the articles on the main news pages were on technology and engineering (29.4%) and medical (26.4%).

In all, about 23 sections were identified in the corpus constructed from the artificial week sampling procedure (appendix 2) used for the coding. The column breakdown shows the bulk of science news items were on the main news pages (21.8%) followed by financial (15.6%).

The Guardian has for several years been at the forefront of the campaign for alternative medical therapy, for which it maintains a good spread of pages every Friday, accounting for 6.7% of the articles, surprisingly more than those devoted directly to orthodox medicine (2.8%), which, however, often finds expression in the main news. Health, made up of both alternative and orthodox medicine, accounted for 9.5%; and foreign news for about 6.4%. Other major interests were in homes and property, 5.7%; IT and telecom, 5.2%; opinion and editorial pages, 4.5% and energy, 4.4%. Other sections science featured include among others fashion and style, labour, appointments and industry, religious issues, agriculture and sports.

5.3.3 Journalistic practice

The interest in why the article was found to be newsworthy is to allow the making of plausible assumptions based on certain attributes of the article as to why the editors found it necessary to publish.

The subcategories in the news value include reference to elite institution or person; bad news, accident or catastrophe; good news, etc. Journalists are not always scientists themselves, and even if they have a science background, the field is so vast and complex they often rely on experts for information and balance. It was thus not too surprising to see that almost half (47.6%) of the primary news value was due to reference to an elite person or institution (Appendix 2).

	Novelty	Elite	Bad news	Good news	Controversy	Protest	Others	Total
2001	11.9	45.8	14.4	14.4	5	0	8.5	100
2005	21.5	44.4	8.3	7.3	10.8	0	7.6	100
2009	10.5	51.4	12	14.7	2.7	0.9	7.8	100
Total	14.7	47.6	11.3	12	6.1	0.4	7.9	100

Table 39 Year and primary news value in row percentages (N=822)

The main agent in the headline or first paragraph is who or what the story is about and is categorised as environment, animals, humans, microorganisms, pharmaceuticals, waste, equipment and others.

	Environ	Animal	Human	Institutions	Microbes	Pharma	Waste	Material	Others
2001	8.5	2.5	17.4	34.3	8.5	8.5	0	13.9	6.5
2005	8.7	3.5	16.7	35.1	7.6	6.9	0.3	14.2	6.9
2009	5.7	1.5	14.1	45.3	7.5	2.7	0	14.1	9.0
Total	7.4	2.4	15.8	39.1	7.8	5.6	0.1	14.1	7.7

Table 40 Year and main agent in row percentages (N822)

The main agent in the first paragraph/headline also confirms the importance of institutions in science communication. Thirty nine percent of the articles mentioned formal institutions in the first paragraph or the headline. Reference to formal institutions as main agents in the first paragraph also grew annually, as the table above shows. Science articles were thus chosen largely due to elite influence which shows increases over the years

Also important here is the location of the issue in the event life cycle, which provides more information on if the story is a mature and recurring issue or whether it is still in the discovery or invention stage. The findings show that more than half of the stories were about recurring issues (59.6%). Awareness accounted for 20.4%, while funding and resource allocation accounted for another 10.8%. Other event life cycle categories include product improvement and diffusion or awareness (see Appendix 2).

5.3.4 What is present, what is propagated?

The analysis also maps the field of coverage using subcategories delineated by academic fields such as physics, medical, social science, technology and engineering. Also important for the analysis is the presence or absence of certain technologies found strategic to modern societies

such as nuclear power, genetic engineering, internet, environment, and so on. The interest was to see if despite not having a nuclear power station, the debate over its use is in the local media and how the volume of stories compares with environmental issues (pollution, conservation) and energy (oil exploration and power shortages), which are major sources of concern locally. Slightly less than half of the articles published (45.3%) were categorised as strategic, given its very narrow definition for this research. Prominent among them were energy, telecoms, pollution and HIV/AIDS. Energy issues accounted for 14% while IT and telecoms accounted for another 14.2%. Also in the news were environmental pollution and protection, the probable fallout of oil exploration and conservation at 5.8% and HIV/AIDS at 4.3%. The prevalence rate of HIV/AIDS in the country is comparatively high and has been a subject of rigorous media campaigns on safe sex. Although the country has only one nuclear research centre located at the Obafemi Awolowo University, Ile Ife, South West Nigeria, it plans to join the league of nuclear power countries as a solution to its increasing energy needs. Its presence (1.6%) shows the Nigerian media are part of the nuclear debate.

	Arts	Phy/Che	Biology	Medical	Earth	S/Science	Tech/Engr.	Others
2001	0.5	2.5	0.5	35.3	5	2.5	45.8	8
2005	1	1.7	0.3	38.2	4.9	4.2	46.5	3.1
2009	0.3	0.9	0.6	33.9	5.1	5.1	52.3	1.8
Total	0.6	1.6	0.5	35.8	5	4.1	48.7	3.8

Table 41 Year and Academic field in row percentages (N=822)

The academic field was dominated by technology at 48.7% and followed closely by medical at 35.8%. The dominance of technology may be attributed to the increasing interest in the internet, computers and telecommunications and the perennial anxiety over the epileptic state of the country's power supply and fuel shortages. Combined, medicine and engineering related issues form about 84.5% of the total coverage. While the percentage of articles on medicine was about steady between 2005 and 2009, that of technology and engineering rose by 6 percentage points in 2009.

5.3.5 How were the news sourced?

The interest in how the news is sourced is also about its impact on the audience and its capacity to shape its meaning, particularly on issues concerning risk (Otway and Wayne, 1989). If you trust the risk manager, argues Slovic (1999) communication is relatively easy and a “miserly” public argues Nisbet and Scheufele (2009) relies heavily on their trust in science and scientists as a dominant heuristic in reaching judgments about policy matters. Trust for Luhmann (1998) is a solution for specific problems of risk. Thus, the trust bestowed on the source of news is crucial to how the public make common sense of issues and events. This was particularly crucial in the vaccination controversy. This analysis shows writers sourced science articles mainly from press releases, seminars and conferences. About 44.6% of the articles fall into this category of direct presentation of science news by officials. The wire services, including AFP and Reuters (14.6%) also played a substantial role as sources of science news.

	Wire services	Interview	Scientific journal	Research report	Investigation	press release	Foreign media	Others	Total
Novelty	19	11.6	29.8	0	14	20.7	5	0	100
Elite/institution	11	13.3	1.3	0.8	9.2	56.8	7.4	0.3	100
Bad news	26	8.6	3.2	1.1	10.8	41.9	6.5	1.1	100
Good news	6.1	7.1	6.1	0	12.1	61.6	7.1	0	100
Controversy	20	10	8	16	12	18	14	2	100
Protest	0	0	0	0	0	100	0	0	100
Others	20	3.1	16.9	1.5	24.6	12.3	21.5	0	100
Total	14.6	10.7	7.9	1.6	11.8	44.6	8.4	0.4	100

Table 42 Source of news and primary news value in row percentages (N=822)

The source of news can be read alongside primary news value as the cross tabulation above shows. Thirty percent of the novelty stories were accounted for by scientific journals and another 21% by press releases. The elite’s main entry point to the news was through press releases, accounting for 56.8%. Not surprisingly too, most good news (61.6%) were from press releases.

The usefulness of the separation between foreign and local sources will become more apparent in the discussion on the trust section of the public understanding of science survey.

The Guardian parades a sizeable number of specialist writers, including science writers, in its various sections but because of the multiple nature of news beats, some science stories will originate from the political – National Assembly, or business – stock market.

	Science writer	Other writers	Columnist	Foreign writer	Total
2001	17.9	62.2	7.5	12.4	100
2005	14.9	53.1	7.6	24.3	100
2009	28	46.1	4.8	21.1	100
Total	21	52.5	6.5	20.1	100

Table 43 Year and story writer in row percentages (N=822)

It is informative that 21% of the stories were explicitly written by specialist science reporters; columnists and non-specialist reporters accounted for about 59%, while the rest were written by foreign journalists. The interest here is again in the direction of movement. More stories were written by specialist science writers in 2009 than in 2001, and while the figure for foreign writers dropped by about three percentage points between 2005 and 2009, the number of local science writers almost doubled. The high local content was also remarkable due to the country's low industrial base and high dependence on imported technology. An increasing localisation of science and may be linked with growing interests in specialist reporting. However, more longitudinal data would be needed to monitor this trend.

Thus, when it comes to science in the Nigerian media, about half of the news in *The Guardian* originate from official sources (press releases and conferences) and the presence of foreign stories is an indication that world events play a prominent role in how the public make sense of science. However, the bulk of the stories (80%) were written by local journalists including science writers.

5.3.6 How were they presented?

The public use media messages to make meaning (Gamson and Modigliani, 1989), thus how the message is presented to them will contribute to how they make sense of it. The objective of the coding categories here is to examine those aspects of the story that will help establish the common sense interpretation of issues and events about science in the news: where the consequences of the issues are located; whether it is presented as risk or benefit; if it is a subject of controversy; and its evaluation in the local context may all combine to influence how it is received by the public.

The subcategories under primary location of consequences include socio-cultural and moral which accounted for about half of the articles (48.5%). Science also had applications in economic and financial fields (34.4%) while about 6.9% were in science itself. 8.3% were in environment and ecological and 1.8% in politics and power. Also interesting was the finding that most of the articles (66.2%) espoused the benefits of science, 13% both benefits and risk while 10% focused on risk alone. Similarly, about 83% of the articles were free of any scientific controversy and this can be interpreted alongside the event life cycle which shows that over 80% of the articles were about mature and recurring issues and awareness.

The evaluation was based on positive or negative consequences of science. The ranking employed the projected impact of the technology on the local populace and the wider society at large. The positive evaluation was lowest in terms of impact on individuals and highest for long term benefit to a generation. The negative was lowest for impact on individuals and highest for damages projected as capable of crossing continents and affecting this generation. The evaluations were recoded (see Appendix 2 for syntax of recoded variables) to high positive; low positive; low negative and high negative.

High Negative	Mixed messages		High Positive
NEG2 (N2)	NEG1 (N1)	POS1 (P1)	POS2 (P2)

Table 44 Systems of communication adapted from Castro and Gomez (2005) N=822

Genre analysis

The table of chi squares shows evidence of association between primary news value, discourse of benefits and risk, strategic technology and evaluation. The Cramer's V shows strong enough variation in the data (Blasius, 1994) to support a geometric display for the three combinations separately for correspondence analysis and concatenated for genres of science.

Cross tab of Evaluation vs	Chi square	P value	Cramer's V
Discourse of Benefits and risk	459.7	0.01	0.4
Primary news value	367.6	0.01	0.4
Strategic technology	172.4	0.01	0.3

Table 45 Chi square values for genre analysis

The bi-plots and numerical solutions for the association between two of the variables - primary news value and strategic technology - are discussed here.

For primary news value and evaluation, 99% of the inertia was accounted for in a two dimensional solution.

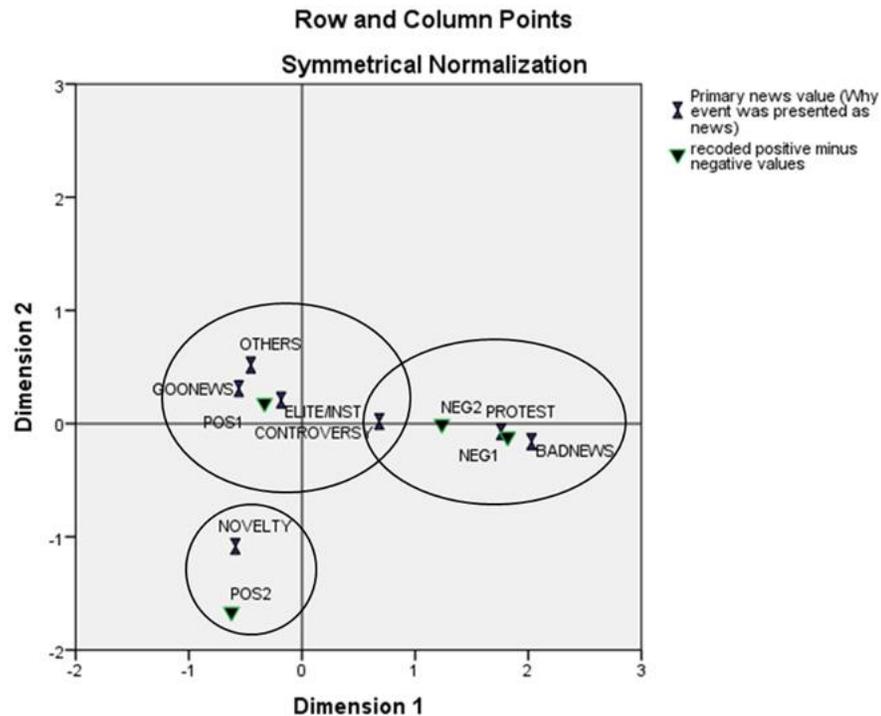


Figure 20 Bi-plot of evaluation and primary news value

Dimension	Inertia
One	87.6%
Two	11.7%
Total inertia	99.4%

Table 46 Inertia accounted for primary news value and evaluation

Dimension one separates the good news from bad and the positive from the negative.

The clustering of variables in the geometric space allows us to see how the variables position themselves. This is a collective identity (McQuail, 2005) we can aptly describe as genres. The bi-plot for the association shows about three genres. Novelty and highly positive consequences (POS2) form one genre, while good news, reference to elite and other news values form another genre with low positive consequences (POS1). These two genres have positive meaning and expectations in the media, and plausibly, in common sense. The third genre encases protest, bad news, and the two negative evaluations (NEG1 and NEG2). Controversy can be positioned as both positive and negative, thus of mixed genre.

	Mass	COORDINATES		Inertia	CONTR		CORR2		Quality
		F1	F2		F1	F2	F1	F2	F1 + F2
Novelty	0.15	-0.59	-1.08	0.07	0.08	0.76	0.45	0.55	1
Elite/Institutions	0.48	-0.19	0.21	0.02	0.03	0.09	0.68	0.32	1
Bad news	0.11	2.03	-0.16	0.29	0.74	0.01	1.00	0	1
Good news	0.12	-0.56	0.31	0.03	0.06	0.05	0.89	0.10	1
Controversy	0.06	0.68	0.02	0.02	0.05	0	0.95	0	1
Protest	0	1.76	-0.07	0.01	0.02	0	0.84	0	0.84
Others	0.08	-0.45	0.52	0.02	0.03	0.09	0.68	0.32	1
NEG2	0.03	1.24	0	0.03	0.08	0	0.92	0	0.92
NEG1	0.14	1.82	-0.12	0.29	0.75	0.01	1.00	0	1
POS1	0.75	-0.33	0.18	0.06	0.13	0.11	0.90	0.10	1
POS2	0.07	-0.62	-1.66	0.06	0.05	0.88	0.28	0.72	1

Table 47 Numerical solution for evaluation and primary news value

The sum of squared correlations (F1+F2) in the overview of row and column points shows that the two dimensional solution well represents all the points.

Notably also, the geometric display shows the horseshoe or Guttman effect, which occurs when the first dimension is very dominating and dimension two becomes a quadratic transformation of dimension one. Different explanations occur for this phenomenon (van der Heijden et al., 1984; Clausen, 1998).

For evaluation and modern technologies, 91% of the inertia was accounted for in a two dimensional solution. From left to right on dimension one, the bi-plot shows a separation of potent and unfamiliar technologies – nuclear, environment, biotech, immunisation and space -

from the ones the public are more familiar with and have daily experiences of, such as telecommunications, cancer, HIV and energy.

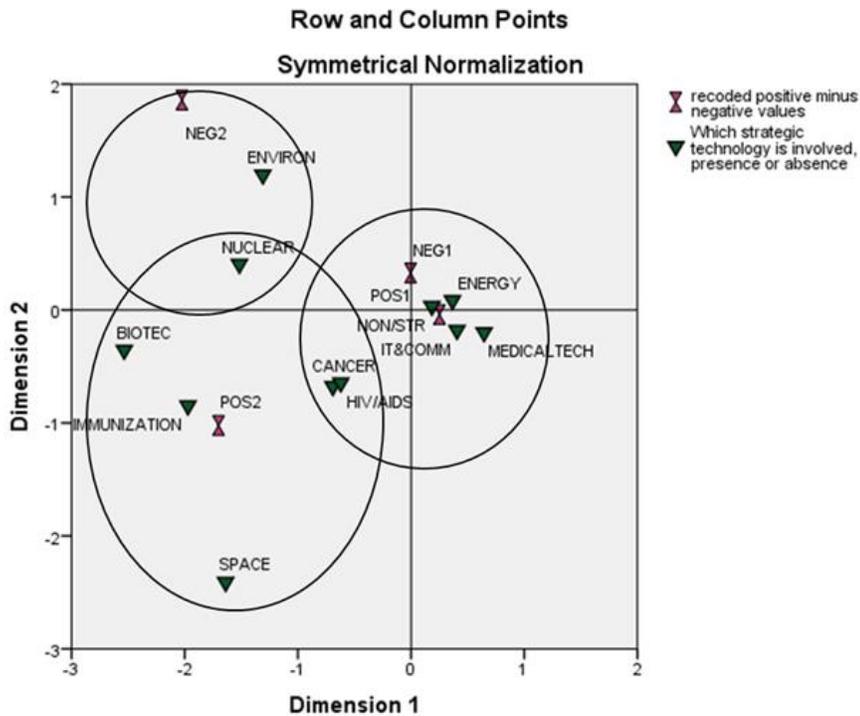


Figure 21 Bi-plot of evaluation and modern technologies

Dimension	Inertia
One	71.9%
Two	19.4%
Total inertia	91.4%

Table 48 Inertia accounted for strategic tech and evaluation

The bi-plot shows immunisation, space and biotechnology as being more closely associated with high positive consequences (POS2), forming a genre. Cancer and HIV/AIDS can also be identified with this genre although it overlaps with those variables around the centroid. Environment is closer to high negative consequences, forming another genre. Nuclear can also be categorised as being in this genre with environment but also overlaps with the high positive genre. Overlapping between both POS2 and NEG2 shows that nuclear power poses extreme consequences for society, both positive and negative. The remaining variables cluster together with both single positive and negative evaluations and are all close to the centroid thus not likely

to be associated with high positive or damage expectation and may be classified as belonging to a genre that is neutral in outlook or with slightly positive or negative consequences.

	Mass	Coordinates		Inertia	CONTR		CORR2		
		F1	F2		F1	F2	F1	F2	F1+F2
Nuclear	0.02	-1.52	0.41	0.02	0.09	0.01	0.96	0.04	1
Biotech	0.02	-2.54	-0.36	0.04	0.24	0.01	0.98	0.01	1
IT & Telecom	0.14	0.41	-0.18	0.01	0.06	0.02	0.81	0.08	0.90
Space	0.01	-1.64	-2.41	0.03	0.09	0.39	0.47	0.53	1
Cancer	0.01	-0.69	-0.68	0.01	0.01	0.03	0.26	0.13	0.38
Environ	0.06	-1.31	1.2	0.06	0.26	0.41	0.70	0.30	1
HIV/AIDS	0.04	-0.62	-0.64	0.01	0.04	0.09	0.62	0.35	0.96
Energy	0.14	0.37	0.09	0.02	0.05	0.01	0.46	0.01	0.47
Medical	0.01	0.65	-0.2	0	0.01	0	0.50	0.02	0.52
Immunization	0.01	-1.97	-0.85	0.02	0.1	0.04	0.86	0.08	0.95
Other issues	0.55	0.18	0.03	0.01	0.05	0	0.84	0.02	0.85
NEG2	0.03	-2.03	1.86	0.07	0.33	0.54	0.68	0.30	0.98
NEG1	0.14	-0.01	0.33	0.02	0	0.07	0	0.18	0.18
POS1	0.75	0.25	-0.04	0.02	0.12	0.01	0.89	0.01	0.90
POS2	0.07	-1.70	-1.02	0.1	0.54	0.38	0.84	0.16	1

Table 49 Numerical solution for evaluation and modern technology

The numerical solution expatiates on the associations. The sum of the squared correlations which expresses the fit of each point's representation in the solution or the quality of description ($F1 + F2$), shows that nuclear power, genetic engineering, space technology, environment, telecommunications, HIV/AIDS, NEG2, POS2 and POS1 are well described, while low negative is outside the plane in the two dimensional solution.

Concatenated table for genres

Since the evaluations form a common reference point for all the variables, it is possible to merge several correspondence analyses into one geometric space and still retain the characteristics of the genres. This joint relationship of discourse of benefits and risk, strategic technologies and primary news value with evaluation can be visualised in a concatenated (or staked) table - a block matrix composed of several two-way cross tabulations (Greenacre, 2010; Greenacre and Blasius, 1994). This is an intermediate between simple and multiple correspondence analysis.

The geometric representation is produced by the software called **R** and it retains as much as possible of the individual spatial arrangements in the simple correspondence analyses and a two dimensional solution accounts for 93.11% of the inertia.

	NEG2	NEG1	POS1	POS2
BEN	1	11	486	46
RISK	21	52	10	0
BENRISK	2	17	81	9
NOBENRISK	2	36	43	5
NOVELTY	1	1	91	28
ELITE	10	35	324	22
BADNEWS	10	62	21	0
GOONNEWS	0	0	93	6
CONTRO	4	15	29	2
PROTEST	0	2	1	0
OTHERS	1	1	61	2
NUCLEAR	2	2	6	3
BIOTEC	2	2	3	5
IT&COMM	0	12	101	4
SPACE	0	0	6	5
CANCER	0	3	4	2
ENVIRON	9	9	23	7
HIV	1	5	22	7
ENERGY	0	26	86	3
MEDTECH	0	0	4	0
IMMUN	1	0	4	3
NONSTR	11	57	361	21

Table 50 Concatenated table for genres

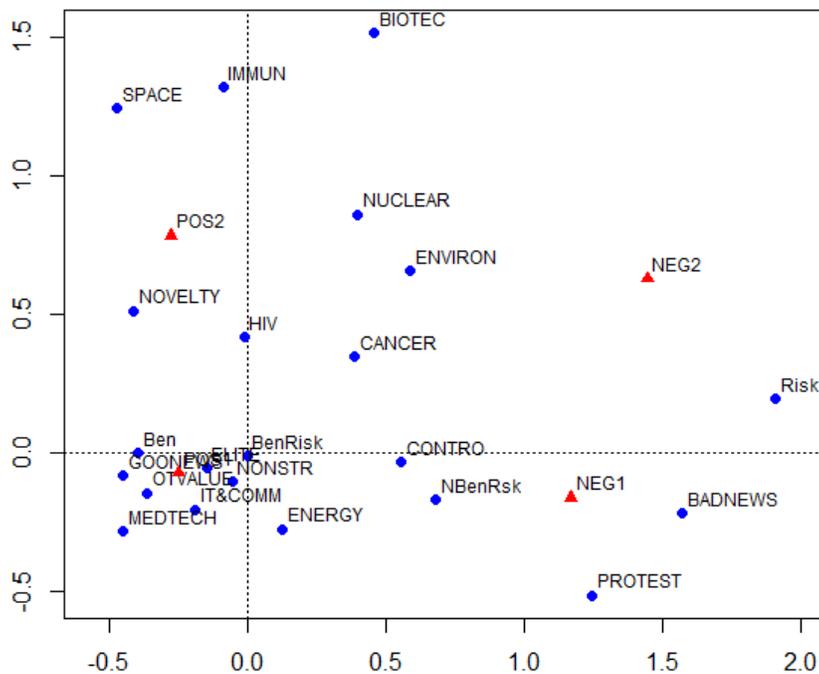


Figure 22 R output for concatenated table of science news

Dimension	% Inertia explained
One	77.02
Two	16.09
Three	6.89
Total inertia	100

Table 51 Inertia explained for three concatenated variables of science news

Left to right (dimension one) shows the more positive aspects of science while the middle variables are essentially mixed and the negative ones to the right of the plot.

	Ben	Risk	Ben & Risk	No Ben Risk	NOVELTY	ELITE	BADNEWS	GOONNEWS	CONTRO	PROTEST	OTVALUE
Mass	0.22	0.03	0.04	0.03	0.05	0.16	0.04	0.04	0.02	0	0.03
ChiDist	0.4	1.96	0.09	0.8	0.7	0.18	1.61	0.47	0.55	1.52	0.44
Inertia	0.04	0.13	0	0.02	0.02	0	0.1	0.01	0.01	0	0.01
Dim. 1	-0.71	3.42	-0.01	1.22	-0.75	-0.27	2.81	-0.81	0.99	2.23	-0.66
Dim. 2	-0.01	0.77	-0.04	-0.66	2.01	-0.22	-0.85	-0.31	-0.13	-2.01	-0.56
	NUCLEAR	BIOTEC	IT&COMM	SPACE	CANCER	ENVIRON	HIV	ENERGY	MEDTECH	IMMUN	NONSTR
Mass	0.01	0	0.05	0	0	0.02	0.01	0.05	0	0	0.18
ChiDist	0.96	1.59	0.28	1.49	0.85	0.98	0.49	0.34	0.57	1.32	0.13
Inertia	0	0.01	0	0.01	0	0.02	0	0.01	0	0.01	0
Dim. 1	0.71	0.82	-0.34	-0.85	0.69	1.05	-0.02	0.22	-0.81	-0.16	-0.1
Dim. 2	3.38	5.94	-0.8	4.87	1.36	2.57	1.64	-1.07	-1.11	5.17	-0.4
	NEG2	NEG1	POS1	POS2							
Mass	0.03	0.14	0.75	0.07							
ChiDist	1.73	1.19	0.26	0.88							
Inertia	0.09	0.20	0.05	0.06							
Dim. 1	2.58	2.09	-0.45	-0.50							
Dim. 2	2.47	-0.63	-0.28	3.08							

Table 52 R output of the numerical solution for concatenated table of science news.

5.3.7 The Guardian and herbal medicine

The media, according to McQuail, (1979; 2007) direct attention to issues, cause certain public to be and maintains them and can also be for mobilisation and persuasion. Through regular appearance of certain columns and issues, it also maintains a public devoted to these causes. Take the herbal column in *The Guardian* as a case in point. The column has run every Friday for more than three decades and has continued to promote alternative medical practices side by side with western orthodox medicine. It has accounted for 6.7% of the science news on the inside pages (Appendix 2), slightly more than foreign section (6.4%), home and gardening (5.7%), IT and telecomm news (5.2%) and energy (4.4%).

The Guardian, it is plausible, is both revealing the place of herbal medical practices in common sense and at the same time cultivating healthy living as a mixture of both western and orthodox

practices. This proposition is also founded on the hypothesis of agenda setting and cultivation analysis.

5.4 Summary

The media though not always the faithful mirror, provides a map of the representations of the oral polio vaccine in the Nigerian press: the actors; what is being debated; and what is, surprisingly, ignored. While the media told the public what to think about, it did not quite succeed in telling them what to think (Cohen, 1963) as disease incidence remained high despite generally positive coverage from the media. And quite revealing in the analysis is the absence of debate about scientifically determined risk from vaccine associated paralytic poliomyelitis, circulating vaccine derived polioviruses and immuno-deficient vaccine derived polio virus. The concern was over risk from expired vials. The initial resistance did not have much to do with scientifically determined risk but in socio-cultural factors such as conspiracy theories and compatibility with religious belief. As Moscovici (1984) argues, the images, ideas and languages shared by the group always seem to dictate the initial direction by which the group tries to come to terms with the unfamiliar. The images of America in the Moslem world which the public were familiar with and the compatibility of Islam with science significantly shaped the debate about the vaccine. This research also shows that the social representations theory is well suited to characterising the evolution of content, structure and the functions of voices and images of public concern (Bauer and Gaskell, 1999) and that emotional and social forces shape different forms of knowing (Jovchelovitch, 2008). It also confirms Joffe (1999) argument that the motivations which underpin risk perception are not based on a need for accurate information but a want in people to protect from threat, themselves and the groups with which they identify.

The coverage of science in *The Guardian* shows that in the period covered by the study, the paper devoted more space to science and technology articles, rising from 6.8% in 2001 to 8.3% in 2009. Also, about 22% of the articles were on the main news pages comprising the front and

back cover and pages two to five. With journalistic practice, reference to elites and formal institutions played a major role in news value confirming that reporters lean most heavily on official sources. There was a higher focus on technology and engineering (49%) compared with medicine (36%) and it may be appropriate to regard technology as the face of science in Nigeria in the period under review, with medicine following closely. In his analysis of results of surveys and media analysis, Bauer (1998) found medicine to be the nucleus of the representations of science in Britain following a shift from the physical sciences, which dominated from 1930 to 1980. For Bauer, the dominance of physics in that era may have been the less likely state of affairs and the reestablishment of biomedical news is a return to status quo ante. Has the trend changed again in the 2000s towards technology, which now dominates our lives, especially computer and mobile phone technology? Or is the proportion of both in the news a marker of cultural differences? More worldwide research is needed in this field to bring figures up to date and compare across cultures.

The evaluation shows a generally positive outlook for science in the Nigerian press, with about 83% of the articles classified as positive. This makes a strong case for interpreting the outlook of science in common sense in the Nigerian context as generally positive.

6.1 Introduction

Two surveys were conducted in the course of this study. The first was online in 2010 and modelled after the "Icelandic Omnibus Version" of Public Understanding of Science (PUS) survey with 168 participants from Nigeria and abroad. Some of its findings were discussed earlier in Chapter 4. The expanded survey, comprising 377 respondents and conducted in 2012 was designed with major input from the Eurobarometer, National Science Foundation, Taiwan and Malaysia Science in Society surveys and was administered mainly in Lagos State, South West Nigeria. Factor analysis, univariate and regression analysis were used to analyse the data guided by some hypotheses developed in line with the research objectives.

6.2 Methods

The main objective of the online survey was to prepare for the main survey by testing the relationship between certain variables and for input into the question guide for the interviews (see Appendix 3 and 4). The survey questionnaires for the main survey were administered using a network of volunteers mostly in Lagos (see Appendix 4, 5 and 6). In all, about 480 questionnaires were returned. Some were however too poor to be included, too many questions having been left out. 377 returned questionnaires were classified fit for the survey and used for the analysis. Unanswered questions were coded as missing and the survey was used to test hypothesis 3, 4, 5, 6, 7 and 8.

Hypothesis 3 Trust in institutions and persons

Both science and religion are used as the basis of statements about the 'truth' (Gaskell, et al., 2010), a situation that is often interpreted as incompatibility, since you cannot have two truths about the same phenomenon. Thus, the more religious you are, the more likely you are to oppose the scientific establishment. For science communication, where trust is a compensation for

deficiencies on the cognitive level (Neidhardt, 1993), the more you trust religious leaders, the less you should trust scientists. But as Giddens (1999, 2002) also argued, religious belief is a substitute for risk in some societies. The question then is can we have trust in God and scientists at the same time? Can a society concurrently expect Magnetic Resonance Imaging devices (MRI's) and miracles?

Null Hypothesis: Levels of trust in scientists and religious leaders in Nigeria are negatively correlated in the context of trust in other institutions.

Alternate Hypothesis: Levels of trust in scientists and religious leaders are positively correlated in the context of trust in other institutions.

Method of analysis: Factor analysis.

Hypothesis 4 Structures of attitudes to science

The analysis of attitudes to science has evolved from the construction of two aggregated indexes capturing benefits and risks, to one of a single continuum, measuring negative to positive to an aggregation of four items, and most recently to measures of promise and reservations (Pardo and Calvo, 2002). Gaskell et al. (2010) classified attitudes to technology as optimism or pessimism and Durant et al. (2000) as progress, panacea, future shock and pessimism. This research adopted the two factor solution as the null hypothesis.

Null Hypothesis: 2 facets: optimism and pessimism characterise the attitudes of Nigerians to science and technology.

Alternate Hypothesis: Attitudes are characterised by more than two facets.

Method of analysis: Factor analysis.

Hypothesis 5 Knowledge and attitudes (Fundamental) I

The association between knowledge and attitudes to science is moderated by a fundamental attitude to the world, between an existential view and an engineering perspective.

Null Hypothesis: There is no interaction between knowledge and fundamental attitudes to the world in the public's attitude to science.

Alternate Hypothesis: There is an interaction between knowledge and fundamental attitudes to the world in the public's attitude to science.

Method of analysis: MANOVA for interaction effects.

Hypothesis 6 Knowledge and attitudes (religiosity) II

The association between knowledge and attitudes to science is moderated by religiosity.

Null Hypothesis: There is no interaction between knowledge and religiosity in the public's attitude to science.

Alternate Hypothesis: There is an interaction between knowledge and religiosity in the public's attitude to science.

Method of analysis: MANOVA for interaction effects.

Hypothesis 7 Knowledge and attitudes III

Public understanding can be equated with the factual knowledge of science (Gregory, 2001) leading to a situation of "knowledge equals appreciation," also rephrased: the more you know it, the more you love it.

Null Hypothesis: Knowledge and attitudes to science are positively correlated.

Alternate Hypothesis: Knowledge and attitude to science are not positively correlated.

Method of analysis: Binary logistic regression of attitude facets

Hypothesis 8 Public understanding of vaccination

Opposition to vaccination is associated with knowledge, religiosity, trust in institutions and persons and attitude to science in Nigeria.

Null Hypothesis: There is a positive association between knowledge, trust, religiosity, attitude to science and opposition to vaccination.

Alternate Hypothesis: There is no positive association between knowledge, trust, religiosity, attitudes to science and opposition to vaccination.

Method of analysis: Binary logistic regression.

6.3 Trust in leaders and worldview

Most authors, as discussed earlier, agree that trust is a compensation for deficiencies on the cognitive level and that the more you trust scientists, the less you should trust religious leaders.

This section analyses the trust variables in the PUS survey with the following hypothesis:

Null Hypothesis: Levels of trust in scientists and religious leaders in Nigeria are negatively correlated.

Alternate Hypothesis: Levels of trust in scientists and religious leaders are positively correlated.

Method of analysis: Factor analysis of trust variables.

			Politicians	Religious leaders	Scientists	Military leaders	Judiciary	Foreign NGO's
Kendall's tau_b	Religious leader	P	0.70					
	Scientists	P	0.02	0.01				
	Military leaders	P	0.01	0.06	0.05			
	Judiciary	P	0.01	0.01	0.01	0.01		
	Foreign NGO's	P	0.82	0.01	0.01	0.04	0.00	
	Local NGO's	P	0.01	0.01	0.00	0.01	0.01	0.01

Table 53 Correlation matrix showing levels of significance for trust variables N=377

The correlation matrix shows significant correlations among the trust variables, a requirement for factor analysis. The association between religious leaders and politicians and Foreign NGO's and politicians are however not significant.

Both unrotated Varimax and rotated Oblique (Promax, Kappa 4) solutions show three factors which in both cases account for 70.6% of the variance (Cronbach alpha of 0.699). The scree plot below also shows an elbow at the three factor solution.

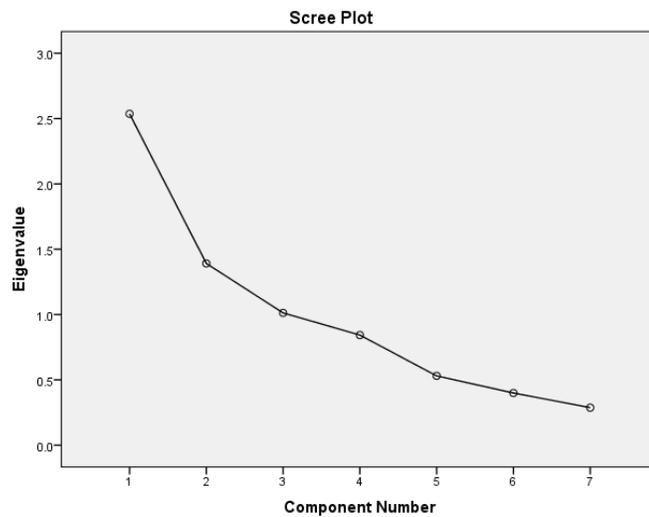


Figure 23 Scree plot for trust structure

The Promax Kappa 4 is reported here because the variables are expected to be correlated and the rotation approximate to real life social science situations.

Factors	I	II	III
Trust in military leaders	0.829		
Trust in Judiciary	0.788		
Trust in politicians	0.605		
Trust in foreign NGO's		0.913	
Trust in local NGO's	0.45	0.865	
Trust in religious leader			0.845
Trust in Scientists and professors		0.428	0.842
Variance explained	36.2%	19.9%	14.5%

Table 54 Structure matrix for trust items (N=377)

6.3.1 Interpretation of factors

The first dimension, which I called the "public service factor" accounts for 36% of the variance explained and groups the public servants, which make up the judiciary, the politicians and the military.

Trust scale from 0 (no trust) to 6 (maximum trust)		
Rotated PCA FA (Promax Kappa 4 SPSS)		
3 factors, 70.6% of the variance		
•	Factor 1 (36.2%);	
•	Factor 2 (19.8	
•	Factor 3 (14.5%)	
Kaiser-Meyer-Olkin (sampling adequacy)	0.614	>0.5 7-8 good
Bartlett's (Sphericity)	P<0.001	sig
Determinant (multicollinearity)	0.183	>0.00001

It is not surprising, given that Nigeria has been governed by eight military heads of state and six civilians, that they are grouped with politicians; what is surprising is the judiciary. However, the judiciary's mean of 2.45 puts it slightly ahead in trust (see Table 56).

The third factor, I labelled the "faith/science factor," accounts for 14.5% of the variance and combines trust in scientists and professors with religious leaders. These are specialist leaders and in their various fields expected to be out of political life. What is more interesting and surprising here however, is the similarity of the levels of trust in both institutions. The population have same levels of trust in both science and religion. They trust both MRI's and Miracles.

The second factor, I called the "independents factor" and group's foreign and local non-governmental organisations. Trust in scientists and professors also loads fairly on independents and this may be because scientists are both domestic and foreign and domestic science also has a

lot of foreign components and some of the trust on both sides may influence each other. It is the same for local NGOs, which also loads on both public service and may have been influenced by the "Nigerian factor" in the public service. Loadings less than 0.40 were suppressed in the analysis.

The component correlation matrix showed a strong correlation between independents and faith (0.345) and between independents and public service (0.287). The correlation between faith and public service is less strong (0.159).

The analysis shows we can reject the null hypothesis of negative correlation and accept the alternate hypothesis that there is significant positive correlation between trust in scientists and religious leaders.

Trust in social institutions and actors can be categorised into three facets: faith, public service and independents.

I also explored the means for more explanation of the variables that make up the factors. The mean for the public service latent variable was more varied, with the trust in politicians posting the lowest mean. However, the judiciary was higher in terms of mean than the military and politicians.

	Mean	Std. Deviation	Skewness
Military leaders	1.93	1.70	0.57
Judiciary	2.45	1.63	0.02
Politicians	0.70	1.24	2.34
Foreign NGOs	3.85	1.82	-0.69
Local NGOs	3.08	1.76	-0.12
Religious leaders	3.61	1.79	-0.46
Scientists and professors	3.65	1.58	-0.38

Table 55 Mean and standard deviation for trust variables

The distribution of the Independents and faith/science factors (figure 21) are slightly skewed to the left (-0.15 and -0.34 respectively) while public service is skewed to the right (1.31).

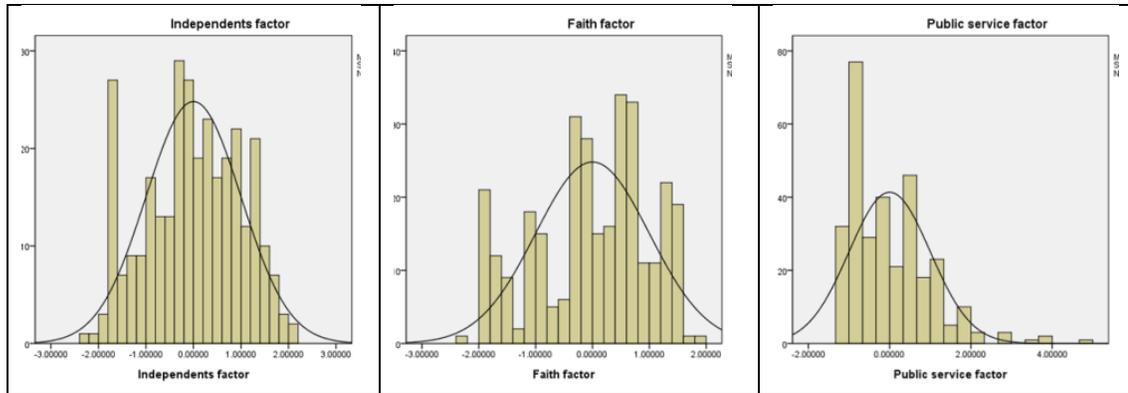


Figure 24 Histogram of distribution for independents, faith and public service

6.4 General attitude to science

Null hypothesis: 2 facets: progress and pessimism characterise the attitudes of Nigerians to science and technology

Alternate hypothesis: Attitudes are characterised by more than two facets

			More job	Worried science	Lives healthier	Few control	Sort problems	Scientists dangerous	New inventions	Easier, comfort	Environment	Too fast	Scientists better	Universe picture
Kendall's tau_b	Worried science	P	0.43											
	Lives healthier	P	0.01	0.06										
	Few control	P	0.01	0.21	0.01									
	Sort problems	P	0.01	0.75	0.01	0.01								
	Scientists dangerous	P	0.03	0.01	0.32	0.01	0.02							
	New inventions	P	0.01	0.61	0.01	0.01	0.01	0.28						
	Easier, comfort	P	0.01	0.57	0.01	0.04	0.31	0.01	0.12					
	Environment	P	0.97	0.01	0.01	0.01	0.05	0.01	0.06	0.24				
	Too fast	P	0.02	0.01	0.01	0.84	0.10	0.01	0.05	0.01	0.01			
	Scientists better	P	0.01	0.46	0.01	0.02	0.01	0.93	0.07	0.01	0.99	0.01		
Universe picture	P	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.03	0.01	0.01		
Benefits than harm	P	0.01	0.99	0.01	0.10	0.25	0.59	0.01	0.01	0.64	0.01	0.01	0.01	

Table 56 Kendal Tau_b correlation matrix for attitudes N=377

The correlation matrix also shows that the attitude variables meet the condition for a factor analysis. The factor analysis was conducted using SPSS. The unrotated PCA accounts for 54.5% of the variance, with a 4-factor solution and eigenvalue of fourth factor at 1.078. The first factor explains 22% of the variance, the second 15%, third 9% and fourth 8%. The point of inflection on the scree plot was three, indicating a 3-factor solution is preferred. The component matrix

was however difficult to interpret and a series of rotations followed to identify the most meaningful pattern in the data.

5 point scale from disagree to agree, DK coded as 3 with neither/nor		
Rotated PCA FA (Promax Kappa 4 SPSS)		
3 factors, 46% of variance		
•	Factor 1 (22%);	
•	Factor 2 (15%);	
•	Factor 3 (9%)	
Kaiser-Meyer-Olkin (sampling adequacy)	0.723	>0.5 7-8 good
Bartlett's (Sphericity)	P<0.001	sig
Determinant (multicollinearity)	0.118	>0.00001

A Promax Kappa 4 oblique rotation shows three meaningful factors but accounts for a lower 46% of the variance with point of inflection on the scree plot at three.

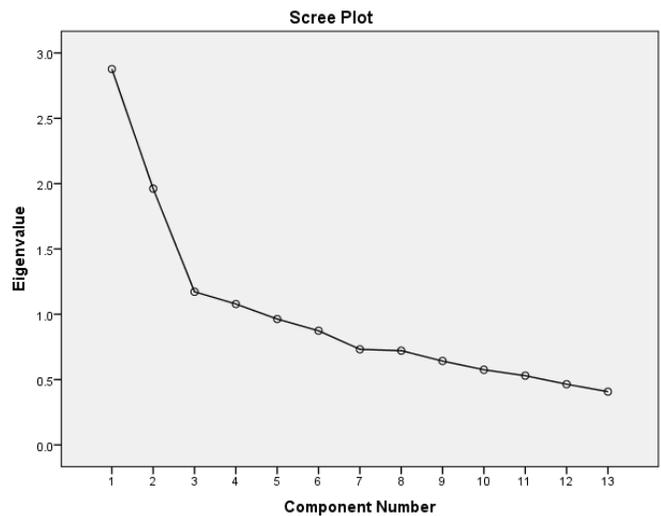


Figure 25 Scree plot for attitudes structure

The three factors identified are as below.

Factors	I	II	III
Sort any problem	0.756		
Universe picture	0.643		
Few control	-0.594		
New inventions	0.462		
Benefits greater than harm		0.691	
Scientists better		0.633	
Lives healthier	0.553	0.624	
Easier, comfort		0.56	
More job	0.415	0.526	
Too fast		-0.449	
Environment			0.749
Worried science			0.735
Scientists dangerous			0.701

Table 57 Structure matrix attitude items N=377

Loadings less than 0.4 were suppressed to make presentation and interpretation easier.

6.4.1 Interpretation of factors

Gaskell et al. (2010) classify attitudes to technology as optimism or pessimism. Durant et al. (2000) also identify four attitudinal dimensions: progress, panacea, future shock and pessimism. Progress (or optimism) is a classification of positive experiences. Factor II in my analysis can be identified as a factor comprising variables that describe such experiences through science making lives better, healthier, more comfortable and providing job opportunities. Notably, all the variables on this factor have levels of agreement above 50%, all others are below (Table 19). Two of the variables, however, concomitantly load on factor I. “Lives healthier” and “More jobs” have elements of both I and II. They also have the lowest levels of agreement on the factor.

The variable “science and technology can sort out any problem” loads highest on factor I. It also has the lowest level of agreement of all attitude variables at 23.9% (Table 19). With other variables, they touch on the contentious issue of science being limitless in possibilities and therefore capable of solving all problems? One interpretation of this factor is apprehension/pessimism since agreements are low. An alternative interpretation follows from the works of Mary Midgley. Midgley (2004; 2011) argues that any claim to the “inevitable progress and the omniscience of science” is a myth. She describes as an extraordinary claim of inevitable progress, Rudolf Carnap’s statement that “there is no question whose answer is in principle unattainable by science”. This is the underlying assumption of the variables on this factor. Midgley (1992; 2006) also disagrees with what she describes as “ambitious estimate” and “high hopes” of what science is and can do, an example of which is one of Stephen Hawking’s arguments, in his book: *A Brief History of Time*. Hawking argues that the goal (of science) is “a complete description of the universe we live in.” Midgley asks if there is something as a complete description since there is no limit to the questions that might need answering. Description of the universe is the second question that loads on the factor.

Factor III loads highest on the variable “science is responsible for most environmental problems and also captures concerns about the perceived danger in scientists’ knowledge, which makes them dangerous. The variables that make up this factor appear to signify a fear of the artefacts of science, another category of pessimism. Factor I thus expresses apprehension or pessimism; factor II is about progress or optimism while factor III is about the fear of science and scientists. The component correlation matrix shows that factors I and II are positively correlated (0.322). Factor I is, however, less correlated with the III (-0.065) and II with III (0.043). The analysis shows we can reject the null hypothesis of two factors and confirm the alternate hypothesis that there are more than two, and in the case of the data for this research, three factors.

	Mean	Std. Deviation	Skewness	Cronbach alpha
Factor I (Pessimism)				0.4
Sort problems	2.75	1.09	0.35	
Universe picture	3.39	1.11	-0.23	
Few control	2.88	1.02	-0.03	
New inventions	3.36	0.91	-0.41	
Factor II (Progress)				0.53
Benefits greater harm	3.70	0.92	-0.65	
Scientists better	3.95	0.80	-0.53	
Lives healthier	3.61	0.98	-0.46	
Easier, comfort	4.08	0.83	-0.98	
More job	3.63	1.05	-0.49	
Too fast	2.09	0.88	0.90	
Factor III (Fear)				0.61
Environment	2.67	1.13	0.16	
Worried science	2.82	1.13	0.09	
Scientists dangerous	2.90	1.12	0.01	

Table 58 Mean, standard deviation and skewness for attitude variables N=377

The table of means also shows the variability in the data. With the exception of "Too Fast," other variables that make up the latent variable progress have higher means than Factor I (pessimism) and generally lower standard deviation from the mean. Factor III also has lower means and higher standard deviation from the mean. Cronbach alpha for the fear factor was 0.61: for the progress factor 0.53 (0.65 if you remove fast); and for pessimism it was 0.4 (0.64 if you remove control).

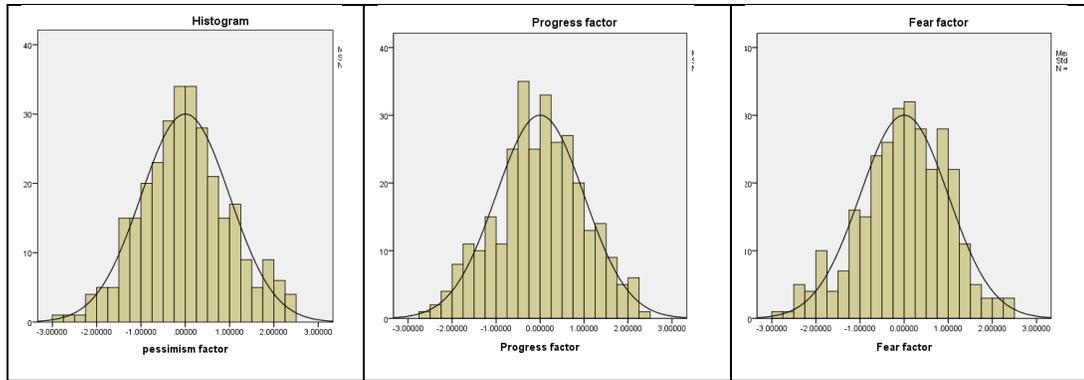


Figure 26 Histogram of distribution for pessimism, progress and fear factors

6.5 Fundamental attitude to the world

The association between knowledge and attitudes to science is moderated by a fundamental attitude to the world, between an engineering view and an aesthetic perspective.

Null Hypothesis: There is no interaction between knowledge and fundamental attitude to the world in the public's attitude to science

Alternate Hypothesis: There is an interaction between knowledge and fundamental attitude to the world in the public's attitude to science.

The Multiple Analysis of Variance (MANOVA) statistical technique was used to see the effects of the interaction between fundamental attitudes to the world and knowledge on the three attitude facets: pessimism, fear and progress. However, only on the fear facet was a significant effect observed. There was a very significant interaction effect between knowledge and fundamental attitudes on the fear of science, $F(2, 230) = 8.74, p=0.01$ and the combined effect also shows a higher value of partial η^2 (0.07) than either main effects. There was, however, surprisingly no significant main effect between fear of science and knowledge, $F(2, 230) = 2.17, p=0.12$, partial η^2 0.02 and between fear of science and fundamental attitude to the world $F(1, 230) = 0.87, p=0.35$, partial η^2 0.01. The profile plot shows a quadratic trend with both fundamental attitudes close together at low knowledge only to show polarity at mid knowledge with the engineering attitude showing less fear of science.

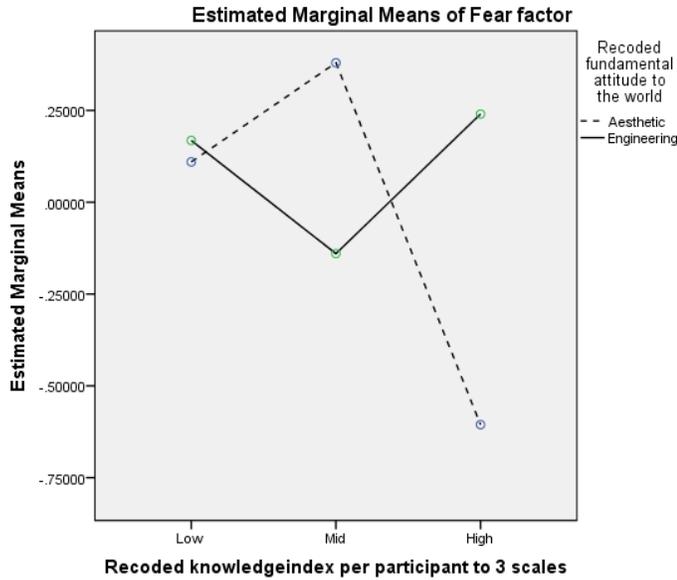


Figure 27 Interaction: knowledge and fundamental attitude on fear

Tests of Between-Subjects Effects				
	Mean Square	F	Sig.	Partial Eta ²
Dependent Variable: Fear factor				
Rec_Knowledgeindex_3	1.92	2.17	0.12	0.02
Rec_Atti_Fund	0.77	0.87	0.35	0.01
Rec_Knowledgeindex_3 * Rec_Atti_Fund	7.75	8.74	0.01	0.07
R Squared = .139 (Adjusted R Squared = .121)				
Dependent Variable: Progress factor				
Rec_Knowledge_3	5.51	6.41	0.01	0.05
Rec_Religiosity_3	4.29	4.99	0.01	0.04
Rec_Knowledge_3 * Rec_Relig_3	2.92	3.40	0.01	0.05
R Squared = .122 (Adjusted R Squared = .093)				
Dependent Variable: Fear factor				
Rec_Knowledge_3	6.61	7.84	0.01	0.06
Rec_Relig_3	4.90	5.81	0.01	0.05
Rec_Knowledge_3 * Rec_Relig_3	6.42	7.62	0.01	0.11
R Squared = .220 (Adjusted R Squared = .193)				
Dependent Variable: Fear factor				
Rec_Knowledge_3	4.96	5.31	0.01	0.04
Gender	4.61	4.94	0.03	0.02
Rec_Knowledge_3 * Gender	7.68	8.23	0.01	0.07
R Squared = .139 (Adjusted R Squared = .120)				
Dependent Variable: Fear factor				
Gender	2.90	3.03	0.08	0.01
Rec_Relig_3	3.63	3.79	0.02	0.03
Gender * Rec_Relig_3	3.42	3.57	0.03	0.03
R Squared = .072 (Adjusted R Squared = .055)				

Table 59 Interaction effects

The polarity was reversed at high knowledge and those with aesthetic attitude now show less fear of science and the engineering perspective showing more fear but comparable with what was observed at low knowledge.

We can therefore reject the null hypothesis of no interaction and infer that there is an interaction between knowledge and fundamental attitudes to the world on the fear of science factor.

6.6 Religiosity, gender and attitudes

Null Hypothesis: There is no interaction between knowledge and religiosity in the public's attitude to science.

Alternate Hypothesis: There is an interaction between knowledge and religiosity in the public's attitude to science.

The Multiple Analysis of Variance (MANOVA) statistical techniques were also used to see the effects of the interactions between religion, gender and knowledge on the three attitude facets: pessimism, fear and progress. There was no significant interaction effect with the pessimism facet. There were, however, interactions with progress and fear.

Interaction with progress

The combined effect of knowledge and religiosity (recoded into 'weak', 'strong' and 'very strong') showed high levels of significance on the progress factor $F(4, 237) = 3.40, P < 0.01$. The main effect of religiosity was significant with $F(2, 237) = 4.99, P < 0.01$. The main effect of knowledge was also significant $F(2, 237) = 6.41, P < 0.01$.

The profile plot shows a quadratic trend for the strong religiosity declining sharply with high knowledge. Respondents with strong religiosity and high knowledge scored low on the progress factor but those with very strong religiosity generally score higher on the progress factor.

Increasing knowledge leads to more positive scores on the progress factor for respondents with weak and very strong religiosity as shown with an upward linear trend on the plot. There is a

noticeable polarity of views on progress factor at high knowledge between those with weak and very strong religiosity and those with strong religiosity.

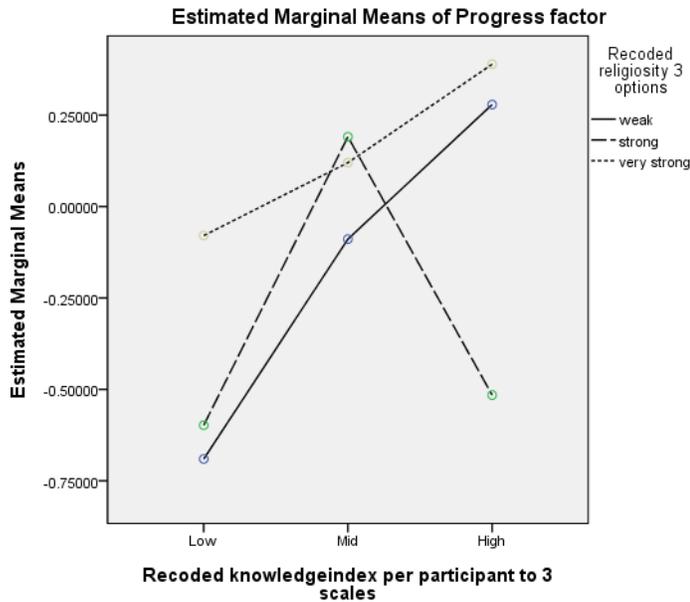


Figure 28 Interaction: knowledge and religiosity on progress

Interaction with fear

Again with the fear factor, the discriminating group with religiosity is the strong group. The main effect for religiosity on the fear factor was significant $F(2, 237)=5.81, p<0.01$. The main effect of knowledge was also significant, $F(2, 237)=7.84, p<0.01$. There was also significant interaction effect between religiosity and knowledge on the fear factor, $F(4, 246)=7.62, p<0.01$ and the partial η^2 (0.11) was again greater than the main effects.

Increasing knowledge increases fear marginally up to the mid knowledge bracket for all religiosity groups but while the weak religiosity group continues its upward linear trend, the slope for the very strong religiosity takes a downward trend with a deflection much smaller than that of the strong religiosity group. The strong religiosity group shows the greatest departure with a sharp quadratic turn to low levels of fear scores for high knowledge. This is another example of polarity of views at high knowledge. The strong religiosity and high knowledge groups score very low on the fear factor compared to others as with the result of the progress facet.

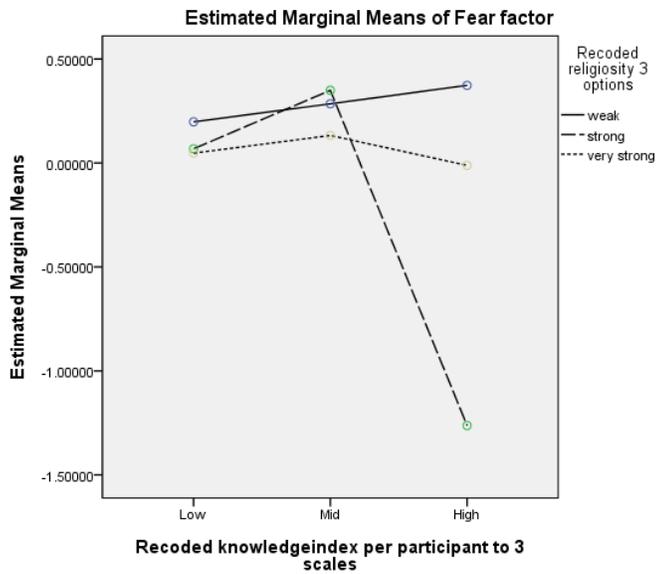


Figure 29 Interaction: knowledge and religiosity on the fear

Gender, knowledge and fear

There was also significant interaction between gender and knowledge on the fear factor, with highly knowledgeable women having less fear of science than men. There was no significant interaction effects on progress and Pessimism.

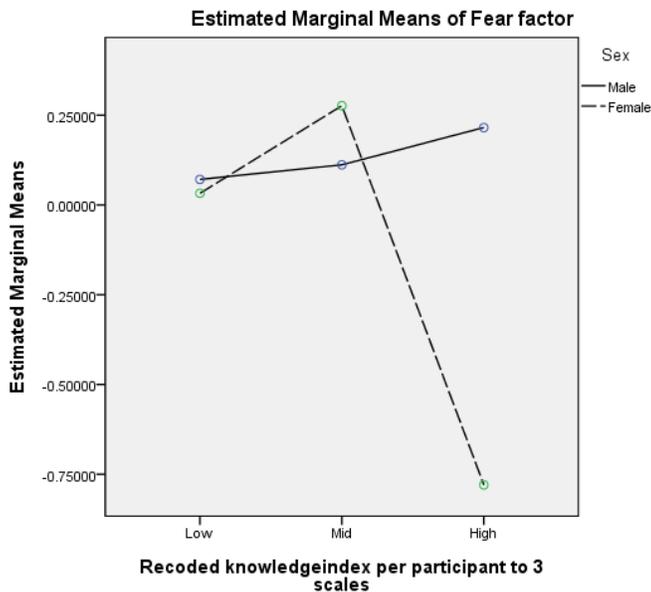


Figure 30 Interaction: knowledge and gender on fear

The main effect for knowledge was significant, $F(2, 235)=5.31$, $p<0.01$. the main effect for gender was significant, $F(1, 235)=4.94$, $p<0.03$. the interaction effect between gender and knowledge was also significant $F(2, 235)=8.23$, $p<0.01$ and partial η^2 0.07.

Gender, religiosity and fear

Another interesting finding was the significant interaction between gender and religiosity also on the fear factor but not on the progress and Pessimism. There was a significant interaction effect between gender and religiosity, $F(2, 277)=3.57$, $p<0.03$ and partial η^2 0.03. The main effect between gender and fear of science was moderately significant, $F(1, 277)=3.03$, $p<0.08$.

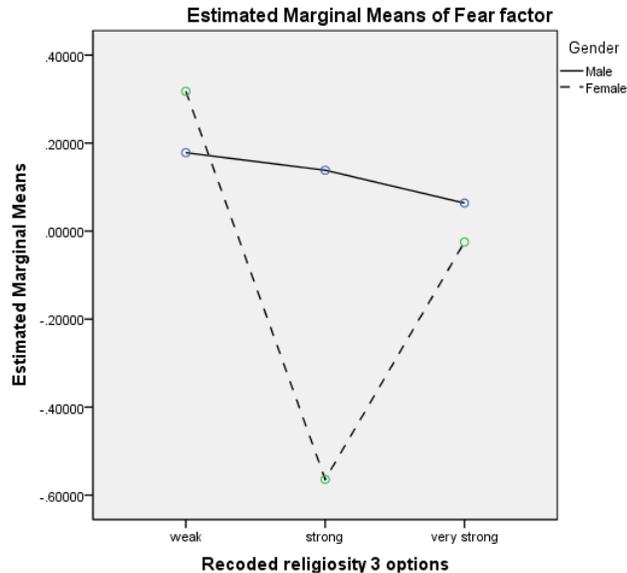


Figure 31 Interaction: religiosity and gender on fear

The main effect of religiosity was very significant, $F(2, 277)=3.79$, $p<0.02$. The results show that women with strong religiosity have much less fear of science than men of equal religiosity.

6.7 Knowledge and facets of attitude to science: Model building

Null Hypothesis: The relationship between knowledge and attitudes to science are simple and always significantly positively correlated.

Alternate Hypothesis: The relationship between knowledge and attitude to science are complex when you control for other variables and may not always be significantly positively correlated.

All attitude facets from the factor analysis were saved as variables using the regression method in SPSS. The variables were then recoded (binned) into positive values for progress, pessimism or fear (dummy variable) and (see syntax in Appendix 5) used as binary response variables.

6.7.1 Progress of science facet of attitudes

The graphical representation below (full table in Appendix 6) showed that controlling for other variables (sex, age, trust, religiosity, fundamental attitude to the world and belief in destiny will henceforth be referred to when I indicate controlling for other variables), the odds of expressing the progress of science attitude for a respondent in the mid knowledge bracket are 3.384 times the odds for a respondent in the low knowledge bracket (238.4% higher). Note that those significant at 0.05 do not cross the 0 line on the graph.

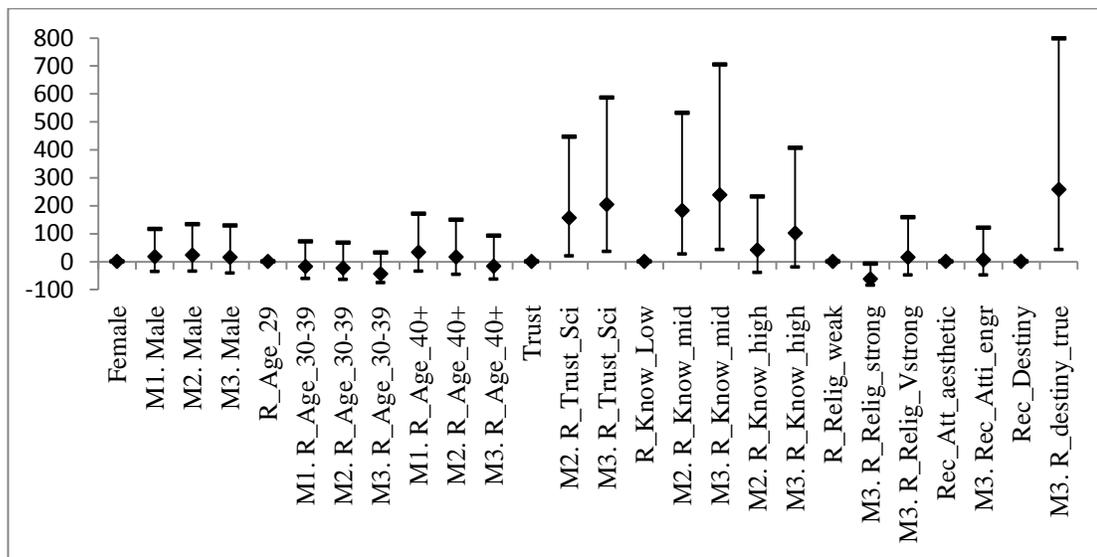


Figure 32 Regression models (Otherwise=0; Progress=1)

	Model I	Model II	Model III
Log likelihood	251.46	236.07	217.68
Nagelkerke R Square	0.02	0.12	0.24

Table 60 Model statistics for progress

The odds for a person with trust in scientists are 3.04 times that of a person with low trust (204% higher), controlling for other variables. Also, controlling for other variables, the odds of a person with strong religiosity expressing the progress of science is 0.37 times the odds of a person with weak religiosity (62.8% lower) while the odds of a person with very strong religiosity is 1.15 the odds of a person with weak religiosity (15.2% higher) although this is not significant. The odds of a person who believes in destiny is also 3.57 times the odds of one who does not believe in destiny (257% higher) being progressive about science.

In summary, a respondent who is of mid knowledge about science, trusts scientists and believes in destiny is more likely to be positive about the progressive nature of science. With religiosity also, like knowledge, the group one belongs to matters and those in the medium bracket are less likely to have a progressive attitude.

6.7.2 Pessimism about science facet of attitudes

Trust is an important issue with regards to the Pessimism about science and controlling for other variables, the odds of a person with high trust in scientists having a positive score for the pessimism about science factor are 2.8 times that of a person with low trust (180% higher). Its level of significance also strengthens as the variables in the models increase from Model II to III (full table in Appendix 6).

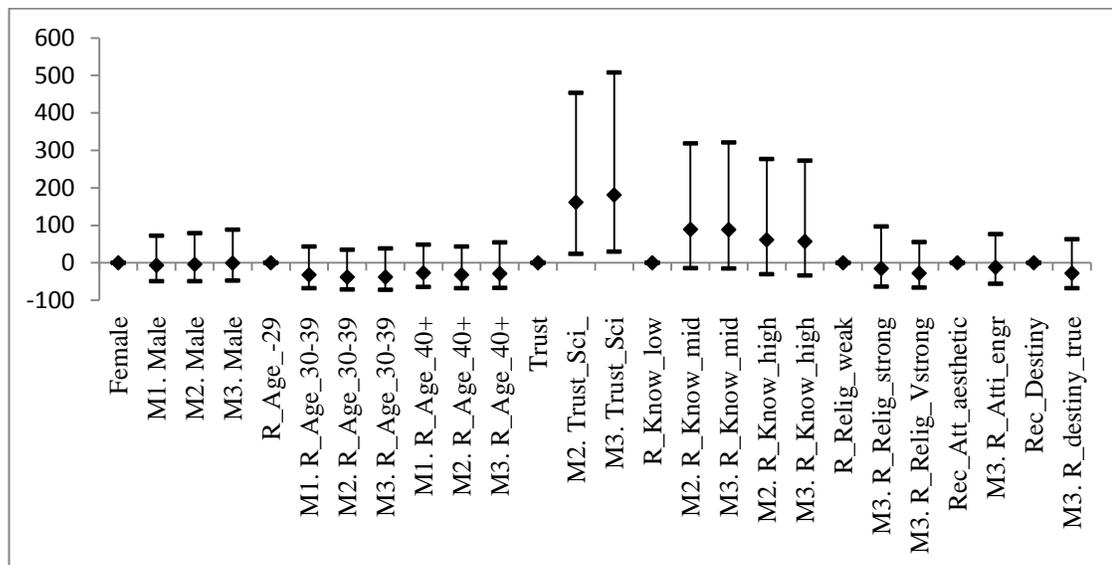


Figure 33 Regression models (otherwise=0); Pessimism=1)

	Model I	Model II	Model III
Log likelihood	252.20	241.84	240.07
Nagelkerke R Square	0.01	0.08	0.10

Table 61 Model statistics for pessimism

In summary, a person with high levels of trust in scientists is more likely to have a pessimistic attitude than those with low level trust.

6.7.3 Fear of science facet of attitudes

The significant issues with the fear facet of attitudes are gender and knowledge. The significant association with age groups disappears in Model III. Controlling for other variables, the odds of a man expressing the fear factor are 1.95 times the odds of a woman (94% higher). The odds of a respondent in the high knowledge bracket expressing fear of science are 0.31 times the odds of a person in the low knowledge index (69% lower). In summary, a man is more likely to express fear of science than a woman. A person with high knowledge index is less likely to express the fear of science than a respondent with low knowledge.

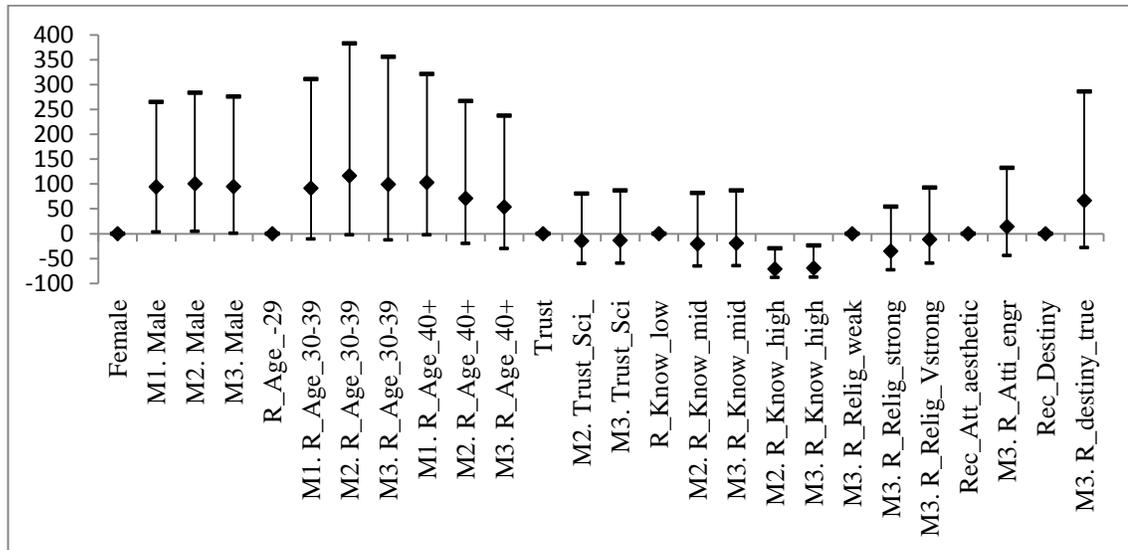


Figure 34 Regression models (Otherwise=0; Fear=1)

	Model I	Model II	Model III
Log likelihood	239.58	229.01	226.21
Nagelkerke R Square	0.08	0.15	0.17

Table 62 Model statistics for fear

The findings of the knowledge and attitude relationship show that it is a complex relationship. Average knowledge, average religiosity, trust and belief in destiny are good predictors of a progressive attitude to science. Trust is the only good predictor of pessimism, while gender and high knowledge are good predictors of fear. We can therefore reject the null hypothesis of simple association to accept the alternative that the association between knowledge and attitudes

to science are complex when you control for other variables and may not always be significantly positively correlated.

6.8 Opposition to vaccination

Null hypothesis: There is a positive association between knowledge, trust, religiosity, attitude to science (3 facets) and opposition to vaccination

Alternate hypothesis: There is no positive association between knowledge, trust, religiosity, attitudes to science (3 facets) and opposition to vaccination.

The analysis here was about predicting the characteristics of those persons not in support of vaccination. This is also a specific scientific phenomenon compared with the previous models, which looked at general attitudes expressed in facets of pessimism, progress and fear.

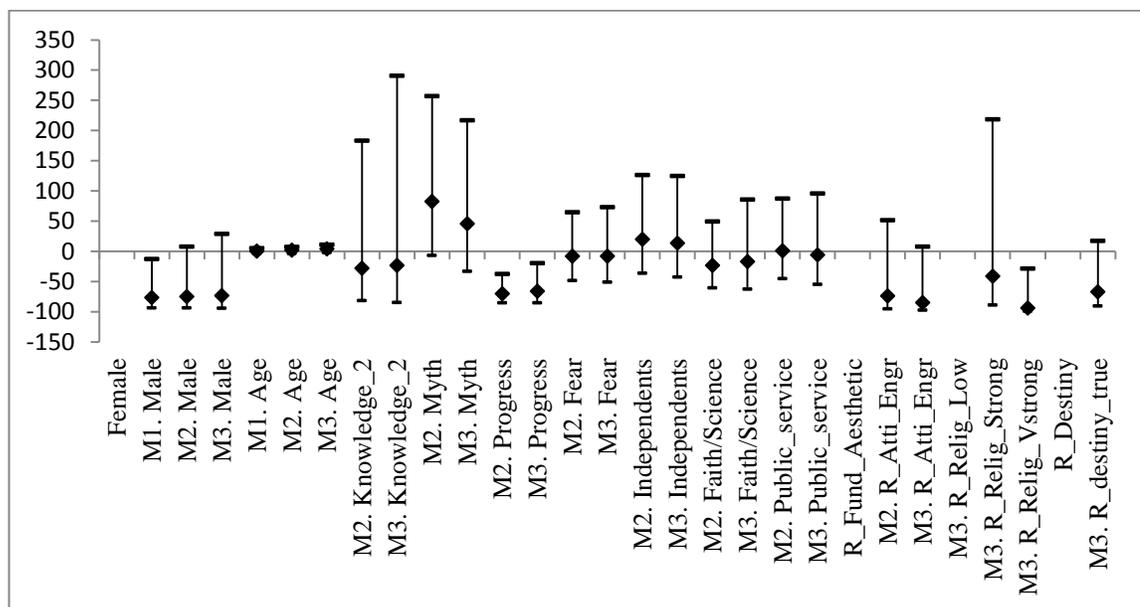


Figure 35 Regression models (Otherwise=0; opposition to vaccination=1)

	Model I	Model II	Model III
Log likelihood	105.37	86.04	74.11
Nagelkerke R Square	0.07	0.29	0.41

Table 63 Model statistics for opposition to vaccination

The results showed that controlling for other explanatory variables, a one point increase in the measure of progress decreases the odds of opposing vaccination by 66.1%. Also controlling for other variables, the odds of a person in the very strong religiosity category opposing vaccination

are 94% lower than the odds of a person with weak religiosity, while the odds of a person with strong religiosity opposing vaccination are 41% lower than the odds of a person with weak religiosity, although this is not significant. The odds of a person with an engineering fundamental attitude to the world opposing vaccination are 85% lower than the odds of a person with an existential attitude although this is moderately significant (0.59). The progress attitude facet, very strong religiosity and fundamental attitude to the world are good predictors of attitudes to vaccination. Interestingly, knowledge is not a significant factor.

We can therefore reject the null hypothesis and accept the alternate that there is no significant positive association between very strong religiosity, an engineering fundamental attitude to the world and progressive attitude to science controlling for other variables.

6.9 Summary

With the main survey, the levels of trust in public institutions and persons shows three latent variables which categorise them into public service, independents and faith/science. Factor analysis also shows the attitude factors as having three latent variables, namely pessimism, progress and fear. There is an interaction effect between fundamental attitude to the world and knowledge on the fear factor with polarity of views at high knowledge. Respondents with strong religiosity and high knowledge score low on the progress factor and increasing knowledge leads to more positive scores on the progress factor for respondents with weak and very strong religiosity. Gender differences are also surprising as highly knowledgeable women have much less fear of science than men of equal knowledge. There is polarity of views at high knowledge for progress and fear facets of attitudes in the interaction with religiosity.

The regression models for knowledge and attitude shows that with the progress facet, a respondent who has mid knowledge about science, trusts scientists and believes in destiny is more likely to be positive. With religiosity however, the group you belong to matters and those in strong category are less likely to have a progressive attitude when compared with the weak.

The model for pessimism shows that a respondent with a high level of trust in scientists is also more likely to have a pessimistic attitude than those with low level trust. The model for fear shows that a man is more likely to express fear of science than a woman and a respondent with high knowledge is less likely to express the fear of science than a respondent with low knowledge.

The association between knowledge and attitudes to science is therefore complex when you control for other variables and may not always be significantly positively correlated. Also, an engineering fundamental attitude to the world, a progress of science attitude and very strong religiosity are strong predictors of support for vaccination. We can infer that having very strong religiosity does not translate to opposition to vaccination.

7.1 Synopsis

This chapter is about how modern day Nigerians live with science and God. It presents the results of the interviews conducted in Lagos on the relationship between God and science and if interviewees consider it contradictory or complimentary or if they will place one ahead of the other. This follows survey results which found that answers to some knowledge questions may have been informed by religiosity. The interviews also examine the relationship between Islam and Christianity, the north and the south and the possibility of science acting as a bridge between the two Abrahamic faiths and the country's peoples.

7.2 Methods

Interviews were designed to capture how citizens live their everyday with science, gods and God in a multi-ethnic society. The chapter includes narratives from published ethnographic surveys, journal articles, books and local cinema. Sixteen interviews were conducted by me in Lagos, most of them at the Ikeja Military cantonment which offered an opportunity to interview Nigerians from across the country.

The questions were worded to see how science and religion coexist and to confront interviewees with some of the findings of the pilot survey. The episodic interview format adopted was to allow participants narrate personal experiences and how this has shaped their views and actions, particularly common sense experiences with science and religiosity. Interviewees were chosen randomly around the cantonment and had to sign the consent forms before the interview commenced. The approach employed in the analysis of the interviews was thematic. Themes here were to capture the essence of the data in an inductive approach and could be semantic or latent.

7.3 The doctor and God in the hospital

"If today, the stamp of science is usually sufficient to give them a kind of privileged credit that is because we have faith in science. But this faith is not essentially different from religious faith. The value that we ascribe to science depends, in short, on the idea that we, collectively, have of its nature and its role in life – that is, it expresses a state of opinion. This is because everything in social life, even science itself, rests on opinion." - Durkheim (1912, 2008)



Figure 36 The Church inside the Lagos University Teaching Hospital complex

Herzlich (1973) observed that when it comes to health and illness, for some groups, there is no difference between medicine, magic or religion. This phenomenon was also observed in the Nigerian data. When respondents in the main survey were asked their first option for health, 54.6% said western medicine, 24% said prayers and 6.4% said traditional herbs. The second option was more revealing: 34% said prayers, 29% said western medicine and 20% said traditional herbs. The respondents consult all three and none appears to have a monopoly on health. When it comes to explanations for facts of life, this is also shared by science and God. In the pilot survey, 78.6% of respondents agree that it is not the mother's gene that determines sex of child but a lower 64% agree it is the father's gene, and a surprising 67% also agree it is God. A cross tabulation shows that 43% of the online survey respondents agree it is both God and the father's gene and although where they live has a significant effect on response ($\chi^2 = 9.0$; $P < 0.05$), more than half of those who live abroad still ascribe a child's sex to God's work (59%)

compared with 75% of those who reside in Nigeria. The main survey shows a similar pattern as 74% agree God decides sex and a lower 69% agree it is the father's gene. 60.3% of those who ascribe it to father's gene, the scientifically correct explanation also ascribe it to God.

Both the scientific and the religious have explanations for life's workings, but it appears slightly more are prepared to put God ahead of science. The factor analysis of the trust variables also shows a similar pattern, with science and religious leaders accorded about the same level of trust and grouped together as the faith/science factor. This combination of scientific and lay epistemologies - a plurality of modes of thought in the same individual and group, is what Moscovici describes as *cognitive polyphasia* (Moscovici and Markova, 1998; Jovchelovitch, 2002).

To further validate these findings, I visited the Ikeja General Hospital in Lagos, South West Nigeria. Apart from its traditional role as a diagnosis and treatment centre, the hospital also serves as the Lagos State government's University Teaching Hospital. It is located at the heart of the state itself, its capital city and thus almost always full to capacity with patients having various medical conditions from acute and long term ailments to accidents and emergencies. The patients also come from far and wide, even beyond the borders of the state. It is currently undergoing rapid transformation but some of the buildings expose its colonial past.

On a Sunday afternoon in June 2011, I used a visit to an ailing relative to see how the hospital ran on this day, which is the holy day for Christians. I was heralded to the admission wards by several shouts of "alleluia, alleluia and alleluia"; "amen, amen and amen". There was singing and clapping and it was not from the chapel located in the hospital and donated by the Archbishop Vining Memorial Cathedral Church a few metres away, but from the admission wards, and the congregation, I soon saw, were the patients themselves.

One particular prayer session which lasted about ten minutes (there were several going on at the same time in different wards, and one often following another in the same ward apart from beside ministering to specific needs) was led by a team of three women and two men, who said

they were from one of the orthodox churches. Although they were not inclined to be quoted, their mission, according to one of the young men in his 20s, was to seek divine healing from God for the patients. The young man said, “God will guide the doctors to do the right thing and the patients to respond to treatment.” I also met a lady from the Pentecostal movement who ran an independent hospital visitation ministry with her friends and a few family members. She was also there to pray and counsel the sick.

The admission wards were several bungalows joined together by roofed sidewalks and on the grass lawn by one of such passages was a vendor of mobile phone recharge cards. I approached him and he gave me a plastic stool to sit and we spoke for a while under the shade provided by the roof over the sidewalk. Our discussions soon shifted to my observations. “It’s like this every Sunday,” the vendor said, “people from various churches come to pray for the sick.” I wanted his views on the events but he would not volunteer any, being from a different faith. He was there to make a living and would not risk losing the spot that was officially allocated to him to trade. Indeed, earlier, the car park had given a glimpse of what was going on in the hospital. Buses with one church insignia or the other filled the car park but these were not private visits as I soon learnt, but routine calls to pray for the sick. And the callers were not from the orthodox churches alone, the Pentecostal presence was equally strong.

The Pentecostal movement itself is a symbol of the coexistence of scientists and the church. The Mountain of Fire and Miracles Ministry (MFM) is headed by Dr Kolawole Olukoya who obtained his PhD in molecular genetics from the United Kingdom (MFMM, 2011; E-LIFE, 2011). Pastor Enoch Adejare Adeboye, formerly university teacher with PhD in Mathematics heads the Redeemed Christian Church of God, (RCCG), a movement which prides itself in having branches all over the world (RCCG, 2001). In December 2008, he was named by NEWSWEEK (Miller et al., 2009) as one of the top 50 most influential people in the world. The church’s Camp Ground (spiritual headquarters) is on Kilometre 46, Lagos-Ibadan Expressway. Nearer to Lagos on the same highway is another Pentecostal church, the Deeper Christian Life

Ministry (DLCM) headed by another former university teacher (also in mathematics), Pastor William Kumuyi (DCLM, 2011).

Overnight church services held monthly at the RCCG camp ground and the MFN attract thousands of worshippers from all over the country and the traffic gridlock from the Lagos end of the Lagos-Ibadan expressway, on the eve of such services, is a testimony to its attractiveness to worshippers, some of them even from the orthodox churches. Similar crusades espousing the power and presence of miracles are held regularly all over the southern part of the country, not just by the Pentecostals; most Christian denominations have taken cue.

Burgess (2008) describes the expression of Christianity in Nigeria as "contextual theology". Practical concerns of African Pentecostals, according to Burgess, tend to focus on issues like healing, economic security and fertility and their theologies also reflect character formation, identity construction and contextual relevance. This is an enacted theology that emerges through reflection and practice in contrast to the more formalised written theology of the European mission churches. Obadare (2006) expatiates the economic dimension to the Pentecostal movement. He argues that the monthly Holy Ghost service held in the 12,000-acre Redemption Camp, which draws in excess of 300,000 people, including successful professionals, bank managers, university professors, business magnates and leading political figures including governors and presidents is "a real space for social and economic networking." The counter argument however is that prosperity and faith go hand in hand in the ethos of the 'good Samaritan'. Also, the Nigerian Pentecostal theology, Burgess argues rejects the African traditional system of divination and sacrifice, but has retained the belief in the influence of lesser spiritual entities over the material world and the efficacy of prayer as the key ritual for influencing the powers. Burgess describes MFM as a prime example of such ministry and problems associated with demons from which deliverance through prayers is sought include bad dreams, sickness, business failure and barrenness. The activities of the Pentecostal movement are however severely restricted in the north, due to tensions between the two faiths and fears of

religious violence. A planned crusade by the German evangelist, Reinhard Bonnke led to massacres in Kano in October 1991 (Falola, 1998).

“Did God make the world? Is science a natural part of religion, part of leaning to know God”, Knight asked (2004). Are science and religion two sides of the same coin? What is the origin of disease? Is it un-Islamic to cure disease? To whom do we go when we are ill, the religious leader or the hospital, or both? The drama at the Okija shrine in South Eastern Nigeria documented by Ellis (2008) shows that answers to these questions vary from one part of the country to another; one context to another and at times varying between private and public identities. The preference of the "Bakassi Boys" by the citizenry when civil society and the scientific method failed to control armed robbery in the South Eastern Nigeria (Smith, 2004; McCall, 2004) is another case in point.

More than half a century after Christianity and the British way of life had attempted to banish the egungun, abiku, and ogbanje, they have continued to exist in the south, and more than two centuries after the Uthman Dan Fodio led an Islamic jihad to rid the northern part of the country of wabi and shan-inna, they have remained active among the communities.

Tunde Kelani's movie, *Thunderbolt*, is an adaptation of a book by renowned Yoruba author, Adebayo Faleti titled: *Magun (Sex is Forbidden)*. *Thunderbolt* is set in South West Nigeria after 1973 when the National Youth Service Corps Scheme (NYSC) commenced and features the relationship between Nigerians from two different parts of the country, Christianity, African Traditional practices and western medicine. It was about love, suspicion, evil, betrayal and the role of the gods in maintaining societal norms. Nollywood, the local film industry, is awash with such movies depicting the power of a Supreme Being (or spirits) whose solutions are beyond scientific explanations. The main characters in the movie are Ngozi, an Igbo girl who falls in love with and marries Yinka, a Yoruba man, during the mandatory one year National Youth Service Programme (NYSC).



Figure 37 Cover of Tunde Kelani’s adaptation of ‘Magun’

Designed to bring Nigerians from all parts of the country in close proximity to each other, the NYSC is well noted for fostering intertribal marriages, one of which was depicted in the movie. Yinka and Ngozi have a child forcing her to postpone her NYSC programme. When she resumed, she was posted to a village about 100 kilometres away from her family home, to teach in a primary school as part of her community service. There, she starts having strange dreams in which she is warned about imminent death, and since medical doctors cannot diagnose dreams, her worried landlady, whom she calls "mama" (mother) takes her to a medicine man who confirms the worst: she has been laced with Magun. Being from a different tribe, she does not know what it means and thus disregards it. But the strange dreams continue in which she receives a warning in the voice of her late grandmother that she is about to die.

Ngozi’s father asks, “What is *Mango*?” He had also never heard of Magun but had been summoned by the worried landlady to a meeting called to convince Ngozi of its deadline and to take the medicine man’s advice on the cure.

Her school vice principal called VP who was also at the meeting, explains: “You know the AIDS (Acquired Immune Deficiency Syndrome) they talk about, Magun is worse”

“They say one can carry AIDS for nine years, no one can carry Magun for more than nine weeks. Whereas AIDS is sexually transmitted disease, Magun is sexually assisted death. The carrier, usually a woman, is afflicted with Magun, and any man who contracts this by having sex with her dies either immediately or very shortly afterwards.”

VP explains that there are many types of Magun, The first, he explains, is called "the cock crow" and in this, the male partner crows like a cock immediately after sexual intercourse with the carrier and dies. The second is "the somersault" where the adulterer somersaults three times immediately after sex and dies. The third is where the man who contracts the Magun bleeds to death by vomiting or urinating blood continuously and another, which is less common but the most dangerous, is where the partners are joined together after sex and cannot be separated and both die, he said.

One can only imagine the impact of such powerful narratives in Yoruba culture and on Ngozi and her father from a different tribe, the Igbo. Its truth or falsity is not the focus of this research but the existence of the narrative and its essence as societal norm.

“Such evil, but why?” asks a bewildered Ngozi’s father.

“Women suspected to be unfaithful to their husbands are usually afflicted with Magun”, the headmaster replies. He insists that the whole process is beyond medical explanation

VP, who ends his morning school assembly of pupils with The Doxology: "Praise God from whom all blessings flow", written in 1674 by Thomas Ken (1637-1711), an ordained English priest of the Anglican communion, seems very well-informed about the aetiology of HIV/AIDS and both Christian and traditional African beliefs.

The solution, according to the local medicine man who consults the "spirits" on Ngozi’s behalf, was for her go through certain rituals, the last of which was to find a man who will have sexual intercourse with her in the presence of other herbalists who will then apply the final cure to save his life and clean her completely of the Magun, failing which she will die. Dr Oladimeji Taiwo, a medical doctor, whose advances she has always spurned, was the only one who will take part

in the rituals, with one caveat. The condition is that it will be an experiment witnessed by his colleagues in a hospital setting, if only to prove the falsity of traditional beliefs and provide the case study for an academic paper to be presented at the next obstetrics and gynaecology conference. However, after the "experiment" in the chosen hospital, Dr. Taiwo's body suddenly goes into a state of uncontrollable spasmodic movements and he starts to vomit blood as predicted by the headmaster and the herbalist and it takes the traditional medicine men and their concoctions and incantations to bring him back from the gates of heaven (or hell!).

Dr Taiwo's medical colleagues unwittingly became witnesses not to the falsity but to the efficacy of traditional medicine and the power of evil spirits. The message in the movie is that in modern day Nigeria, Magun (spiritual death) exists despite contrary claims by western education. But are such movies in local media cultivating common perspectives by such gruesome narratives of death? Does Magun really exist?

The Yoruba traditional medicine men in Kelani's movie are similar to what the Hausa call "Maganin gargajiya" (Hausa traditional medicine) as opposed to "Maganin bature" (western medicine). The Maganin gargajiya comprises several groups of practitioners, prominent among which is the "Bori" who claim cures for ailments for which western medicine has no solution through communicating with the spirit world. Andersson, an anthropologist who was embedded with the "Mai Bori" (Bori practitioners) in Jos, Northern Nigeria, said they define themselves in medical terms and see themselves as part of the Muslim community (Andersson, 2002). He however noted that in academic literature, they are described as a pre-Islamic spirit possession cult that has survived among the Muslim Hausa-speaking population, while Muslim sceptics describe their practices as "falsity."

The Bori, according to Andersson, constantly stress that they did not chose to be practitioners but were "chosen" by the spirits called "Iskoki" through illness. He narrated the story of a woman Bori who resorted to the initiation rites after doctors at the local Church Missionary Hospital and the Jos University Teaching Hospital failed to diagnose and find cure for her illness

and barrenness. The gynaecologist at the teaching hospital said she could not find anything wrong with her but the lower abdominal pain persisted along with the dreams, during which a spirit would appear wanting to have sex with her. Since the hospitals could not solve the problem, some villagers, according to Andersson's narrative, suggested she may have been afflicted by spirits and encouraged her to seek traditional help. She only agreed when she found in the Koran that Allah has identified the existence of Iskoki. She was subsequently cured, gave birth to children and became a practitioner as the Iskoki demanded.

Bori practitioners interpret their practice from an Islamic point of view and the Iskoki are seen as the "Jinn" of the Koran, created by Allah. Andersson also noted that throughout his interviews in Jos, he did not meet any scholar of Koran who denied the existence of Jinn or met any Christian or Moslem who questioned the existence of Iskoki. Belief in spirits as part of the creation of God is embedded in both Abrahamic faiths; either you call them angels (English) or Jinn or Iskoki (Hausa), or Esu (Yoruba). They perform similar functions, mediating between man and the unseen world. Knowledge of illness, according to the Mai Bori, comes from the spirits. The Igbos consult the Afa oracle to diagnose illness, the Yoruba's the Ifa oracle. In modern times, western medical doctors are the norm and while Islam, Christianity and western medicine have become the public face of life, for some, the traditional priests are the private face.

For Herzlich (1973), the meaning of health and illness arises partly through individual experience and partly through the views current in society (public opinion) which reflects its values and for some groups, there is no difference between medicine, magic or religion. Illness, she argues, can be attributed to an offence against God, the dead or society, infringement of a taboo, or failures to observe values of a group and symptoms are thus sanctions for the infringement. These observations appear to hold in the Nigerian scenario where Islam, Christianity, Ifa oracle and western medicine exist side by side. And as the main survey showed, when respondents were asked their first option for health, 55% said western medicine while 24%

said prayers. The second option was more diverse. 29% said western medicine, 20% said traditional herbs and 34% said prayers.

7.4 Faith in God and faith in science

Can the faith the people of Nigeria have in religion be likened to the faith they have in science? Again to Knight's (2004) question: 'Is scientific study a natural part of religion, part of leaning to know God?' The place of science and God in the everyday life of the Nigerian was the focus of a series of interviews I conducted in Lagos, with participants from across the country. Sixteen persons were interviewed and 12 were used here for the analysis. The main issues were knowledge of vaccination, protection by God and/or science and the relationship between science and religion, if the two are in conflict or complement each other.

My analytical approach was largely guided by Attride-Stirling's (2001) thematic networks but the nature of the data necessitated a modification of the approach to include metaphors and key words in context (see Appendix 7). The rest of the analysis was quite similar and it was both top-down and bottom-up.

Two global themes were identified: the world is by design; and the world is in your hands.

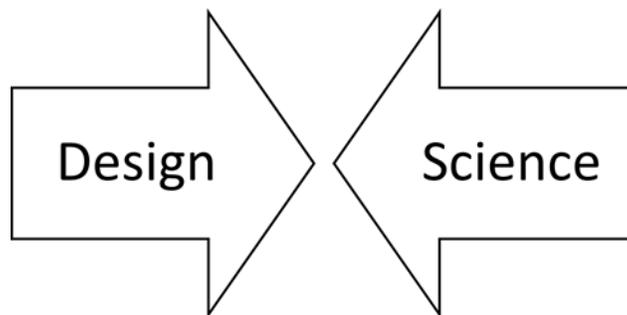


Figure 38 Global themes

“The world is by design” captures those responses about the relationship of the respondents with God and the roles He plays in their lives. Most interviewees described Him as the unseen, who guides and protects them as well as providing for all their needs. They also seem to believe

largely that science and religion can coexist peacefully and interestingly, too, that all knowledge is from God, including scientific knowledge.

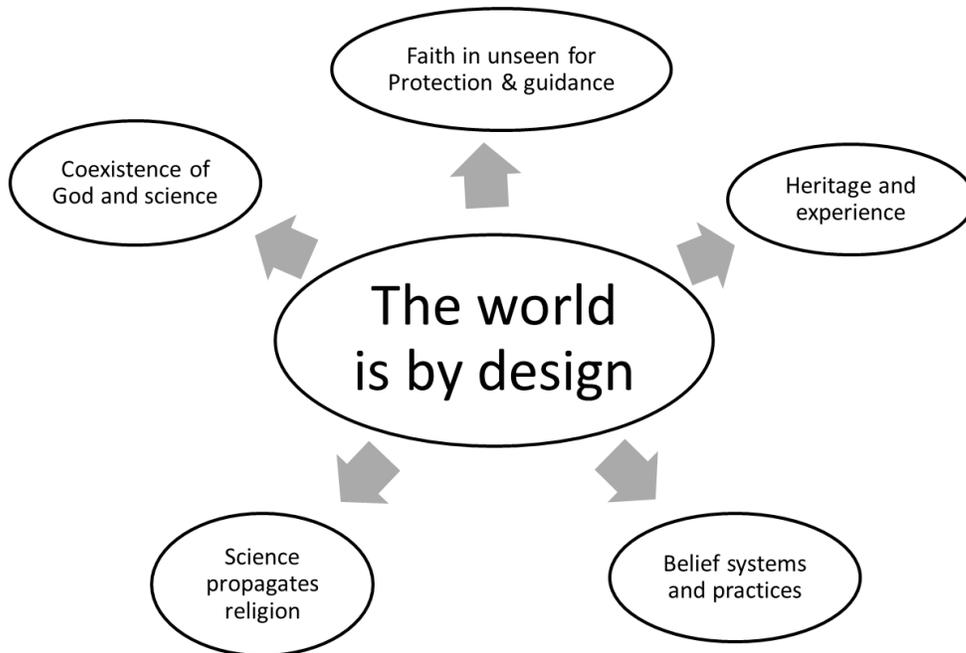


Figure 39 Organising themes A

“The world is what you make of it” captures the relationship with science. Faith in science is largely through what is seen, its artefacts: recent advances on the internet, telecommunications and banking. While there is concern about the direction of science in some areas, particularly the ability to cause good and evil, there is general agreement among the respondents that it has made life easier.

Remarkable for this research is the role of experience with religion and science in common sense notions of both. Respondents said they were born into faith and have experienced the work of God in their lives. They have also developed faith in science because they have experienced its usefulness in their lives. Common sense thoughts about science and religion are both founded on personal and shared experiences. Since science and religion can coexist, the question then is if the two religions can coexist peacefully, and indeed the various tribes and regions. Some of the

respondents were of the view that easier communication brought by science (internet, telephone, social media) can break barriers.

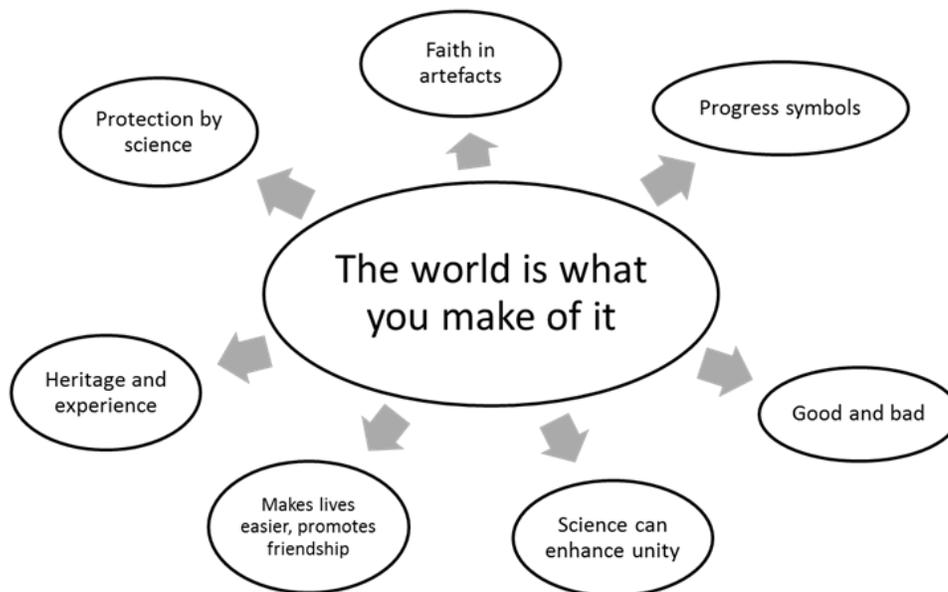


Figure 40 Organising theme B

Some of the themes are presented here in more detail. Space constraints will not allow a detailed study of all of them but some quotes which define the themes can be found in Appendix 7. Table 65 below shows the grouping of the themes to organising themes and then global themes.

Protection by vaccination

A common sense notion of vaccination is protection against disease and the accepted wisdom is that it does work. Most interviewees can recollect that they were vaccinated for protection against specific diseases. What is also important is if they know how it works, which may tell us if the participant has interest in and is more informed about vaccination or has little interest and less information.

Participant 1 has been vaccinated both as a young man and as an adult. He said:

"Essentially, it is supposed to protect you against diseases ... like cholera, meningitis, when I went for my youth service, because meningitis was prevalent in Borno State we ...were vaccinated." - P.1.

Themes	Organizing themes	Global themes
1. Faith in the unseen who controls the world and me	Protection and guidance	The world is by design
2. He guards and guides me		
3. He provides for all my needs		
4. He heals my body of disease		
5. Source of life and all knowledge		
6. Sense of direction in the world		
7. All were born into faith/experience work of God	Heritage and experience	
8. Coexistence of God and science	Coexistence of God and science	
9. Belief systems and mode of worship	Belief systems and practices	
10. Concern over present day practices		
11. Technology as a propagator of religious doctrine and activities	Science as propagator of religious practices	
12. Faith in what is physical, what has been proven to work	Faith in artefacts	The world is what you make of it
13. Artefacts have made the country a better place to live		
14. Advances have brought solutions to many health problems	Protection by science	
15. Experienced from youth	Heritage and experience	
16. Technology has made communication cheaper, faster and easier	Makes lives easier and promotes friendship	
17. Technology has promoted friendship across regions		
18. Two-faces: Can make or destroy	Choice is between good and bad	
19. Areas of life science has made positive and remarkable impact	Progress symbols	
20. Issues militating against a united country	More science can further unity	
21. Factors capable of enhancing unity among various groups		

Table 64 Themes, organising themes and global themes

Some of the interviewees, born in northern Nigeria, however, have mixed stories. Participant 4 was delivered outside the hospital but recalls being vaccinated in primary school while Participant 5 has no knowledge at all of vaccination.

"I really can't tell because my mum, for instance, wasn't educated then and I wasn't born in the hospital ... that's what she told me, I was born at home in the village then ... I never had eh ... this is what my mum told me, I never had measles, all those other things, I never had them, and up till today I never had any of those sicknesses." - P.4.

"... yes I can remember when I was in primary school some people ... yes on the left arm or shoulder like that some group of doctors or nurses they came ..." - P.4.

When I asked Participant 5 (a soldier rating) if she had been immunised, she looked rather puzzled, redefining the word as vaccination did not help matters at all; she had obviously never heard of it. The conversation went thus:

P.5. Vaccination (she asked back in bewilderment) ... No

Q. So you are not sure if you were vaccinated as a child

P.5. No

Q. Or you've heard of polio before

P.5. No

Q. Diphtheria and all others

P.5. Those ones I really don't know anything about them

Q. But you do go to the hospital

P.5. I hardly fall sick ...

Some of the interviewees said vaccination provides some form of protection. I also wanted to know if they had some scientific knowledge of how vaccines work or they just accepted what has been passed on by word of mouth.

"Well, they say that they inject the virus into the system and then it undergoes certain mutations and it ends up preventing the occurrence of the disease." -P.3.

Participant 6 had a more detailed knowledge being of the medical profession, a nurse.

"(It) prepares the body for invasion of let's just say micro-organisms of the particular vaccine you are given. For instance if you are given measles vaccine it

helps prepare the body for any invasion. if there is measles in the air now, you are actually immune to it, so your memory T-cells have it somewhere and before it actually comes into your system there is already a fight, should I say a fight back, or let's say an army in our blood cells like microphages and the rest they help us fight against it. So when the memory T cells have it already, because immunisation is ... should I say, a lower strength of the infection is injected into you, so that will be the one to create that memory and help prepare the body for this fight, so when you have the stronger one coming, your body is like prepared better so it doesn't weigh you down you don't get infected ...you might actually get it but no signs and symptoms will occur on you. You are already immune to it." –P6

Participant 6 then crossed into the biblical world while explaining a scientific phenomenon

"Immunity is just like saying you are strong enough to fight it like you are prepared with shield and armour (shield and armour is a biblical saying)." -P.6.

The participants have varying degrees of knowledge of vaccines and how they work as expected in any population, from the scientist who has detailed knowledge, to a non-scientist who has never heard of vaccination. The scientist surprisingly also adopted religious terms to explain the scientific without worrying about the contradiction. She seems comfortable with having “MRIs and miracles” together.

Protection by God

This part of the interview was about reconciling protection through vaccination with protection by God from diseases, and was quite revealing as people sought to separate religious belief from scientific advances while at the same time accepting both as solutions to the variety of illnesses and issues they encounter in their daily lives.

"Because He is a living God and He is invisible, we are taught from our youth to have faith in whatever we are told about God, because He lives, we believe He can do and undo, so if somebody is sick, if you pray for the person with faith, we just believe God will heal such a person." - P. 2.

"Let me shed more light on this, for example I take analgesic. As in ... predominantly when you talk about this ...paracetamol brands, it is only Panadol

that works for me ... and there is Emzor ...there are so many brands of paracetamol, but I rest my faith in Panadol because I grew up to know Panadol." - P.1.

The expression of faith in medicine was surprising and I sought to find out if it was the essentially the same faith in God that has been bestowed on medicine. Participant 1 tried to separate the two faiths

"No definitely not, I believe God will make the Panadol work." - P.1.

Participant 2 also tried to separate the two, claiming the supremacy of God over science.

For him, you need God for science to work.

"Even as a Christian, if you are given any medication, your faith in God that is, if I take this Panadol, because I have the faith that God is always there, then it will work, if I don't have faith in God, if I take thousands of Panadol then it won't work." – P.2.

Participant 7 also believes it is when you think you have enough faith that your religion can protect you against illnesses but acknowledges that even though it works for some people, for others it may not work. It depends on the strength of your belief, he stressed.

"It depends on someone's believe or faith, ... We've seen instances whereby some people will say no, I can't use drugs, some people will tell you that for the past 10 years they have not used drugs ... you see, some people, even if they are having headache, if they have not been to doctor and doctor gives them, even if it's the same Panadol they will buy at chemist, ...if they take it themselves they don't believe it will work until they see doctor and doctor approves that or prescribes that use so so and so medicine or medication ... and you see the case of some people, until they get injection, even if it is ordinary water that is in the syringe (placebo), once it touches their body they believe that they are well. It is believe ...in some instances I put it into practice, that no, I will not be taking drug this time around, I pray, while in some, I say ha no, let me take so so drug." –P.7.

Participant 1 narrated an experience he had when he was stranded and he challenged God to show him He was there.

"There was this time I was going to Ado Ekiti (town) and I got stranded at Ijebu Ijesha (town) you know where it is. It was drizzling and I was out there between 7 till about 10.30 in the night and there was no vehicle that had a space to take me. The spot I was (very dangerous at night), was where they had their night market and before my eyes everybody vacated the market and I was the only person left and I said a little prayer to God, with faith that show me you are God and I want it in the next five minutes and I had a miracle. An Okada man (motor bike taxi) came by and I told him take me to the nearest police station or anywhere I can rest ... lay my head for the night and he told me that was not God's injunction that I should just move further down and he drove off." –P.1.

He was eventually picked up on the spot by a friend he had not seen in about 15 to 20 years who recognised him even in the dark.

"That is the way God can work ... and science would probably not work like that."
–P.1.

Participant 3 widened the debate from assured protection from God through science to a cautious protection from God through science. His narrative could be captured with the popular saying that "heaven helps those who help themselves." For him, God and science are separate.

"Eh ... well if you indulge in unprotected sex and you think God will prevent you from contracting gonorrhoea or HIV am afraid the answer is no. But to the extent that nowadays in churches they spare time for people to come and lecture them on better lifestyle that way if you are told not to eat sugar because you are over 40 or to slow down on alcohol or smoking to that extent if you obey you would have helped yourself but it is not a direct God's business preventing malaria or contracting STD's." –P.3.

But while he believes heaven helps those who help themselves when it comes to contracting HIV/AIDS through deliberate exposure, he also believes God offers protection for unforeseeable events:

"Maybe you are travelling and you are not sure of what the road will look like, you can pray and God may make your car not to work whereby you are still here when incidences would have happened which if you were on the road you would have

been involved, that is possible, I have experienced that before. You can pray things to be for you, things to happen for good." –P.3.

Participant 8 was however empathic he "personally will first deploy science before prayer."

For him, science can help God protect you although he still prays that God does not allow him contract HIV. He said:

"I rate prayer as 40% ... for me to protect myself from a particular disease like HIV... Now, I pray that God do not give me HIV, please I don't want to contract HIV from anybody. But I go ahead and have sex with someone that is HIV positive without any protection I will get the HIV no matter the prayer I conduct no matter what I do. Without me praying, I keep away from it, I make use of the protection that science has offered, that could be the best possible means of protecting yourself from HIV, I won't get it, so I take prayer as 40% and science as 60%." -P.8.

When asked if he can actually put one before the other when some people will say if they pray now they will not even meet someone who has HIV. When given the example of wanting to travel and praying that they don't have an accident on the way, or that the person who is going to cause an accident will not be there when they are passing and that offers them some kind of protection, he said:

"Yes ... because ... like the example you gave now, once I know I am travelling the next day, I have to sleep well, if I don't sleep well, I know I will mess up on the road and two, over speeding: I must run at the required speed rate while the third one, on the probability that somebody will come from somewhere and smash me (he laughs) on that particular event it happens, it's a natural thing, it happens, mistakes are bound to happen." –P.8.

The key words of note here are "grew up", "taught", "works for me" which leads to "faith" and all share a common underlying factor which is experience. This faith in God and in the drug working was the result of personal experience. For some, "heaven helps those who help themselves" by adopting what science has to offer while for others, God is there to help the helpless who pray to him for intervention in the unknown and unpredictable.

Source of all life

Who is God to the respondents and how do they relate with him in their daily lives? Interesting here are the metaphors used to capture this relationship with the divine, the ‘Master Designer’.

"For me being alive up to this very minute is part of the role that God plays in my life ... providing everything, my need, everything I ask for I get it ... even when it delays sometimes ... but it will never be taken away from me, just as it is said destiny can only be delayed it can never be taken away from you ..." -P.5.

"God is the ultimate. ...God is just like the director of my life I believe ...everything that happens to me, the way I am today, God is the reason, so I believe he directs my life." -P.11.

"He is the author and finisher, when I woke up this morning and I had to say thank you to Him because without Him I know I won't be alive. I will describe him as my all and all." -P.9.

"God is the overall. He is like a general overseer; let me put it that way." -P.6.

"My faith is strong, I believe in Him, in that whatever I ask he might give me, that very time, or He may not give me due to some reason or the other that He knows much better than me, that's why we say man proposes, God disposes." -P12.

"I believe God is my life, He is as important as that. ...He controls everything I do. He is actually my breath." -P.10.

Source of all knowledge

An issue that came up during the interviews was the attribution of the origin of scientific knowledge to God. For some of the respondents, having faith in science is underpinned by the faith they have in God. Scientists were created by God for a purpose and all the knowledge they have was given to them by God and no matter what they are able to create, God had not yet made it possible for them to make life.

For Participant 3, knowledge is from God but with individual agency involved.

"(The) scientific knowledge that people have come up with was derived from God aided by their own ingenuity because all these things came through inspiration." – P.3.

Participant 12, a traditional medicine practitioner, looks at the source of knowledge from his professional perspective. For him, scientific knowledge was given to man by God and it is left to man to decide how to use it. In his herbal medicine practice, he noted, drugs were given in the past without dosage but science has since introduced measurement, and as practitioners, they now know what to do, how to convert, what to give and what the patient is taking and this has greatly enhanced treatment instead of causing other ailments in the patient (ostensibly from overdose). That for him is the impact of science on traditional medicine practices.

Participant 4 shares his views. She believes that it is through science we know that herbs and (orthodox) medicine can work and the knowledge to understand all these comes from God. When confronted with the question that scientists don't believe in God, she was quick to counter that some believe and some do not and all the knowledge we have today comes from God since "He is our creator, we didn't create ourselves." Creativity, she argued, is within:

"You imagine things within you so it's inside of you before you bring them out and start doing them. So, I believe it's God that gives us the knowledge and everything they need." -P.4.

Her views were supported by Participant 10.

"Whatever the scientists are practising today, actually God did it before. It was out of God's creation. Whatever the scientists are doing today is actually out of imagination. The bible says as you can imagine, whatever you imagine is already in existence as a human being. This tells that even if scientists are using things to protect lives ...the immune system or whatever, it is God that inspires them, that is my belief. It is God that inspires them. You may do a lot of thinking, if God says no, there is no way..." -P.10.

When Participant 10 was confronted with fact that many scientists don't believe in the existence of God, he was of the view that there are still some things beyond them which belong to the supernatural.

"...am very sure, I know about it, because some people have researched to the extent that they see living as a normal phenomenon, they see it as something ... that there is no God, we are just created to live, to do whatever you want to do. But just as I said before, if there are still some things that man cannot do, it means there is one who is supernatural ...

"Scientists have gone the extra mile to make something beautiful out of God's creatures. But there is one thing that is left, even when they try to design a kind of human being, I laugh, that breath, yes they find it difficult. They may create a kind of robot, they may create a kind of thing that looks like a human being, they may even talk, they may be electrified, whatever, but the truth is, it is never that breath that is still there, so it is something that differentiates (God and the scientist)." – P.10.

For many of the participants, all knowledge, even scientific knowledge, is from God and it is now up to man to decide what to do with the knowledge; for good or for bad.

"Knowledge comes from God that's why I said science has its positivity and its negativity it now depends on your mind set on what you want to use it for. If you have a gun, a gun can be protective; it can be offensive that's science for you ... Social networking for example ... some people have turned it into something else look at the Synthia case (a young girl was lured on Facebook to a hotel and killed) that happened very recently ... it is what we turn it to." –P.1.

Participant 3, while believing that scientific knowledge has significantly improved our way of life, is worried, like Participant 1 about the negative aspects:

"For science and technology, for all the good they have done to mankind, there is also a murderous impact. Everything that science has done that can make you enjoy life better, can also destroy life from the toothpick to the airplane ... they can make and destroy." - P3

God and science: conflict or compliment

At times we are confronted with contrasting views of life, living and the future and we have to choose between what our faith says and the "rational" view of science, when the two are perceivably in conflict. The other view is that science and religion are two parallel thoughts which need not conflict but explain different aspects of our lives (Gould, 1997; Midgley, 1985) in which case we resort to both without seeing any contradiction in our thoughts.

Participant 9 brought up the role of religion in spreading the gospel as an example of complimentary roles and technology helping disseminate antagonistic messages about religion as conflicting roles. He said:

"You can be here, you might not be in the church and you will be receiving or hearing or watching your pastor preaching. Maybe you are not feeling too well ...you can just be at home and receive the message. But when you say contradictory, yes, sometimes technology might contradict part of religion. Just like what is happening now, the anti-Islamic thing (video that caused outburst in the Middle East), if there was no technology, I think they would have acted it on a stage, in a theatre and people would have watched and put it in their heads ...but now it was aired, everybody saw it ...like on the social media ...Technology seems to have spread it that fast. I think that's the negative aspect." –P.9.

For Participant 11, science and religion are not against each other, in fact, for him, they work hand in hand since "God is the chairman of everything."

"The Bible they printed, the Koran they printed, is it not machine that printed them ...since I know you need me and I need you, we don't have to fight, there shouldn't be (conflict), even though there is right now, there shouldn't be." -P11

For Participant 6, it is all about knowing the Bible and what it preaches:

"Should I say God doesn't teach us to be foolish? Even in the Bible it is written that we should be as wise as the serpent ... And if you are a Christian that you believe in God ...you can't just expect things to happen without you actually doing something. And science teaches us how to do something, how to actually go researching, and in short finding answers." –P.6.

Participant 6's views on combining both scientific and religious knowledge, knowing when to pray and when to use what science has provided are shared by Participant 1.

"You see... What I think the Bible equally says is that... apart from exercising faith you must make effort. Now, (for instance) you believe God will make provision for you, you stay back home ...and you want to pay school fees, you don't go out, it is when you reach out that somebody says go and do this for me and you make some money of it ... you are enjoying the grace of God, you are enjoying favour from God, having prayed to him ..." -P.1.

An interesting question was if you had to choose, what comes first for you, your faith or science?

"When science fails, you go back to God ... sometimes we have a tendency to start with science believing in science, you have this headache, you first buy Phensic, you buy Panadol, it continues but when it fails your last hope, your last resort, is always God ..." - P.1.

For Participant 7 as well, faith comes first: "belief comes first because you have to believe this thing will work". For Participant 8, however, it is science: "personally, I will first deploy science before prayer" he said. Participant 8 said he believes science has a more important role to play than religious belief.

One source of conflict for Participant 6 was her concerns over the scientific explanation of the evolution of man. She said:

"Science gave us a different evolution and there is also an evolution in the bible. That evolution is actually going to contradict the one in the bible which puts you as a Christian in a psychological dilemma and it's something I don't think, if we try putting our self in that space, we will actually be okay...

"I believe ... I choose that of ... you know ... God, the evolution in the bible. But I think with the facts that science has actually provided, it actually puts me in that state too sometimes, but nonetheless, I still have one mind and I still chose that..." - P.6.

Participant 6 appears to hesitantly approve of the scientific theory of evolution but the Christian faith preaches a contrary philosophy and identifying more with her faith than with science on

this particular issue, she hesitantly chooses the biblical explanation. But what if I had not compelled her to choose publicly, what does she believe in the deeper recesses of her mind?

Science can be a platform for unity

If we assume that science and religion don't necessarily compete; that both Christians and Muslims alike see science as a tool and not a competitor; that common sense is all about shared experiences and conversation, can more positive experiences with science serve to bridge existing divides?

Participant 7 is positive based on a personal experience during the NYSC scheme.

"Yes, it stands a chance to move us closer, like when I was serving (NYSC) I had a friend from the north and I am from the West here. ...we communicate now and I have not been to the north before, but now I can say I have a friend from the north, and maybe from what we have shared and the way we talk ...and if more of science things can be brought or developed in the country, it can do more of such." –P.7.

For Participant 8, communication is key:

"Through communication someone can know what another person is, there are some particular things ...they will say okay ...these people are so wicked ...but it's through communication and internet most especially, you can read more things and know that it's not only bad, but they have some good sides." –P.8

For Participant 3, the divisions are rooted in culture and identity as he is more comfortable being among his tribe than being a Nigerian. He is, however, worried about literacy in the application of science and corruption in government where funds for scientific advancement may be diverted for personal uses:

"It is possible to the extent that science has the characteristic of enhancing quality of life and living regardless of your religion or tribe, unfortunately using Nigeria as an example, there are no Nigerians, what we have are ethnic peoples. ... I am comfortable being seen as an Ogun State indigene than a Nigerian.

"Again let's not forget again that corruption, people have voted money for things to impact certain societies, the monies were withdrawn but those things were never

delivered ... Besides the level of literacy is a function of how much science you can exploit. Like somebody who cannot read or write cannot use an ATM, cannot use a cell phone ..." –P.3.

Participant 1 also does not see a fusion of the Nigerian state, and like Participant 3, his fears are rooted in identity, particularly, the in-group versus out-group:

"It will only attempt to bring us together; I don't see a fusion of the Nigerian state as a whole eventually, as long as you have this feeling you are a Yoruba and there is this person that is Hausa." - P.1.

Participant 2 was also worried about corruption and those powerful elites who want to maintain the status quo at all costs and the resistance they may have to any scientific progress:

"We are talking about INEC (the electoral commission) going more scientific ...the end result would have been to eliminate fraud, rigging and so on. But to the bad eggs amongst our political leaders who believe that the status quo must be maintained at all times, that is, so and so group of people must hold on to power by hook or by crook, they might not like the role science is playing and whereas to somebody with a discerning mind who says that I want Nigeria to move forward, the role of science will be embraced by such a group of people." – P.2.

Participant 1 was however very optimistic about the benefits:

"If it is channelled the right way, we stand to benefit and I think the benefits are still so much there ... we have not exploited to the fullest." –P.1.

7.5 Summary

The two main religions, Christianity and Islam, live with the African traditional religion and you often find some sections of the public practising two or three religions together. Such multi-faith practices may, however, be in private for some and public for others but faith in either of the religions can be attributed to storytelling handed down through generations, personal experience and conversation in society. It is fashionable to belong, and not belonging risks isolation.

Scientific knowledge, like Islam and Christianity, has not displaced the worship of Bori and Ifa completely plausibly because people don't believe it has answers to all their problems, some of which have been attributed to the spiritual. There is also ignorance of existing cures (like vaccines) which may be attributed to literacy and the poor spread of scientific advancements in the population.

Faith in God to resolve personal issues seen as beyond human powers, and faith in science to resolve those issues seen and known to be within its ambit are seen generally not to be in conflict but rather as complimenting each other (co-influence). Which comes first may not be as important as combining both. Experience and storytelling are the driving forces for common sense and to change certain practices such as resistance to vaccination (or any scientific phenomenon), there needs to be access to more positive experiences with science to feed the story mill. The more positive experiences the people of Nigerian have with science, the more goodwill they may bestow on it and the more faith people will have in it for understanding and resolving some of the issues in their daily lives.

Chapter 8 Summary and recommendations for future research

8.1 Synopsis

My research has taken a mixed design approach to the study of the place of science in Nigeria. This chapter summarises the results of the research which shows that science is part of common sense but the acceptance of any new scientific phenomenon depends on public opinion. Notwithstanding the revolt against the oral polio vaccine, the research shows that the people of Nigeria are not anti-science; rather they hold both science and religion in high esteem. They trust scientists, just as they trust God and see no contradiction. They believe in miracles just as they look up to MRI's for health and wellbeing. The chapter also makes recommendations for future research.

8.2 Common sense

Common sense has been described as a corpus of knowledge based on shared traditions and enriched by thousands of well-practised experiments and observations (Moscovici and Hewstone, 1983); historically evolved mentalities which determine our present thinking (Wagner and Hayes, 2005); and our shared values and beliefs and those things that bind us together as a group (Achebe, 1958:2010). No one, the Brazilian author, Freire (1998), argues is ignorant and what you already know will influence what is new.

For Durkheim, the value we ascribe to science depends on the idea that we, collectively, have of its nature and its role in life and while common sense needs to be informed by the sciences (Habermas, 2003), learning a new thing about the world still depends on the mutual understanding between actors and the public. For science to become part of common sense, therefore, it is not enough for it to exist; scientists and the public must communicate, at least.

The impact of risk communication, according to Breakwell, (2000), depends on a complex interaction between the characteristics of the audience, the source of the message and its content.

When science is being communicated, argues Miller (2001), communicators need to be aware of the nature and existing knowledge of the intended audience. Also, the source of risk can shape its meaning (Otway and Wynne, 1989; Wynne, 1992) and trust, according to Moscovici (2001) is both at the origin and at the limit of social knowledge. If we do not trust the source of risk communication, it is unlikely to be accepted as new knowledge. If we do not have faith in the source of a message, it is unlikely to change our common sense. Communicating change then starts with knowing the existing knowledge and having high levels of trust in actors but for the public to accept the new science, it needs to see it as one that is going to make their lives easier and more comfortable and not complicate or destroy it. Science rests on the opinion of the public that it is adding value although the idea of "value" is culturally specific. At the peak of the OPV controversy, it was seen in the south of Nigeria as adding value while in the north it was perceived as a threat to Moslems.

There is no public opinion without representations (Bauer and Gaskell, 2008) and the social representation paradigm has provided the conceptual framework to analyse the OPV controversy, the communication genres of the discourse about the controversy, science in the media and science in common sense.

8.3 Representations and the oral polio vaccine controversy

The media analysis of the Oral Polio vaccine controversy was about understanding how knowledge about the vaccine was produced, who made it, why, how this knowledge shaped individuals and groups, and how it changed over time. Actors identified in the controversy were the federal government, the state governments, the religious leaders, the foreign non-governmental organisations and other private individuals. The main themes attributed to knowledge formation in the period covered by the study were western conspiracy, logistics or coverage, un-Islamic, effective vaccine and risk.

The western conspiracy theme was initially formulated as being against the developing world but this soon transformed into a conspiracy against Muslims which resonated more with the Northern public. There were experiences to draw from. The America drug firm, Pfizer, had recently conducted a field trial which led to the death of several children in Kano and there were ongoing wars in Afghanistan and Iraq perceived as targeting Muslims. Even the Bosnian war was a reference point. These incidences have formed a picture of suspicion and the abduction to the OPV shows the role of experience in how we make sense of events.

But what makes a particular representation of an object, such as the OPV as a western conspiracy, survive for long in public discourse? Gamson and Modigliani (1989) postulated three broad classes of determinants that combine to produce particular package careers. These are sponsor activities, media practices and cultural resonance.

Sponsor activities: Relatively few people have the resources needed to resist authority. A variety of inhibitions against disobeying authority come into play and successfully keep the person in his place (Milgram, 1974). Thirty two year-old Aishatu Mohammed was being obedient to authorities when she told IRIN NEWS (2004) that she rejected the vaccine because their leaders said it contains harmful substances. The western plot, propagated by leaders of two very influential Islamic groups gave an ongoing debate a new meaning and reshaped it among the adherents of Islam. Dr Ahmed, a renowned medical doctor and leader of one of the Islamic groups, went on an intensive media campaign in Nigeria and abroad, opposing the vaccination exercise. The various campaigns led by John Gibbs in England in 1856 and John Pitcairn in America in 1908 were very similar as were the campaigns by the Church in Cameroon in 1990 and the Association of Parents of Vaccine Damaged Children in the United Kingdom in 1974. Not all were swayed by the directives of authorities, however. Some, like Amina Abdulkadir, disobeyed: "I heard about the controversy but my husband agreed that we still give our baby the polio vaccine", she told IRIN NEWS (2004).

Media activities: In the Brazilian revolt, the official package seemed to have had less voice and the work of the opposition newspaper, *Correio da Manhã* (Needell, 1987) is a good example, dramatising the rumoured consequences of vaccination. The same role was played by the Central Broadcasting Service radio in Uganda. The media in the Nigerian case study became the platform for pro and anti-vaccination campaigners to debate which side was deceiving the public and which side was spreading the disease.

Cultural resonance: Vaccination was robustly resisted in Victorian England and America for similar reasons in the 19th century but changing cultures also changed the perception of the two countries of MMR and DTP controversies in the 21st century. While rejection was high in the UK, no such widespread reaction was witnessed in the US. The different perceptions of Western interests by the North and South in Nigeria also restricted the spread of the controversy.

The anchoring of an unfamiliar scientific debate about risk from genetically-modified crops as a food quality issue significantly transformed the debate in France. The Confederation Paysanne was able to cultivate more cultural clout than environmental NGOs by developing an anti-GMO/anti-globalisation perspective cast in cultural terms that resonated with the public (Heller, 2002). The OPV debate followed a similar pattern. Cultural resonance was found in common sense notions of incompatibility with Islam. Also, anchoring an unfamiliar debate over risk of infertility on a western conspiracy against Muslims resonated with the northern public, galvanising it to a revolt which did not spread to the south. The resistance against the vaccine was also exported to Pakistan (AP, 2006; BBC, 2007), a country with similar religious convictions and suspicion of American interests as the Muslims of northern Nigeria.

For me, it is like planting a seed, no matter how good the seed (theme) is, it can only sprout if the soil (culture) is favourable. How long it survives post sprouting now depends on the weather (media practices) which fluctuate between favourable and unfavourable and further activities by the planter (sponsor activities). All three: sponsor activities, media practices and culture - act together to determine the dominance and survival of a frame in public discourse.

Now, considering the fact that several vaccines were circulating in the northern part of the country at the time of the revolt, the primary cause of the dramatic change in public opinion against the OPV in the second half of 2003 and the first half of 2004 was its representation as a western conspiracy to sterilise Muslim women. The difference between all the vaccines in circulation during this period was how each was represented. The public that resisted the OPV vaccine was even calling for and accepting other vaccines and drugs of western origin.

The conspiracy theory was made more believable with the ongoing controversy over the interpretation of research findings. The committee of stakeholders eventually confirmed traces of a sex hormone estradiol (or oestradiol) in samples of the vaccine which was earlier vehemently denied by the authorities. Oestradiol, estriol and estrone are three sex hormones that make up oestrogen and are responsible for reproduction in females. Synthetic oestrogens are, however, used in combination with other compounds such as contraceptives and Ludicke, et al. (2001) said they are very effective. Oestrogen has also been linked with male reproductive disorders such as declining male fertility and testicular cancer (Sharpe and Skakkebaek, 1993; Carlsen, et al., 1992). Turner and Sharpe (1997) argue that while there may be rational explanations for all kinds of changes that have occurred in humans, including cancers, that have little or nothing to do with exposure to hormones, but when we know that oestrogens can arguably affect all of these parameters it is foolhardy to dismiss its possible involvement just because we have no data. The absence of evidence, they argue, is not evidence of absence. Denying the presence of oestradiol in samples of the vaccine further strengthened suspicions of a conspiracy agenda and dismissing its relevance that it can be found in recycled drinking water in developed countries does not meet the need for transparency and mutual understanding. A new report by United Nations Environment Programme (UNEP, 2012) found there is a strong likelihood that exposure to endocrine disrupting chemicals (EDCs) which are found in food, cosmetics, phytoestrogens, personal care products, etc., plays a role in the increases seen in male and female reproductive,

endocrine-related cancers, behavioural and learning problems, asthma, obesity and diabetes. EDCs, according to the report, can impair the health of our children and their children.

The suspected contamination of the vaccine by a sex hormone was a major issue in the controversy and given the pre-existing beliefs of the intentions of the US towards Muslims, it was difficult to accept the contamination was not part of a grand plan.

However, as Miller (2001) argues, the key to the new age of public understanding of science is that citizens need to get used to scientists arguing out controversial facts, theories and issues and what goes on backstage in the scientific community has to become more visible as part of “full frank and publicly inclusive dialogue, discussion and debate about science and its implications for individuals and society.” Frank dialogue between the federal government and the states on the contamination may have contributed to an earlier resolution of the issue and the source of the vaccine changed as was later done. One of the leaders of the anti-vaccination campaign, Dr Ahmad had advocated for a suspension of the exercise to allow for a resolution of the crisis as the “common sense” thing to do (Abuh, 2004 in *The Guardian*, 11/01/2004).

The compatibility of science and religion was another issue that had to be resolved in the vaccination controversy. Treating diseases of unknown origin, to some believers is playing God by attempting to undo man’s destiny but the counter argument is that God does not wish his people to suffer and has provided the knowledge which is used to cure the disease. That was the message the traditional rulers brought from Egypt, that “immunization is Halal” and as one interviewee captured it: “God does not teach us to be foolish.”

The "western conspiracy" and "incompatibility with Islam" themes typify the role of “old categories in pushing new meanings and objects through society” (Castro and Gomes, 2005); the need to understand an issue that has no clear and consensual meaning (Lorenzi-Cioldi and Clemence, 2001) and a want in people to protect from threat themselves and the groups with which they identify (Joffe, 1999). How the vaccination debate progressed, confirms Moscovici’s (1984) argument that the initial direction, the angle from which a group will try to cope with the

unfamiliar, will be determined by the images, concepts and languages shared by the group. It also shows that both sides in the debate adopted reified arguments from scientists while the anti-OPV group in addition deployed consensual or common sense arguments (see also Batel and Castro (2009). The consensual arguments were the deciding factors for public opinion. The OPV debate also confirms Bauer and Gaskell's (2008) wind rose model that representations are a function of subject, object, project, time medium and intergroup context.

8.4 Science in the Nigerian media

The objectives of the analysis of science in the media are to see what is promoted, the intensity of coverage, the sources of news and how they are presented. This is with a view to providing a window into the culture of science in Nigeria and its positive or negative implications for public opinion. Park (1940) argues that every public has its own universe of discourse and a fact is only a fact in a particular universe of discourse and it is the facts in the Nigerian universe of discourse this section is about.

In a review of research on public understanding of science in Britain, Bauer (1998) found medicine to be the nucleus of the representations of science. This analysis, more than a decade later and in a different context, reflected a higher focus on technology and engineering (49%) compared with medicine (36%). Bauer also found that biomedicine became the current core of the public representation of science in Britain following a shift from the physical sciences which dominated from 1930 to 1980. Has the trend changed worldwide again in the 2000s towards technology, which now dominates our lives especially computer and mobile phone technology? Or is this a marker of cultural differences? More worldwide data is needed in this regard. The space allocated to science coverage in terms of column inches was about 6.8% of the total available space in 2001, rising to 8.3% in 2009. The interest here is in the direction of the movement and the Nigerian data shows promise of more science articles in the news. The analysis also shows that with increasing globalisation, science and its artefacts are becoming

issues in international discourses. While an issue like power failure remains significant only in the local context, others like biotechnology, cancer, AIDS and nuclear power have international appeal. Notably also, apart from promoting orthodox medicine, *The Guardian* has for several years been at the forefront of the campaign for alternative medical therapy, for which it has had a section every Friday over the decades and continues to maintain a significant presence in the publication.

Science reportage is increasingly being domesticated despite the weak industrial base of the country as more local journalists take the lead in reporting. However, only 21% of science news can be accounted for by science writers.

The analysis of all that is science in *The Guardian* shows that about 83% of the articles are positive, and this makes a strong case for a positive outlook for science in the Nigerian media and society.

8.5 Interest, Attitudes, knowledge and opposition to vaccination

The pilot survey shows that both science and religiosity informed the answers to some knowledge questions. About 80% gave the scientifically-correct answer that the mother's gene does not determine sex but a lower percentage 64.3% said it was the father's gene. This phenomenon was also observed in the United States survey data (NSF, 2010) where the percentage that agreed it was the father's gene (62%) was lower than that which agreed it was not the mother's gene (71%). When the Nigerian respondents were further asked if it was down to God, 67% said yes. This was also observed in the expanded survey, where 69.5% agreed it was father's gene and 74.5% also agreed it was God.

In the expanded survey, when asked how interested respondents were about issues in the news, interest in religion was highest, while medical and scientific discoveries were at the bottom of the table. The state of feeling informed did not fare better, with only about 58% indicating they feel informed about new medical discoveries, while religion again topped the table at 90%.

Levels of interest in new science and new medicine were higher in the EU (EU, 2005) compared with the results of the survey. The respondents in the Nigerian survey also showed higher levels of engagement with religion (attending and donating) than with science. Given that the respondents feel more interested than they feel informed about science and medicine, is this gap a craving for more information and an expression of lack of fora (science propagation activities like museums, etc.) to engage with science related activities in Nigeria?

The levels of trust conferred on scientists and religious leaders were also strikingly similar. This will be surprising to any resident of Europe largely due to the negative correlation expected between science and religion but this may well be the expectation in America and some other more religious countries as well. You can trust your doctor and your priest to both take care of your health needs in different ways. That these two positively correlate is interesting.

Equally surprising is the low level of trust in politicians. Only 10 of the 332 respondents that answered the question rated politicians above five on a seven point scale of increasing trust. The implication of this for any public debate is obvious, where trust is a solution for risk and you do not trust the risk manager, then the message of politicians will fall on deaf ears.

Factor analysis categorised levels of trust in public institutions into three latent variables named: public service, independents and faith/science. Attitude variables were also categorised into three factors: pessimism, progress and fear. The analysis shows that the interaction between your take on the world, an engineering or existential perspective and knowledge can significantly mediate your fear of science. The analysis also shows that increasing knowledge leads to more positive scores for respondents with weak and very strong religiosity on the progress factor but low scores for those with strong religiosity at the high knowledge. The same polarity at high knowledge of strong versus very weak and very strong religiosity was observed on the fear factor. Highly knowledgeable women and those with strong religiosity also have much less fear of science than men of equal knowledge.

Regression analysis shows that with 'progress', a respondent in the mid knowledge bracket who trusts scientists and believes in destiny is more likely to be positive about the progressive nature of science. A respondent with high level of trust in scientists is also more likely to have a pessimistic attitude than those with low level of trust. Men are more likely to be afraid of science than women. The regression analysis also shows that knowledge is not a significant issue when it comes to opposition to vaccination. Neither is very strong religiosity. Being strongly religious and highly knowledgeable is not an indication of opposition to vaccination.

The association between knowledge and attitudes is therefore complex with culture and socio demographics playing significant roles and being strongly religious does not indicate a significant association with opposition to vaccination.

8.6 Living with faith in science and religion

For many Nigerians, the doctor and God reside in the hospital, both catering for specific needs. While God has given the scientist knowledge, he also provides divine cure. Divine intervention in life's events and problems are also sought from traditional medicine men through Ifa, Afa and Bori, said to be spiritual messengers and belief in the supernatural is held across social classes in the society: rich and poor, politicians and public. For some groups, as Herzlich (1973) observed, there is no difference between medicine, magic or religion.

The participants in the interviews believe God and science offer protection. Some place God before science, others place science before God. Which comes first may not be as important as combining both. This idea of holding what some view as conflicting explanations for social phenomena ran through the surveys as well where respondents attribute the sex of child to God and genes. Interesting is that the same population with the scientific explanation also hold the religious explanation. Polyphasic representational fields, Jovchelovitch (2002; 2007; 2008) argues, are assets from which individuals and communities draw the tools, concepts, practices, and meaning that enable them to cope with the everyday and make sense of what is going on.

Common sense is a composite of several knowledge systems encased in a system of values and opinions. Experience with one scientific phenomenon or product, is a meaning-making substitute for lack of experience or common sense knowledge of another, similar phenomenon. Experience with God among the Nigerian public leads to faith in God. Experience with science also leads to faith in science. Thus, faith, which used to be the exclusive preserve of religion, has lost its dominion; it is now shared with science. As Gould (1997) argues, science and religion are not separated by an extensive no man's land and many of our deepest questions call upon aspects of both to provide different parts of a full answer. The issue in contemporary social psychology (Moscovici and Hewstone, 1983) is if these two epistemologies are opposite or complimentary. The Nigerian data shows that having faith in God and science is not seen as contradictory.

8.7 Recommendations for future research

Science and technology are crucial to Nigeria's growth and development and some respondents are of the view that they may also be instrumental to its stability. However, this is an area that needs more research. Thus, the first recommendation is to expand the PUS survey to cover the whole country. This will show how the different nationalities interact with science and if the north-south gap really exists for science as much as it does for politics and religion. If it does not exist for science, then it may provide an additional source to encourage communication across tribes and regions. A Nigerian survey can be complemented with an Africa-wide Afro-barometer. Such a structured survey will make for more meaningful benchmarking with the Euro-barometer, Asia and the Americas to possibly create a global barometer of science in society.

Another map that needs be constantly monitored is the media map of science. The analyses of the Oral Polio Vaccine controversy and science in the Nigerian media have shown the importance of media mapping in interpreting results of surveys. Complementing global PUS surveys with media analyses will add more value to the interpretation of the survey results. It will also contribute to research on the role of the media in public opinion.

Another area to note is the importance of updating some of the constructs and scales which are used internationally to reflect current concerns about science and methodological issues. Some of the constructs have been in use since 1975, when the first survey of knowledge and attitudes about science was conducted. This should be with a view to including knowledge questions that reflect current realities, particularly telecommunication, and that can lead to more internal consistency. Also, looking at the attitude items of the Euro-barometer surveys, Pardo and Calvo (2002) present a strong case for the construction questionnaires that are able to capture the different facets of attitudes and that are sensitive to the degree of salience each facet has for the population under study, in addition to being based on a metric that can accommodate greater variability. Pardo and Calvo (2004) also argue that the crucial issue of the plausibility of the knowledge-attitude relationship is the validity of and robustness of the two scales. Low reliability of one or both could attenuate the correlations between them, and suggest weaker relationships than those that actually exist. According to them, adding more knowledge items and a better balance between the different scientific areas as well as giving more weight to central concepts; both classical and more recent scientific developments, could also significantly improve the power of the test.

For me, improving the survey items and its analysis are probably overdue and need be supported but such transformation should be designed by an international collaboration of scientists given the continual need for cross-cultural comparisons. Such collaboration may produce variables that can be compared across cultures while individual countries have the freedom to add some variables germane to the local environment.

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Appendices

Appendix 1 Code book for coverage of immunization controversy

Frequencies of variables (N=212)

	Percentage		Percentage
Newspaper name		Main theme in story	
The Guardian	25.9	Un-Islamic	2.4
The Punch	22.2	western conspiracy	9.4
This Day Newspapers	18.9	effective vaccine	56.6
Tribune	10.4	risk issue	1.4
The Vanguard	16	coverage	25.9
Champion	6.6	others	4.2
Year of publication		Secondary theme in story	
2001	8.5	Un-Islamic	0.5
2002	9.9	western conspiracy	9.9
2003	16	effective vaccine	7.1
2004	24.1	risk issue	0.9
2005	10.8	coverage	29.7
2006	14.2	others	51.9
2007	4.2		
2008	7.1	Primary actor	
2009	5.2	federal government	43.4
		state, LG's	26.4
Size of article		sectional leaders	3.3
Small	27.8	world bodies	9
Medium	53.3	others	17.9
Large	18.9		
		Secondary actor	
Accompanying graphics and pictures		federal government	9.9
Number of illustrations	0.9	state, LG's	19.8
Number of pictures	12.3	sectional leaders	4.2
No pictures	86.8	world bodies	9
		others	57.1
News format			
news	80.2	Tertiary actors	
opinion, interviews	7.1	federal government	1.4
features	9.9	state, LG's	1.9
editorial	2.4	sectional leaders	3.3
others	0.5	world bodies	7.1
		others	85.8
Positive valuation of story		Positive minus negative valuation of story	
0 (no value)	14.6	-7 (northern ban and deaths from polio)	0.9
1 local positive issues	2.8	-6 (state ban)	0.5
2 local positive issues	2.4	-5	3.3
3 strategy and plans	29.7	-4	9.4
4 funding, media reviews	30.2	-3	2.8
5 endorsement by religious leaders	3.3	-2	1.4
6 (state immunization campaign events)	11.3	-1 (slightly negative story)	1.4
7 (national immunization campaign events)	5.7	0 (no value)	0.9
		1 (slightly positive story)	4.7

Negative valuation of story		2	9.4
-7 northern ban and deaths from vaccines	0.9	3	33
-6 state ban	0.9	4	15.6
-5 Religious dissent, corruption	5.7	5	5.2
-4 negative events, funding gaps, strikes	11.8	6 (state immunization campaign events)	8.5
-3 negative events, funding gaps, strikes	2.4	7 (national immunization campaign events)	2.8
-2 Local negative issues	12.7		
-1 Local negative issues	20.8	recoded positive minus negative value	
0 (no value)	44.8	Propaganda/N2	4.7
		Diffusion/N1	15.1
		Diffusion/P1	63.7
		Propagation/P2	16.5
Percentages of articles before and after ban			
before ban lifted	50.5		
after ban lifted	49.5		
before ban		after the ban	
main themes		main themes	
Un-Islamic	4.7	western conspiracy	3.8
western conspiracy	15	effective vaccine	53.3
effective vaccine	59.8	coverage	40
risk issue	2.8	others	2.9
coverage	12.1		
others	5.6	secondary themes	
		Un-Islamic	1
secondary themes		western conspiracy	2.9
western conspiracy	16.8	effective vaccine	2.9
effective vaccine	11.2	risk issue	1.9
coverage	31.8	coverage	27.6
others	40.2	others	63.8
primary actors		primary actors	
federal government	38.3	federal government	48.6
state, LG's	27.1	state, LG's	25.7
sectional leaders	6.5	world bodies	11.4
world bodies	6.5	others	14.3
others	21.5		
		secondary actors	
Secondary actors		federal government	6.7
federal government	13.1	state, LG's	21
state, LG's	18.7	sectional leaders	1.9
sectional leaders	6.5	world bodies	10.5
world bodies	7.5	others	60
others	54.2		

Syntax for recoded variables

RECODE tonesum (-7=1) (-6=1) (-5=1) (-4=2) (-3=2) (-2=2) (-1=2) (0=3) (1=3) (2=3) (3=3) (4=3) (5=4) (6=4) (7=4)
 INTO evaluation.
 VARIABLE LABELS evaluation 'recoded positive minus negative valuation'.
 EXECUTE.

Appendix 2 Code book for Science and Technology in The Guardian

Artificial week for Guardian press

2001		2005		2009	
Jan 1	Monday	Jan 8	Saturday	Jan 25	Sunday
Jan 26	Friday	Feb 2	Wednesday	Feb 19	Thursday
Feb 15	Thursday	Feb 27	Sunday	Mar 16	Monday
Mar 2	Friday	Mar 24	Thursday	April 10	Friday
March 27	Tuesday	April 18	Tuesday	May 5	Tuesday
April 21	Saturday	May 13	Friday	May 30	Saturday
May 16	Wednesday	June 7	Tuesday	June 24	Wednesday
June 10	Sunday	July 2	Saturday	July 18	Saturday
July 5	Thursday	July 27	Wednesday	August 12	Wednesday
July 30	Monday	Aug 21	Sunday	Sept 6	Sunday
Aug 25	Saturday	Sept 15	Thursday	Oct 1	Thursday
Sept 18	Tuesday	October 10	Monday	Oct 26	Monday
October 14	Sunday	Nov 4	Friday	Nov 20	Friday
Nov 7	Wednesday	Nov 28	Monday	Dec 15	Tuesday

Frequencies of variables (N822)

	Percentage		Percentage
Year of publication		Page type	
2001	24.5	Front Page	3.4
2005	35	Pages 2 to 3	15
2009	40.5	Other inside pages	77.9
		Back page	3.8
Section story is found		Illustrations used related to article	
Main news	21.8	None	77.4
Foreign news	6.4	Pictures	20.2
Financial Business news	15.6	Tables, data, graphs	0.9
OPED pages	4.5	Caricature/cartoon/diagrams	1.6
Features/Magazines	3.9		
Sports	1	Source of news	
Science/tech column	3.8	Wire services, (AFP, Reuters, etc.)	14.6
Health orthodox	2.8	Interview by local journalist	10.7
Health alternative therapy	6.7	Scientific journal or article	7.9
Politics, parties, legislation	0.4	Research report, poll, survey	1.6
IT and telecom	5.2	Investigation, review	11.8
Energy	4.4	Press release, seminar, conference,	44.6
Agriculture	2.3	Foreign media (online medium, etc.)	8.4
Home, property, gardening	5.7	Others (local contributors, NAN, etc.	0.4
Fashion, style and celebrity	0.5		
Celebrity	0.5	Primary news value	
Education	1.7	Novelty, Invention, Breakthrough	14.7
Labour, appointment, industry	2.7	Elite person/institution/country	47.6
Entertainment	0.2	Bad news, accident, catastrophe	11.3
Transport/motoring	3.4	Good news, upcoming event. Promise	12
Religious matters	0.2	Controversy of any kind	6.1
Children section	1.1	Protest public gathering	0.4
Others (metro, etc.)	5.2	others	7.9
Who/what/main agent in headline		Secondary news value	
Environment	7.4	Novelty	3.3
Animals	2.4	Reference to elite	26.9

Humans, body parts, organs	15.8	Bad news	4.1
Formal institutions, organizations, country	39.1	Good news	14.5
Microorganisms (Disease, bacteria)	7.8	Controversy	3.5
Pharmaceuticals/chemicals	5.6	Protest	0.5
Toxic waste/radiation	0.1	Others	46.5
Material/non-human/equipment	14.1	Missing	0.7
others (food, seed, plants)	7.7		
Was the story about a controversy?	83.1	Story writer	
None	9.7	Specialist science journalist	20.9
balanced	7.2	Other journalists	52.4
Imbalanced, partial		Columnist/contributor	6.4
		Foreign journalist/medium	20.1
Academic field involved		Image of scientist	
History, philosophy, arts	0.6	Neutral, no dominant theme	51.1
Physics, chemistry, astronomy	1.6	Impartial expert, judge	1
Biological	0.5	Creator, healer, solutions provider	35.2
Medical	35.8	Heroes, pioneer	2.7
Earth sciences	5	Humans, like you and me	2.6
Social sciences	4.1	Financially interested, greedy,	5
Technology and engineering	48.7	Eccentric, destroyer, incompetent	2.6
Others	3.8		
Strategic technology involved		Primary location of consequences	48.5
Nuclear power, weapons	1.6	Socio cultural, moral	1.8
Genetic engineering, biotechnology	1.5	politics, power	34.4
IT, computers, communications	14.2	Economic, financial	6.9
Space technology	1.3	Science	8.3
War with cancer	1.1	Environment, ecological	
Environment, protection, pollution	5.8		
HIV/AIDS	4.3	Secondary location of consequences	70.1
Energy (power, oil, etc.)	14	Socio cultural, moral	1.5
Medical technology, transplantations	0.5	politics, power	16.1
Immunization	1	Economic, financial	9.2
Other non-strategic science issues	54.7	Science	3
		Environment, ecological	
Stage of event life cycle		Discourse of benefits and risk	66.2
Discovery, Invention, prototype	3.4	Benefits included	10.1
Process innovation, improvement	2.8	Risks included	13.3
Diffusion, awareness	20.4	Both benefits and risk discourse	10.5
Testing, diagnosis, screening, selection	2.7	Not applicable	
Allocation of resources, funding	10.8		
Mature or recurring issues	59.6		
Evaluation of article, positive		Difference pos and neg evaluation	
0 (No positive consequence)	14.8	-5	1.7
1 Benefit limited to individuals	6	-4	1.5
2 Benefit is to groups	39.9	-3	5.1
3 Benefit is localized within nation state	31.3	-2	6.3
4 Long term benefit across nation states	5.4	-1 (damage limited to individuals)	2.7
5 Long term benefit across continents	2.2	0 (no consequence)	0.6
6 Long term benefit to this generation	0.5	1 (benefit limited to individuals)	9
		2	40
Evaluation of article, negative		3	25.8
0 (no negative consequence)	72.4	4	4.9
1 Long term damage to individuals	8.8	5	1.9
2 Long term damage to groups	8.6	6	0.5
3 Damage is localized within nation states	6.3		

4 Long term damage to nation states	1.9		
5 Long term damage across continents	1.8		
6 Long term damage to this generation	0.1		
Recorded variables			
Length of article grouped		Recorded who is telling the story	
<= 63	66.4	Foreign journalist	20.1
64 - 126	20	Local journalist	79.9
127 - 189	5.8		
190 - 252	5.5	Recorded source of news	
253+	2.3	Foreign origin	31.1
		Local origin	68.9
Recorded academic field			
Biological and medical sciences	36.4	Recorded primary news value	
Physical sciences, engineering, earth sciences	55.2	Other news value	52.3
Arts, social sciences, others	8.4	Reference to elite	47.7
Recorded page type (Agenda setting)		recorded positive minus negative values	
Other functions	77.9	NEG2	3.2
Agenda setting functions	22.1	NEG1	14.1
		POS1	75.4
		POS2	7.3

Syntax for recorded variables

* Visual Binning.

*LENGHT.

RECODE LENGHT (MISSING=COPY) (LO THRU 63=1) (LO THRU 126=2) (LO THRU 189=3) (LO THRU 252=4) (LO THRU HI=5) (ELSE=SYSMIS) INTO LENGTHGRP.

VARIABLE LABELS LENGTHGRP 'Length of article in column inches grouped'.

FORMATS LENGTHGRP (F5.0).

VALUE LABELS LENGTHGRP 1 '<= 63' 2 '64 - 126' 3 '127 - 189' 4 '190 - 252' 5 '253+'.

MISSING VALUES LENGTHGRP (-99).

VARIABLE LEVEL LENGTHGRP (ORDINAL).

RECODE PGTYPE (3=0) (ELSE=1) INTO RECPGTYPE.

VARIABLE LABELS RECPGTYPE 'Recorded page type (Agenda setting functions)'.

RECODE STRTELL (4=0) (ELSE=1) INTO RECSTRTELL.

VARIABLE LABELS RECSTRTELL 'Recorded who is telling the story'.

RECODE SURCE (1=0) (3=0) (7=0) (ELSE=1) INTO RECSURCE.

VARIABLE LABELS RECSURCE 'Recorded source of news'.

RECODE PRINEW (2=1) (ELSE=0) INTO RECPRINEW.

VARIABLE LABELS RECPRINEW 'Recorded primary news value'.

RECODE ACAFIELD (3=1) (4=1) (2=2) (5=2) (7=2) (ELSE=3) INTO RECACAFIELD.

VARIABLE LABELS RECACAFIELD 'Recorded academic field'.

RECODE PRILOC (4=1) (5=1) (ELSE=0) INTO RECPRILOC.

VARIABLE LABELS RECPRILOC 'Recorded primary location of consequences'.

RECODE DIFFER (-7=1) (-6=1) (-5=1) (-4=1) (-3=2) (-2=2) (-1=2) (0=3) (1=3) (2=3) (3=3) (4=4) (5=4) (6=4) (7=4) INTO COMMSYSTEMS1.

VARIABLE LABELS commsystems1 'recorded positive minus negative values'.

Code sheet for manual coding

		V1.Coder	V2. Item No	V3. newspaper					V1.Coder	V2. Item No	V3. newspaper
		1	692	1					1	693	1
V4. Day	V5. Month	V6. year	V7. Wkday	V8. Pg No.			V4. Day	V5. Month	V6. year	V7. Wkday	V8. Pg No.
12	8	9	3	39			12	8	9	3	43
		9. Pg expos	10. Section	11. Size ins					9. Pg expos	10. Section	11. Size ins
		3	11	28					3	11	50
12. Size of paper	13. Illustrations			14. Source of news			12. Size of paper	13. Illustrations			14. Source of news
18144	1			6			18144	1			6
15. main news value	16. second news value	17. Controversy					15. main news value	16. second news value	17. Controversy		
2		1					2		1		
18. What is story about	19. Who is telling story			20. Acada field			18. What is story about	19. Who is telling story			20. Acada field
8	1			7			8	1			7
21. Strat technology	22. Locat within cycle			23. Stereotype			21. Strat technology	22. Locat within cycle			23. Stereotype
3	3			3			3	3			3
24. location 1 Consequences	25. Location 11	26. benefits/risk	27. Positive	28. negative			24. location 1 Consequences	25. Location 11	26. benefits/risk	27. Positive	28. negative
3		1	2	0			1		1	2	0
29. Positive (-) negative							29. Positive (-) negative				
2							2				

Appendix 3 Pilot survey of PUS

Table of frequencies (N=168)

	%		%
Fundamental attitude to the world			
You are fascinated by the beauty of this natural spectacle	67.9	You are thinking of how unimportant you are in the natural order of things	2.4
You are thinking of the quantity of building materials the rock contains and worry about its waste. You are projecting how many houses and roads it can build	2.4	You are thinking of how to set up a tourist centre for people to enjoy nature and to generate income for yourself and the local community	27.4
General attitude to science			
Science and technology are making our lives healthier, easier and more comfortable		We depend too much on science and not enough on God/faith	
Strongly agree	61.3	Strongly agree	27.4
Tend to agree	28.6	Tend to agree	33.3
Neither agree nor disagree	6.5	Neither agree nor disagree	11.3
Tend to disagree	1.8	Tend to disagree	16.7
Strongly disagree	1.8	Strongly disagree	10.7
		Don't know	0.6
Science and technology cannot really play a role in improving the environment			
Strongly agree	4.2		
Tend to agree	5.4		
Neither agree nor disagree	4.2		
Tend to disagree	17.3		
Strongly disagree	68.5		
Don't know	0.6		
Science literacy			
It is the mother's genes that decide whether the baby is a boy or a girl		It is the father's genes that decide whether the baby is a boy or a girl	
True	6	True	64.3
FALSE	78.6	FALSE	19.6
Don't know	15.5	Don't know	16.1
It is God that determines the sex of the child		It is pure luck that determines the sex of the child	
True	67.3	True	16.1
FALSE	16.7	FALSE	61.9
Don't know	16.1	Don't know	22
Electrons are smaller than atoms		Human beings, as we know them today, developed from earlier species of animals	
True	41.7	True	33.9
FALSE	31.5	FALSE	51.2
Don't know	26.8	Don't know	14.9
Demographics			
Self-reported religiosity		Sex of respondent	
10. On a seven point scale how religious are you 1 (least), 2, 3, 4, 5, 6, 7 (Highest).		Male	67.3
1 lowest	3	Female	32.7
2	4.2		
3	6		
4	20.2	Age of respondent	
5	25.6	18 and below	6
6	18.5	19 – 24	11.9
7 highest	22.6	25 – 34	8.9

		35 – 44	26.2
Place of domicile		45 and above	47
Nigeria	50.6		
Abroad	49.4		
Recoded attitude variables			
Fundamental attitude to the world		Science & tech will make lives easier/tech optimism	
Vertical (existential, aesthetic)	70.2	Otherwise	10.1
Horizontal (engineer, entrepreneurial)	29.8	Optimism	89.9
We depend too much on science and not enough on faith/ tech pessimism			
Otherwise	39.3		
Pessimism	60.7		
Recoded knowledge variables			
Father's gene/knowledge		Mother's gene	
Otherwise	35.7	Otherwise	21.4
Correct	64.3	Correct	78.6
Human being developed from animals		Electrons are smaller than atoms	
Otherwise	66.1	Otherwise	58.3
Correct	33.9	Correct	41.7
Science and tech cannot improve the environ		Luck decides sex	
Otherwise	14.3	Otherwise	38.1
Correct	85.7	Correct	61.9
God decides sex			
Otherwise	83.3		
Correct	16.7		
Demographics			
Sex		Age of respondent	
Otherwise/Male	67.3	34 and below	26.8
Female	32.7	35 to 44	26.2
		45 and above	47
Place of domicile			
Otherwise/Abroad	49.4	Rel2 (high)	
Nigeria	50.6	High/reference category	41.1
		Low	7.1
Religiosity		Mid	51.8
Low relig/reference category	7.1		
Medium relig	51.8		
High relig	41.1		

Syntax for recoded variables

RECODE Age (1=1) (2=1) (3=1) (4=2) (5=3) INTO Age1.

VARIABLE LABELS Age1 'recoded age of respondent'.

RECODE Relig (1=1) (2=1) (3=2) (4=2) (5=2) (6=3) (7=3) INTO Relig1.

VARIABLE LABELS Relig1 'recoded self-reported religious belief'.

RECODE Attitoworld (1=1) (2=0) (3=1) (4=0) INTO AttitoworldD.

VARIABLE LABELS AttitoworldD 'dummy variable for vertical attitude'.

RECODE Fagene (1=1) (2=0) (3=0) INTO Fagenesex.

VARIABLE LABELS Fagenesex 'Fathers gene decides sex dummy'.

RECODE Mogene (2=1) (1=0) (3=0) INTO Mogenesex.

VARIABLE LABELS Mogenesex 'Mothers gene decides sex dummy'.

RECODE Godsex (2=1) (1=0) (3=0) INTO Godsexdum.

VARIABLE LABELS Godsexdum 'God decides sex dummy'.

RECODE Lucksex (2=1) (1=0) (3=0) INTO Lucksexdum.

VARIABLE LABELS Lucksexdum 'Luck decides sex dummy'.
 RECODE Elecsmaller (1=1) (2=0) (3=0) INTO Elecsmallerdum.
 VARIABLE LABELS Elecsmallerdum 'Electrons are smaller dummy'.
 RECODE Humfroani (1=1) (2=0) (3=0) INTO Humanfroanidum.
 VARIABLE LABELS Humanfroanidum 'Humans developed from animals dummy'.
 RECODE Sciliveasier (1=1) (2=1) (ELSE=0) INTO liveseasier.
 VARIABLE LABELS technoptimism 'Science makes our lives easier and healthier dummy'.
 RECODE Toomucsci (1=1) (2=1) (ELSE=0) INTO toomuchscience.
 VARIABLE LABELS techpessimism 'We depend too much on science dummy'.
 RECODE Scintimp (4=1) (5=1) (ELSE=0) INTOscienvironment.
 VARIABLE LABELS techoptimismE 'Science cannot improve environment dummy for disagree'.
 RECODE Domicile (1=1) (2=0) INTO DomNigeria.
 VARIABLE LABELS DomNigeria 'Domicile Nigeria dummy'.
 RECODE Relig1 (1=2) (2=3) (3=1) INTO Rel2.
 VARIABLE LABELS Rel2 'Religion with high as dumm'.

Pilot survey Model building for logistic regression analysis

Dependent variable	K_Humans (0 = otherwise; 1 = correct)			
	(Exp(B)-1)X100	(Exp(B)-1)X100	(Exp(B)-1)X100	(Exp(B)-1)X100
Independent variable	Model 1	Model 2	Model 3	Model 4
Fagene(correct)	9.5	5.1	9.6	
Mogene(correct)	132.4	154.1	204.8*	
Elecsmaller(correct)	20	13.6	5.4	
Humanfroani(correct)				
Godsex(correct)	187.1**	184.6**	163.9*	
Lucksex (correct)	-72.6***	-70.9***	-69.8***	
Attitoworld(exist, aesth)		-27.6	-32.4	
techoptimism(optimistic)		169	106.3	
techpessimism(pessimistic)		-15.7	1.9	
TechoptimismE(correct)		-34.9	-13.9	
Relig(low)				(high)
Relig(mid)			-7.5	199.1(low)
Relig(high)			-66.6	176.6(Mid)**
Sex(female)			-49.2	
Domicile(Nigeria)			13.1	
Age(34 & below)				
Age(35-44)			-71.4**	
Age(45 & above)			-48.4	
-2Log likelihood	196.346	193.055	179.611	179.611
Nagelkerke R square	0.147	0.171	0.264	0.264

* is Significant at 10%; ** is significant at 5%; *** is significant at 1%. For all independent variables, correct = 1; 0 = otherwise. Father's gene –correct answer =1; mother's gene – correct answer = 1; electrons are smaller than atoms – correct answer = 1; God determines sex of child- correct answer = 1; Luch determines sex – correct answer = 1; attitude to the world - existential, aesthetic = 1; Technological optimism (science and technology makes lives easier)

Appendix 4 Integrated expanded (74) and pilot survey (14) questionnaires

Concept	Expanded survey	Pilot survey
Interest in Science	1. Sports	
	2. Politics	
	3. New scientific discoveries	
	4. Culture and arts	
	5. Current affairs	
	6. New medical discoveries	
	7. Entertainment	
	8. Religion	
Feeling informed about science	1. Sports	
	2. Politics	
	3. New scientific discoveries	
	4. Culture and arts	
	5. Current affairs	
	6. New medical discoveries	
	7. Entertainment	
	8. Religion	
Engagement with science and religion	1. How regularly do you read articles on science and technology in newspapers or magazines or listen to (science) programmes on radio or watch them on TV?	
	2. How regularly do you attend science exhibitions, visit science museum or participate in other science and technology related activities?	
	3. How regularly do you donate money to fund scientific research such as the sickle cell fund, Malaria, AIDS, etc?	
	4. How regularly do you read articles about religion in newspapers or magazines or listen to such (religious) programmes on radio or watch them on TV?	
	5. How regularly do you attend religious services to pray for divine intervention or participate in other religious programmes?	
Fundamental attitude to the world	a. You are fascinated by the beauty of this natural spectacle	a. You are fascinated by the beauty of this natural spectacle
	b. You are thinking of how much granite the rock could produce for construction	b. You are thinking of how much granite the rock could produce for construction
	c. You are thinking of how unimportant you are in the natural order of things	c. You are thinking of how unimportant you are in the natural order of things
	d. You are thinking of how to set up a tourist center for people to enjoy nature, and to generate income for yourself and others	d. You are thinking of how to set up a tourist center for people to enjoy nature, and to generate income for yourself and others
General attitude to science	1. Thanks to science and technology there will be more job opportunities for the next generation	
	2. The more I know about science the more worried I am	
	3. Science and technology are making our lives healthier	1. Science and technology are making our lives healthier
	4. The growth of science means that few people could control our lives	
	5. Science and technology can sort out any problem	
	6. Because of their knowledge, scientific researchers have a power that makes them	

	dangerous	
	7. New inventions will always be found to counteract any harmful effect of scientific and technological developments	
	8. Science and technology are making our lives easier and more comfortable	
	9. Science and technology are responsible for most of the environmental problems we have today	
	10. Science makes our way of life change too fast	
	11. In general, scientists want to make life better for the average person	
	12. One day, science will be able to give a complete picture of how the universe works	
	13. On the balance, the benefits of science are greater than any harmful effects it may have	
		2. We depend too much on science and not enough on God/faith
		3. Science and technology cannot really play a role in improving the environment
Support for immunization	1. Do you support immunization against diseases such as polio, meningitis and measles	
	2. Have you been vaccinated against any disease as a child or as an adult	
	3. When you were vaccinated, was there any reaction to the vaccine	
Basic knowledge questions	1. Electrons are smaller than atoms	1. Electrons are smaller than atoms
	2. The center of the earth is very hot	
	3. The oxygen we breathe comes from plants	
	4. Antibiotics kills viruses as well as bacteria	
	5. It is the father's gene which determines whether the baby is a boy or a girl	2. It is the father's gene which determines whether the baby is a boy or a girl
	6. All radioactivity is man made	
	7. The continents on which we live have been moving for millions of years and will continue to move in future	
	8. The universe began with a big explosion	
	9. Scientists will never be able to understand the working of the human mind as well as they understand the physical world	
	10. Human beings as we know them today developed from earlier species of animals	3. Human beings as we know them today developed from earlier species of animals
	11. God determines whether baby is a boy or a girl	4. It is God that determines the sex of the child
		5. It is the mother's genes that decide whether the baby is a boy or a girl
		6. It is pure luck that determines the sex of the child
Knowledge of the working of scientific institutions	1. Scientific results are checked by scientific experts before they are made public	
	2. All scientists normally agree on the outcome of a particular experiment	
	3. Science is composed of proven facts	
Understanding the mode of scientific investigation	a. Talk to their patients who have used the drug to get their opinion	
	b. Use their knowledge of medicine to decide how	

	good the drug is	
	c. Give the drug randomly to some patients but not to others then compare what happens to each group	
	d. Don't know	
Understanding genetics	a. If they have only three children, none will have the illness	
	b. If their first child has the illness the next three will not	
	c. Each of the couple's children has the same risk of suffering from the illness	
	d. If their first three children are healthy, the fourth will have the illness	
	e. Don't know	
Trust in Institutions	1. Politicians	
	2. Religious leaders	
	3. Scientists/professors	
	4. Military leaders	
	5. The Judiciary	
	6. Foreign NGO's (WHO, UNICEF, etc)	
	7. Local NGO's (human rights, democracy, etc)	
Health and well being	1. Western medical practice	
	2. Traditional herbs	
	3. Prayers	
	4. African medical/native doctor	
	5. I don't have health problems	
Horoscope	1. How often do you read a personal horoscope report?	
	2. How seriously do you take what these reports say?	
	3. How true is the statement that everyone has his own destiny?	
Religious belief	On a scale of zero to six, how much guidance does religion play in your daily life	On a seven point scale how religious are
Which of the following best describes your main religious affiliation	1. Atheist (non-believer)	
	2. Agnostic (neither believe nor disbelieve)	
	3. Christian	
	4. Moslem	
	5. Traditionalist	
	6. Others (Please Specify)	
Sex		Sex
Age		Age
Which of the country's six zones do you associate with	1. North Central (plus Abuja)	
	2. North East	
	3. North West	
	4. South East	
	5. South South	
	6. South West	
Place of domicile		Nigeria/Abroad

Appendix 5 Expanded (main) survey

Table of frequencies (N=377)

Interest and being informed			
Interest in Sports	Per cent	Informed sports	Per cent
Very interested	39.5	Very well informed	36.9
Moderately interested	47.2	Moderately informed	44.3
Not at all interested	10.3	Poorly informed	15.9
Don't know	1.6	Don't know	0.8
Missing	1.3	Missing	2.1
Interest in Politics			
Very interested	22.3	Very well informed	21.2
Moderately interested	46.7	Moderately informed	53.1
Not at all interested	25.5	Poorly informed	19.4
Don't know	3.2	Don't know	3.2
Missing	2.4	Missing	3.2
Interest in new scientific discoveries			
Very interested	33.4	Very well informed	19.6
Moderately interested	39.3	Moderately informed	43.8
Not at all interested	18	Poorly informed	28.6
Don't know	5.8	Don't know	3.7
Missing	3.4	Missing	4.2
Interest in culture and arts			
Very interested	24.1	Very well informed	19.1
Moderately interested	57	Moderately informed	53.1
Not at all interested	12.2	Poorly informed	21.5
Don't know	3.4	Don't know	2.9
Missing	3.2	Missing	3.4
Interest in current affairs			
Very interested	42.2	Very well informed	31
Moderately interested	49.1	Moderately informed	53.8
Not at all interested	4.8	Poorly informed	9.5
Don't know	1.9	Don't know	1.6
Missing	2.1	Missing	4
Interest in new medical discoveries			
Very interested	35.5	Very well informed	20.2
Moderately interested	39	Moderately informed	38.2
Not at all interested	19.1	Poorly informed	32.6
Don't know	3.4	Don't know	4.2
Missing	2.9	Missing	4.8
Interest in entertainment			
Very interested	44.6	Very well informed	42.4
Moderately interested	45.1	Moderately informed	39.8
Not at all interested	5.8	Poorly informed	12.5
Don't know	2.4	Don't know	2.1
Missing	2.1	Missing	3.2
Interest in religion			
Very interested	61.8	Very well informed	51.2
Moderately interested	30.8	Moderately informed	38.2
Not at all interested	4	Poorly informed	6.4

Don't know	2.1	Don't know	2.1
Missing	1.3	Missing	2.1
Engagement with science and religion			
Engage read and watch science		Engage read religion	
Daily	16.7	Daily	25.2
Weekly	34.2	Weekly	39.3
Monthly	19.6	Monthly	19.6
Once or twice a year	19.4	Once or twice a year	10.3
Never	9	Never	4
Missing	1.1	Missing	1.6
Engage attend science activities		Engage attend religious activities	
Daily	2.4	Daily	24.7
Weekly	3.7	Weekly	55.4
Monthly	12.5	Monthly	10.9
Once or twice a year	36.1	Once or twice a year	3.7
Never	43.2	Never	2.9
Missing	2.1	Missing	2.4
Engage donate science research		Engage donate religion causes	
Daily	0.8	Daily	10.6
Weekly	2.4	Weekly	39.3
Monthly	8.8	Monthly	24.7
Once or twice a year	26	Once or twice a year	17
Never	60.5	Never	5.3
Missing	1.6	Missing	3.2
Fundamental attitude to the world			
Fascinated by the beauty	54.6		
Thinking of how much granite	5.6		
Thinking of how unimportant you are	10.9		
Set up a tourist center and generate income	21		
Missing	8		
Attitude to science			
Attitude to job opportunities		Att science makes lives healthier	
Totally agree	21.8	Totally agree	17.5
Agree	37.9	Agree	38.2
Neither agree nor disagree	20.4	Neither agree nor disagree	24.7
Disagree	13.5	Disagree	9.8
Totally disagree	2.7	Totally disagree	2.4
Don't know	2.4	Don't know	3.2
Missing	1.3	Missing	4.2
Att science and worry		Att few people control our lives	
Totally agree	12.7	Totally agree	8.8
Agree	27.9	Agree	25.7
Neither agree nor disagree	25.7	Neither agree nor disagree	25.5
Disagree	22.8	Disagree	23.6
Totally disagree	6.6	Totally disagree	4.2
Don't know	2.4	Don't know	8
Missing	1.9	Missing	4.2
Att knowledge makes scientists dangerous		Att science sort out any problem	
Totally agree	11.7	Totally agree	6.6

Agree	23.9	Agree	17.2
Neither agree nor disagree	22.5	Neither agree nor disagree	24.9
Disagree	22.8	Disagree	34.5
Totally disagree	7.2	Totally disagree	9.8
Don't know	9	Don't know	1.6
Missing	2.9	Missing	5.3
Att new inventions counteract harmful ones		Att scientists want to make life better	
Totally agree	7.2	Totally agree	23.6
Agree	38.5	Agree	49.9
Neither agree nor disagree	27.6	Neither agree nor disagree	13.5
Disagree	12.5	Disagree	5
Totally disagree	2.9		
Don't know	8	Don't know	4.8
Missing	3.4	Missing	3.2
Att science makes lives easier more comfortable		Att science and complete picture of universe	
Totally agree	31	Totally agree	17.8
Agree	49.6	Agree	27.3
Neither agree nor disagree	12.7	Neither agree nor disagree	27.1
Disagree	3.4	Disagree	15.1
Totally disagree	1.1	Totally disagree	5
Don't know	0.5	Don't know	4.8
Missing	1.6	Missing	2.9
Att science responsible environmental problems		Att on balance, benefits greater than harm	
Totally agree	17.2	Totally agree	17.5
Agree	27.1	Agree	43.8
Neither agree nor disagree	27.1	Neither agree nor disagree	20.2
Disagree	18.8	Disagree	5.6
Totally disagree	5	Totally disagree	2.7
Don't know	2.9	Don't know	7.7
Missing	1.9	Missing	2.7
Att science makes life change too fast			
Totally agree	23.6		
Agree	50.1		
Neither agree nor disagree	14.9		
Disagree	5.6		
Totally disagree	1.6		
Don't know	1.6		
Missing	2.7		
Attitude to immunization			
Do you support immunization		When you were immunized was there any reaction	
Yes	91.5	Yes	23.1
No	5	No	57.3
Don't know	2.4	Don't know	17
Missing	1.1	Missing	2.7
Have you been immunized			
Yes	87.8		

No	8.2		
Don't know	1.6		
Missing	2.4		
Knowledge of science			
Electrons are smaller than atoms		Oxygen breathe comes from plants	
TRUE	35	TRUE	68.7
FALSE	36.1	FALSE	14.9
Don't know	21.5	Don't know	9
Missing	7.4	Missing	7.4
The center of the earth is very hot		Antibiotics kills viruses as well as bacteria	
TRUE	45.9	TRUE	61.3
FALSE	17	FALSE	25.2
Don't know	29.2	Don't know	9
Missing	8	Missing	4.5
All radioactivity is man made		Father's gene determines baby is a boy or a girl	
TRUE	28.9	TRUE	69.5
FALSE	41.6	FALSE	14.3
Don't know	22.3	Don't know	11.1
Missing	7.2	Missing	5
The universe began with a big explosion		Scientists will never understand the human mind	
TRUE	19.9	TRUE	54.1
FALSE	41.6	FALSE	23.3
Don't know	32.6	Don't know	18.3
Total	94.2	Missing	4.2
The continents have been moving for millions of years		Human beings developed from earlier species of animals	
TRUE	57.8	TRUE	37.4
FALSE	13.5	FALSE	44.3
Don't know	23.1	Don't know	13.5
Missing	5.6	Missing	4.8
God determines whether baby is a boy or a girl			
TRUE	74.5		
FALSE	13		
Don't know	10.1		
Missing	2.4		
Knowledge of the working of scientific institutions			
Scientific results are checked by scientific experts		Science is composed of proven facts	
Totally agree	37.9	Totally agree	36.6
Agree	46.7	Agree	43.5
Neither agree nor disagree	7.2	Neither agree nor disagree	10.1
Disagree	1.1	Disagree	3.2
Totally disagree	0.8	Totally disagree	0.3
Don't know	4	Don't know	4
Missing	2.4	Missing	2.4
All scientists agree on the outcome of a particular experiment			

Totally agree	14.6		
Agree	30.8		
Neither agree nor disagree	16.2		
Disagree	28.4		
Totally disagree	1.9		
Don't know	5.3		
Missing	2.9		
Understanding of the mode of scientific investigation			
1	20.4		
2	13.3		
3	50.1		
4	12.5		
Missing	3.7		
Understanding genetics			
1	3.2		
2	12.7		
3	35		
4	29.2		
5	17		
Missing	2.9		
Trust in public institutions			
Trust in politicians		Trust in military leaders	
No trust	56.2	No trust	23.3
1	16.2	1	19.4
2	8.5	2	11.9
3	4	3	15.4
4	0.5	4	10.3
5	1.1	5	4
Complete trust	1.6	Complete trust	2.9
Missing	11.9	Missing	12.7
Trust in religious leader		Trust in Judiciary	
No trust	6.9	No trust	14.9
1	6.4	1	11.1
2	10.1	2	16.4
3	15.1	3	19.1
4	19.9	4	16.2
5	16.7	5	6.9
Complete trust	15.1	Complete trust	1.9
Missing	9.8	Missing	13.5
Trust in local NGO's		Trust in foreign NGO's	
No trust	8.5	No trust	6.6
1	10.6	1	5.8
2	10.9	2	7.4
3	20.7	3	12.5
4	15.1	4	14.9
5	12.7	5	24.1
Complete trust	8	Complete trust	17
Missing	13.5	Missing	11.7
Trust in Scientists and professors			
No trust	3.7		
1	4.5		
2	12.2		

3	20.2		
4	17.5		
5	19.6		
Complete trust	11.1		
Missing	11.1		
What you consider first option for health		What you consider second option for health	
Western medicine	54.6	Western medicine	29.2
Traditional herbs	6.4	Traditional herbs	20.2
Prayers	24.1	Prayers	34.2
African medical practice	4.2	African medical practice	3.4
I don't have health problems	8.5	I don't have health problems	10.3
Missing	2.1	Missing	2.7
Personal Horoscope			
How often do you read horoscope report		How seriously do you take what horoscope says	
Weekly or more	9.3	Very seriously	2.4
Every month	8.2	Seriously	16.2
Once or twice a year	27.3	Not very seriously	22
Never	52.8	Not at all seriously	15.6
Missing	2.4	Not applicable	40.8
		Missing	2.9
Religious affiliations			
How true is the statement everyone has his own destiny		How much guidance does religion play in your life	
Definitely true	51.5	No guidance	0.5
Probably true	26.5	1	3.2
Probably false	7.4	2	3.4
Definitely false	4.8	3	5.3
Don't know	8	4	11.4
Missing	1.9	5	24.9
		Total guidance	47.7
		Missing	3.4
What is your main religious affiliation		What other religious affiliation has influence in your life	
Atheist	1.3	Atheist	1.6
Agnostic	2.1	Agnostic	4.5
Christian	78	Christian	49.1
Moslem	14.1	Moslem	14.1
Traditionalist	2.4	Traditionalist	2.7
Others	0.5	Others	1.9
Missing	1.6	Missing	26.3
Demographics			
Sex		Zone associate with	
Male	41.6	North central plus Abuja	6.6
Female	54.1	North east	2.7
Missing	4.2	North west	5.8
		South east	13.8
Education		South south	11.1
Primary	0.8	South west	55.7
Secondary	3.7	Missing	4.2
Above secondary	85.1		

Missing	10.3		
Recoded variables			
Recoded age groups			
29 and below	28.1		
30 to 39	25.5		
40 and above	32.1		
missing	14.3		
Recoded fundamental attitude to the world			
Vertical (existential, aesthetic)	65.5		
Horizontal (Engineering, entrepreneurial)	26.5		
Missing	8		
recoded support for immunization			
Otherwise	7.4		
Support	91.5		
System	1.1		
Recoded knowledge questions			
Recoded electrons smaller than atoms		Recoded continents have been moving for millions of years	
Otherwise	57.6	Otherwise	36.6
Correct	35	Correct	57.8
System	7.4	System	5.6
Recoded center of earth is hot		Recoded antibiotics kill viruses as well as bacteria	
Otherwise	46.2	Otherwise	70.3
Correct	45.9	Correct	25.2
System	8	System	4.5
Recoded oxygen we breathe comes from plants		Recoded all radioactivity is man made	
Otherwise	23.9	Otherwise	51.2
Correct	68.7	Correct	41.6
System	7.4	System	7.2
Recoded fathers gene decides sex		Recoded God determines baby is boy or girl	
Otherwise	25.5	Otherwise	84.6
Correct	69.5	Correct/Disagree	13
System	5	System	2.4
Recoded God determines baby is boy or girl			
Otherwise	23.1		74.3
Agree	74.5		19.9
Missing	2.4		5.8
Recoded universe began with a big explosion as correct		Recoded universe began with a big explosion	
Otherwise	72.4	Otherwise	52.5
Correct	23.3	FALSE	41.6
Missing	4.2	System	5.8
Recoded scientist will never be able to understand the human mind		Recoded scientist will never be able to understand the human mind as false (optimistic)	
Otherwise	41.6	Otherwise	

True (pessimistic)	54.1	Correct (optimistic)	
System	4.2	Missing	
Recoded human being developed from earlier species of animals as correct		Recoded human being developed from earlier species of animals	
Otherwise	57.8	Otherwise	50.9
Correct	37.4	FALSE	44.3
Missing	4.2	System	4.8
Recoded all scientists agree on the outcome of a particular experiment		Recoded scientific results are checked by experts	
Otherwise	51.7	Otherwise	13
Agree	45.4	Agree	84.6
System	2.9	System	2.4
Recoded science is composed of proven facts			
Otherwise	17.5		
Agree	80.1		
System	2.4		
Recoded understanding mode of scientific investigation		Recoded understanding genetics	
Otherwise	46.2	Otherwise	62.1
Correct	50.1	Correct	35
System	3.7	System	2.9
Recoding understanding genetics male		Recoding understanding genetics female	
Otherwise	55.9	Otherwise	68.7
Correct	44.1	Correct	31.3
Recoded knowledge index Male		Recoded knowledge index Female	
Low	25.2	Low	22.8
Mid	42.9	Mid	43.8
High	31.9	High	33.3
Knowledge index		Recoded knowledge index 3	
0	1.3	Low	19.6
1	5	Mid	33.4
2	13.3	High	24.9
3	17.2	System	22
4	16.2		
5	13		
6	10.1		
7	1.9		
System	22		
Trust religious leaders (binary)		Trust scientists/professors (binary)	
otherwise	23.3	otherwise	20.4
trust religious leaders	66.8	Trust scientists	68.4
Recoded religious affiliation			
Recoded how true is statement everyone has destiny		Recoded religiosity 3 options	
Otherwise	20.2	Weak	23.9

TRUE	78	Strong	24.9
System	1.9	Maximum	47.7
		System	3.4
Recoded belief in destiny as 3 options			
DK	8	Recoded religiosity binary	
FALSE	12.2	Otherwise	48.8
TRUE	78	very strong belief	47.7
System	1.9	System	3.4
Recoded attitudes in increasing positive image of science			
Attitude to job opportunities reversed to increasing positive image of science		Attitude to few could control our lives in increasing positive image of science	
1	2.7	1	8.8
2	13.5	2	25.7
3	22.8	3	33.4
4	37.9	4	23.6
5	21.8	5	4.2
System	1.3	System	4.2
Attitude to worried about science in increasing positive image of science		Attitude to sort problems reversed to increasing positive image of science	
1	12.7	1	9.8
2	27.9	2	34.5
3	28.1	3	26.5
4	22.8	4	17.2
5	6.6	5	6.6
System	1.9	System	5.3
Attitude to lives healthier reversed to increasing positive image of science		Attitude to scientists power makes them dangerous in positive image of science	
1	2.4	1	11.7
2	9.8	2	23.9
3	27.9	3	31.6
4	38.2	4	22.8
5	17.5	5	7.2
System	4.2	System	2.9
Attitude to universe complete reversed to increasing positive image of science		Attitude to counter harm reversed to increasing positive image of science	
1	5	1	2.9
2	15.1	2	12.5
3	31.8	3	35.5
4	27.3	4	38.5
5	17.8	5	7.2
System	2.9	System	3.4
Attitude to benefits greater than harm reversed to increasing positive image of science		Attitude to lives easier and comfortable reversed to increasing positive image of science	
1	2.7	1	1.1
2	5.6	2	3.4
3	27.9	3	13.3
4	43.8	4	49.6
5	17.5	5	31

System	2.7	System	1.6
Attitude to science makes way of life change too fast in the positive image of science		Attitude to science responsible for environmental problems in positive image	
1	23.6	1	17.2
2	50.1	2	27.1
3	16.4	3	30
4	5.6	4	18.8
5	1.6	5	5
System	2.7	System	1.9
Attitude to lives better reversed to increasing positive image of science			
2	5		
3	18.3		
4	49.9		
5	23.6		
System	3.2		
Recoded attitude facets			
Pessimism about science factor (Binned)		Progress of science factor (Binned)	
otherwise	41.4	otherwise	41.1
pessimism	38.5	progress	38.7
System	20.2	System	20.2
Fear of science factor (Binned)			
otherwise	38.5		
fear	41.4		
System	20.2		
Recoded attitude facets (3)			
Pessimism about science		Progress of science	
Low	31.8	Low	31.8
mid	15.9	mid	15.9
high	32.1	high	32.1
System	20.2	System	20.2
Fear of science			
Low	31.6		
mid	15.9		
high	32.1		
System	20.4		
Recoded trust facets			
Trust in independents as dummy		Trust in faith as dummy	
otherwise	41.4	otherwise	39.3
trust in Independents	41.1	trust in faith	43.2
Trust in public service dummy			
Otherwise	47.2		
Trust in public service	35.3		

Syntax for recoded variables

RECODE Age (MISSING=SYSMIS) (0 thru 29=1) (30 thru 39=2) (40 thru 70=3) INTO Rec_Age_grps.

VARIABLE LABELS Rec_Age_grps 'Recoded age into groups'.
RECODE Attitude_Fund (1=1) (2=2) (3=1) (4=2) (MISSING=SYSMIS) INTO Rec_Atti_Fund.
VARIABLE LABELS Rec_Atti_Fund 'Recoded fundamental attitude to the world'.
RECODE K_Electrons (1=1) (2=0) (3=0) (MISSING=SYSMIS) INTO Rec_K_Electrons.
VARIABLE LABELS Rec_K_Electrons 'Recoded electrons smaller than atoms'.
RECODE K_earth (1=1) (2=0) (3=0) (MISSING=SYSMIS) INTO Rec_K_Earth.
VARIABLE LABELS Rec_K_Earth 'Recoded centre of earth is hot'.
RECODE K_Oxygen (1=1) (2=0) (3=0) (MISSING=SYSMIS) INTO Rec_K_Oxygen.
VARIABLE LABELS Rec_K_Oxygen 'Recoded oxygen we breathe comes from plants'.
RECODE K_Antibiotics (2=1) (1=0) (3=0) (MISSING=SYSMIS) INTO Rec_K_Antibiotics.
VARIABLE LABELS Rec_K_Antibiotics 'Recoded antibiotics kill viruses as well as bacteria'.
RECODE K_Fathers_gene (1=1) (2=0) (3=0) (MISSING=SYSMIS) INTO Rec_Fathers_gene.
VARIABLE LABELS Rec_Fathers_gene 'Recoded fathers gene decides sex'.
RECODE K_Radioactivity (2=1) (1=0) (3=0) (MISSING=SYSMIS) INTO Rec_K_Radioactivity.
VARIABLE LABELS Rec_K_Radioactivity 'recoded all radioactivity is man-made'.
RECODE K_Continents (1=1) (2=0) (3=0) (MISSING=SYSMIS) INTO Rec_K_Continents.
VARIABLE LABELS Rec_K_Continents 'Recoded continents have been moving for millions of years'.
RECODE K_Uni_Explosion (1=1) (2=0) (3=0) (MISSING=SYSMIS) INTO Rec_K_Uni_Explo_Corr.
VARIABLE LABELS Rec_K_Uni_Explo_Corr 'Recoded universe began with big explosion as correct'.
RECODE K_Uni_Explosion (2=1) (1=0) (3=0) (MISSING=SYSMIS) INTO Rec_K_Uni_Explosion.
VARIABLE LABELS Rec_K_Uni_Explosion 'Recoded universe began with a big explosion_False'.
RECODE K_Sci_Hum_Mind (2=1) (1=0) (3=0) (MISSING=SYSMIS) INTO
Rec_K_Sci_Hum_Mind_Correc.
VARIABLE LABELS Rec_K_Sci_Hum_Mind_Corre 'Recoded science never understand human mind
sci correct'.
RECODE K_Sci_Hum_Mind (1=1) (2=0) (3=0) (MISSING=SYSMIS) INTO Rec_Sci_Hum_Min.
VARIABLE LABELS Rec_Sci_Hum_Min 'Recoded scientist will never be able to understand the human
mind_True
RECODE K_Hum_Fro_Ani (1=1) (2=0) (3=0) (MISSING=SYSMIS) INTO Rec_Hum_Fro_Ani_Corr.
VARIABLE LABELS Rec_Hum_Fro_Ani_Corr 'Recoded humans developed from earlier species of
animals_Sci correct'.
RECODE K_Hum_Fro_Ani (2=1) (1=0) (3=0) (MISSING=SYSMIS) INTO Rec_Hum_Fro_Ani.
VARIABLE LABELS Rec_Hum_Fro_Ani 'Recoded human being developed from earlier species of
animals_False'.
RECODE K_God_Sex (2=1) (1=0) (3=0) (MISSING=SYSMIS) INTO Rec_God_Sex_Corr.
VARIABLE LABELS Rec_God_Sex_Corr 'Recoded God decided sex sci correct'.
RECODE K_God_Sex (1=1) (2=0) (3=0) (MISSING=SYSMIS) INTO Rec_God_sex.
VARIABLE LABELS Rec_God_sex 'Recoded God decides sex true'.
RECODE K_Res_Experts (1=1) (2=1) (3=0) (4=0) (5=0) (6=0) (MISSING=SYSMIS) INTO
Rec_K_Res_Experts.
VARIABLE LABELS Rec_K_Res_Experts 'Recoded scientific results are checked by experts'.
RECODE K_Sci_Agree (1=1) (2=1) (3=0) (4=0) (5=0) (6=0) (MISSING=SYSMIS) INTO
Rec_Sci_Agree.
VARIABLE LABELS Rec_Sci_Agree 'Recoded all scientists agree on the outcome of a particular
experiment'.
RECODE K_Sci_Facts (1=1) (2=1) (3=0) (4=0) (5=0) (6=0) (MISSING=SYSMIS) INTO
Rec_K_Sci_Facts.
VARIABLE LABELS Rec_K_Sci_Facts 'Recoded science is composed of proven facts'.

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RECODE K_sic_investigate (3=1) (1=0) (2=0) (4=0) (MISSING=SYSMIS) INTO
Rec_K_Sci_Investigate.
VARIABLE LABELS Rec_K_Sci_Investigate 'Recoded understanding mode of scientific investigation'.
RECODE K_Genetics (3=1) (1=0) (2=0) (4=0) (5=0) (MISSING=SYSMIS) INTO Rec_K_Genetics.
VARIABLE LABELS Rec_K_Genetics 'Recoded understanding genetics'.
RECODE Imm_Support (1=0) (2=1) (3=1) INTO Immunization_N_support.
VARIABLE LABELS Immunization_N_support 'recoded opposition to immunization'.
RECODE H_Horos_destiny (1=1) (2=1) (3=0) (4=0) (5=0) (MISSING=SYSMIS) INTO
Recoded_destiny_true.
VARIABLE LABELS Recoded_destiny_true 'Recoded destiny is true'.
RECODE H_Horos_destiny (1=2) (2=2) (3=1) (4=1) (5=0) (MISSING=SYSMIS) INTO
Rec_belief_destiny.
VARIABLE LABELS Rec_belief_destiny 'Recoded belief in destiny as 3 options'.
RECODE R_Belief_Scale (0=0) (1=0) (2=0) (3=0) (4=0) (5=1) (6=2) (MISSING=SYSMIS) INTO
Rec_R_Belief_Scale_3_options.
VARIABLE LABELS Rec_R_Belief_Scale 'Recoded scale of religious belief'.
RECODE R_Belief_Scale (0=0) (1=0) (2=0) (3=0) (4=0) (5=0) (6=1) (SYSMIS=SYSMIS) INTO
Rec_Rel_belief_Scale2.
VARIABLE LABELS Rec_Rel_belief_Scale2 'Recoded religious belief two options'.
COMPUTE Att_Job_oppo_5_rev_posit_image=6 - Rec._Att_Job_Opp_5.
VARIABLE LABELS Att_Job_oppo_5_rev_posit_image 'Attitude to job opportunities reversed to
increasing positive image of science'.
COMPUTE Att_lives_healthier_5_rev_posit_image=6 - Rec_Att_Lives_Healthier_5.
VARIABLE LABELS Att_lives_healthier_5_rev_posit_image 'Attitude to lives healthier reversed to
increasing positive image of science'.
COMPUTE Att_Sort_Prob_5_rev_posit_image=6 - Rec_Att_Sort_Prob_5.
VARIABLE LABELS Att_Sort_Prob_5_rev_posit_image 'Attitude to sort problems reversed to
increasing positive image of science'.
COMPUTE Att_Count_Harm_5_rev_posit_image=6 - Rec_Att_Count_Harm_5.
VARIABLE LABELS Att_Count_Harm_5_rev_posit_image 'Attitude to counter harm reversed to
increasing positive image of science'.
COMPUTE Att_Easier_Comfort_5_rev_posit_image=6 - Rec_Att_Easier_Comfort_5.
VARIABLE LABELS Att_Easier_Comfort_5_rev_posit_image 'Attitude to lives easier and comfortable
reversed to increasing positive image of science'.
COMPUTE Att_Lives_better_5_rev_posit_image=6 - Rec_Att_Lives_Better_5.
VARIABLE LABELS Att_Lives_better_5_rev_posit_image 'Attitude to scientists want to make lives
better reversed to increasing positive image of science'.
COMPUTE Att_Universe_complete_5_rev_posit_image=6 - Rec_Att_Universe_Comp_5.
VARIABLE LABELS Att_Universe_complete_5_rev_posit_image 'Attitude to universe complete
reversed to increasing positive image of science'.
COMPUTE Att_ben_harm_5_rev_posit_image=6 - Rec_Att_Ben_Harm_5.
VARIABLE LABELS Att_ben_harm_5_rev_posit_image 'Attitude to benefits greater than harm
reversed to increasing positive image of science'.
COMPUTE Knowledgeindex=Rec_K_Electrons + Rec_K_Earth + Rec_K_Oxygen + Rec_Fathers_gene +
Rec_K_Continents + Rec_K_Antibiotics + Rec_K_Radioactivity.
RECODE Knowledgeindex (0=0) (1=0) (2=0) (3=0) (4=1) (5=1) (6=1) (7=1) (MISSING=SYSMIS) INTO
Rec_knowledge_2.
VARIABLE LABELS Rec_knowledge_2 'Recoded knowledge index into binary'.

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RECODE Knowledgeindex (0=0) (1=0) (2=0) (3=1) (4=1) (5=2) (6=2) (7=2) INTO
Rec_Knowledgeindex_3.
VARIABLE LABELS Rec_Knowledgeindex_3 'Recoded knowledgeindex 3'.
* Visual Binning.
*FAC1_1_Pessimism.
RECODE FAC1_1_Pessimism (MISSING=COPY) (LO THRU 0=1) (LO THRU HI=2) (ELSE=SYSMIS)
INTO Pessimismscience.
VARIABLE LABELS Pessimismscience 'Pessimism factor (Binned)'.
FORMATS Pessimismscience (F5.0).
VALUE LABELS Pessimismscience 1 '= .00000' 2 '.00001+'.
VARIABLE LEVEL Pessimismscience (ORDINAL).
* Visual Binning.
*FAC2_1_Progress.
RECODE FAC2_1_Progress (MISSING=COPY) (LO THRU 0=1) (LO THRU HI=2) (ELSE=SYSMIS)
INTO Progress_science.
VARIABLE LABELS Progress_science 'Progress factor (Binned)'.
FORMATS Progress_science (F5.0).
VALUE LABELS Progress_science 1 '= .00000' 2 '.00001+'.
VARIABLE LEVEL Progress_science (ORDINAL).
* Visual Binning.
*FAC3_1_Fear.
RECODE FAC3_1_Fear (MISSING=COPY) (LO THRU 0=1) (LO THRU HI=2) (ELSE=SYSMIS)
INTO Fear_science.
VARIABLE LABELS Fear_science 'Fear factor (Binned)'.
FORMATS Fear_science (F5.0).
VALUE LABELS Fear_science 1 '= .00000' 2 '.00001+'.
VARIABLE LEVEL Fear_science (ORDINAL).
RECODE Pessimism_science (1=0) (2=1) INTO Pessimism_sci_dum.
VARIABLE LABELS Pessimism_sci_dum 'Pessimism of science factor'.
RECODE Progress_science (1=0) (2=1) INTO Progress_science_dum.
VARIABLE LABELS Progress_science_dum 'Progress of science factor dummy variable'.
RECODE Fear_science (1=0) (2=1) INTO Fear_Sci_dum.
VARIABLE LABELS Fear_Sci_dum 'Fear of science dummy variable'.
RECODE T_Religious_Leaders (0 thru 2=0) (3 thru 6=1) INTO T_religious_leaders_binary.
VARIABLE LABELS T_religious_leaders_binary 'Trust in religious leaders as binary'.
RECODE T_ScientistsProfessors (0 thru 2=0) (3 thru 6=1) INTO T_ScientistsProfessors_binary.
VARIABLE LABELS T_ScientistsProfessors_binary 'Trust in scientists and professors as binary'.
RECODE Knowledgeindex (0 thru 3=0) (4 thru 7=1) INTO Knowledgeindex_binary.
VARIABLE LABELS Knowledgeindex_binary 'Knowledge index as binary'.
RECODE T_ScientistsProfessors (MISSING=SYSMIS) (0 thru 2=0) (3 thru 4=1) (4 thru 6=2) INTO
T_Scientists_3.
VARIABLE LABELS T_Scientists_3 'Trust in scientists as low, mid and high'.
* Visual Binning.
*FAC1_2_Independents.
RECODE FAC1_2_Independents (MISSING=COPY) (LO THRU 0=1) (LO THRU HI=2)
(ELSE=SYSMIS) INTO Trust_independents.
VARIABLE LABELS Trust_independents 'Independents factor (Binned)'.
FORMATS Trust_independents (F5.0).
VALUE LABELS Trust_independents 1 '= .00000' 2 '.00001+'.

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VARIABLE LEVEL Trust_independents (ORDINAL).
EXECUTE.
* Visual Binning.
*FAC2_2_Faith.
RECODE FAC2_2_Faith (MISSING=COPY) (LO THRU 0=1) (LO THRU HI=2) (ELSE=SYSMIS)
INTO Trust_Faith.
VARIABLE LABELS Trust_Faith 'Faith factor (Binned)'.
FORMATS Trust_Faith (F5.0).
VALUE LABELS Trust_Faith 1 '= .00000' 2 '.00001+'.
VARIABLE LEVEL Trust_Faith (ORDINAL).
* Visual Binning.
*FAC3_2_Public_service.
RECODE FAC3_2_Public_service (MISSING=COPY) (LO THRU 0=1) (LO THRU HI=2)
(ELSE=SYSMIS) INTO Trust_public_service.
VARIABLE LABELS Trust_public_service 'Public service factor (Binned)'.
FORMATS Trust_public_service (F5.0).
VALUE LABELS Trust_public_service 1 '= .00000' 2 '.00001+'.
VARIABLE LEVEL Trust_public_service (ORDINAL).
RECODE Trust_independents (1=0) (2=1) INTO Trust_Independents_dumm.
VARIABLE LABELS Trust_Independents_dumm 'Trust in independents as dummy'.
RECODE Trust_Faith (1=0) (2=1) INTO Trust_faith_dum.
VARIABLE LABELS Trust_faith_dum 'Trust in faith as dumm'.
RECODE Trust_public_service (1=0) (2=1) INTO Trust_public_service_dum.
VARIABLE LABELS Trust_public_service_dum 'Trust in public service dummy'.

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Appendix 6 Binary regression for main survey (N377)

Progress of science factor

Progress of science	B	df	Sig.	Exp(B)	(Exp(B)-1)X100	95% C.I.for EXP(B)			
						Lower	(Lower-1)*100	Upper	(Upper-1)*100
Gender (Male)	0.16	1	0.608	1.174	17.4	0.636	-36.4	2.166	116.6
R_Age_ > 29		2	0.417				-100		-100
R_Age_30-39	-0.207	1	0.589	0.813	-18.7	0.385	-61.5	1.721	72.1
R_Age_40+	0.282	1	0.439	1.326	32.6	0.649	-35.1	2.711	171.1
Constant	-0.103	1	0.696	0.902					
Gender (Male)	0.207	1	0.527	1.23	23	0.647	-35.3	2.337	133.7
R_Age_ > 29		2	0.577						
R_Age_30-39	-0.267	1	0.503	0.766	-23.4	0.351	-64.9	1.672	67.2
R_Age_40+	0.146	1	0.709	1.157	15.7	0.538	-46.2	2.489	148.9
T_Science (binary)	0.94	1	0.015	2.559	155.9	1.198	19.8	5.464	446.4
Rec_Know_low		2	0.024				-100		-100
Rec_Know_Mid	1.037	1	0.012	2.82	182	1.258	25.8	6.317	531.7
Rec_Know_High	0.343	1	0.433	1.409	40.9	0.598	-40.2	3.321	232.1
Constant	-1.372	1	0.006	0.254					
Gender (Male)	0.142	1	0.684	1.153	15.3	0.582	-41.8	2.285	128.5
R_Age_ > 29		2	0.39						
R_Age_30-39	-0.587	1	0.183	0.556	-44.4	0.234	-76.6	1.319	31.9
R_Age_40+	-0.184	1	0.666	0.832	-16.8	0.36	-64	1.92	92
T_Science (binary)	1.113	1	0.007	3.042	204.2	1.349	34.9	6.859	585.9
R_Know_low		2	0.021						
R_Know_Mid	1.219	1	0.006	3.384	238.4	1.423	42.3	8.047	704.7
R_Know_High	0.698	1	0.139	2.01	101	0.798	-20.2	5.061	406.1
R_Relig_Weak		2	0.022						
R_Relig_Strong	-0.988	1	0.032	0.372	-62.8	0.151	-84.9	0.919	-8.1
R_Relig_VStrong	0.141	1	0.732	1.152	15.2	0.513	-48.7	2.584	158.4
R_A_Fun engr	0.055	1	0.883	1.057	5.7	0.507	-49.3	2.203	120.3
R_destiny_true	1.273	1	0.007	3.571	257.1	1.419	41.9	8.983	798.3
Constant	-2.299	1	0.001	0.1					

Pessimism about science factor

Pessimism about science	B	df	Sig.	Exp(B)	(Exp(B)-1)X100	95% C.I.for EXP(B)			
						Lower	(Lower-1)*100	Upper	(Upper-1)*100
Gender (Male)	-0.067	1	0.83	0.935	-6.5	0.508	-49.2	1.723	72.3
R_Age_ > 29		2	0.544						
R_Age_30-39	-0.39	1	0.307	0.677	-32.3	0.32	-68	1.431	43.1
R_Age_40+	-0.32	1	0.381	0.726	-27.4	0.355	-64.5	1.484	48.4
Constant	0.268	1	0.31	1.307					
Gender (Male)	-0.045	1	0.889	0.956	-4.4	0.51	-49	1.792	79.2

R_Age_ > 29		2	0.428						
R_Age_30-39	-0.476	1	0.227	0.621	-37.9	0.287	-71.3	1.345	34.5
R_Age_40+	-0.393	1	0.307	0.675	-32.5	0.317	-68.3	1.434	43.4
T_Science (binary)	0.961	1	0.012	2.615	161.5	1.235	23.5	5.534	453.4
Rec_Know_low		2	0.288						
Rec_Know_Mid	0.636	1	0.116	1.889	88.9	0.854	-14.6	4.18	318
Rec_Know_High	0.478	1	0.268	1.614	61.4	0.692	-30.8	3.762	276.2
Constant	-0.889	1	0.065	0.411					
Gender (Male)	-0.008	1	0.981	0.992	-0.8	0.524	-47.6	1.879	87.9
R_Age_ > 29		2	0.481		-100				
R_Age_30-39	-0.476	1	0.243	0.621	-37.9	0.28	-72	1.381	38.1
R_Age_40+	-0.346	1	0.383	0.708	-29.2	0.326	-67.4	1.538	53.8
T_Science (binary)	1.031	1	0.009	2.804	180.4	1.294	29.4	6.078	507.8
R_Know_low		2	0.301						
R_Know_Mid	0.634	1	0.122	1.885	88.5	0.845	-15.5	4.207	320.7
R_Know_High	0.448	1	0.312	1.565	56.5	0.657	-34.3	3.723	272.3
R_Relig_Weak		2	0.704						
R_Relig_Strong	-0.17	1	0.693	0.843	-15.7	0.361	-63.9	1.968	96.8
R_Relig_VStrong	-0.326	1	0.404	0.722	-27.8	0.336	-66.4	1.552	55.2
R_A_Fun engr	-0.127	1	0.719	0.88	-12	0.441	-55.9	1.759	75.9
R_destiny_true	-0.327	1	0.43	0.721	-27.9	0.32	-68	1.624	
Constant	-0.473	1	0.426	0.623					

Fear of science factor

Fear of science	B	df	Sig.	Exp(B)	(Exp(B)-1)X100	95% C.I.for EXP(B)			
						Lower	(Lower-1)*100	Upper	(Upper-1)*100
Gender (Male)	0.663	1	0.04	1.94	94	1.032	3.2	3.647	264.7
R_Age_ > 29		2	0.115						
R_Age_30-39	0.649	1	0.096	1.914	91.4	0.891	-10.9	4.112	311.2
R_Age_40+	0.707	1	0.058	2.028	102.8	0.976	-2.4	4.213	321.3
Constant	-0.485	1	0.071	0.616					
Gender (Male)	0.694	1	0.036	2.002	100.2	1.046	4.6	3.834	283.4
R_Age_ > 29		2	0.142				-100		-100
R_Age_30-39	0.774	1	0.058	2.168	116.8	0.973	-2.7	4.829	382.9
R_Age_40+	0.537	1	0.167	1.711	71.1	0.799	-20.1	3.666	266.6
T_Science (binary)	-0.161	1	0.675	0.851	-14.9	0.402	-59.8	1.805	80.5
Rec_Know_low		2	0.007						
Rec_Know_Mid	-0.231	1	0.585	0.793	-20.7	0.346	-65.4	1.82	82
Rec_Know_High	-1.24	1	0.006	0.289	-71.1	0.119	-88.1	0.704	-29.6
Constant	0.166	1	0.726	1.181					
Gender (Male)	0.666	1	0.047	1.946	94.6	1.008	0.8	3.756	275.6
R_Age_ > 29		2	0.252						
R_Age_30-39	0.689	1	0.102	1.993	99.3	0.871	-12.9	4.558	355.8
R_Age_40+	0.43	1	0.283	1.537	53.7	0.701	-29.9	3.372	237.2

T_Science (binary)	-0.14	1	0.72	0.869	-13.1	0.404	-59.6	1.871	87.1
R_Know_low		2	0.014						
R_Know_Mid	-0.209	1	0.624	0.811	-18.9	0.351	-64.9	1.872	87.2
R_Know_High	-1.175	1	0.011	0.309	-69.1	0.125	-87.5	0.764	-23.6
R_Relig_Weak		2	0.594						
R_Relig_Strong	-0.437	1	0.326	0.646	-35.4	0.27	-73	1.545	54.5
R_Relig_VStrong	-0.123	1	0.758	0.884	-11.6	0.405	-59.5	1.931	93.1
R_A_Fun engr	0.13	1	0.721	1.139	13.9	0.558	-44.2	2.323	132.3
R_destiny_true	0.508	1	0.237	1.663	66.3	0.716	-28.4	3.862	286.2
Constant	-0.08	1	0.893	0.923					

Opposition to vaccination

Opposition to vaccination	B	df	Sig.	Exp(B)	(Exp(B)-1)X100	95% C.I.for EXP(B)		Upper	(Exp(B)-1)X100
						Lower	(Exp(B)-1)X100		
Gender (Male)	-1.464	1	0.031	0.231	-76.9	0.061	-93.9	0.873	-12.7
Age	0.005	1	0.819	1.005	0.5	0.962	-3.8	1.051	5.1
Constant	-1.942	1	0.012	0.143	-85.7				
Gender (Male)	-1.387	1	0.063	0.25	-75	0.058	-94.2	1.078	7.8
Age	0.017	1	0.544	1.017	1.7	0.963	-3.7	1.073	7.3
Know_2	-0.332	1	0.636	0.717	-28.3	0.182	-81.8	2.832	183.2
FAC1_Pessimism	0.6	1	0.08	1.823	82.3	0.931	-6.9	3.569	256.9
FAC2_Progress	-1.214	1	0.001	0.297	-70.3	0.142	-85.8	0.622	-37.8
FAC3_Fear	-0.087	1	0.769	0.916	-8.4	0.511	-48.9	1.643	64.3
FAC1_Independents	0.182	1	0.574	1.199	19.9	0.636	-36.4	2.262	126.2
FAC2_Faith/Science	-0.266	1	0.434	0.766	-23.4	0.393	-60.7	1.494	49.4
FAC3_Public/service	0.008	1	0.979	1.008	0.8	0.543	-45.7	1.874	87.4
Rec_Atti_Engr	-1.344	1	0.134	0.261	-73.9	0.045	-95.5	1.511	51.1
Constant	-1.205	1	0.4	0.3	-70				
Gender (Male)	-1.331	1	0.099	0.264	-73.6	0.054	-94.6	1.287	28.7
Age	0.041	1	0.204	1.042	4.2	0.978	-2.2	1.11	11
Know_2	-0.265	1	0.749	0.767	-23.3	0.151	-84.9	3.905	290.5
FAC1_1_Pessimism	0.375	1	0.345	1.455	45.5	0.668	-33.2	3.168	216.8
FAC2_Progress	-1.081	1	0.014	0.339	-66.1	0.143	-85.7	0.803	-19.7
FAC3_Fear	-0.085	1	0.791	0.918	-8.2	0.488	-51.2	1.728	72.8
FAC1_Independents	0.125	1	0.719	1.134	13.4	0.573	-42.7	2.244	124.4
FAC2_Faith/Science	-0.19	1	0.644	0.827	-17.3	0.369	-63.1	1.855	85.5
FAC3_Public/service	-0.063	1	0.866	0.939	-6.1	0.45	-55	1.956	95.6
Rec_Atti_Engr	-1.891	1	0.059	0.151	-84.9	0.021	-97.9	1.077	7.7
Rec_Relig_Weak		2	0.083						
Rec_Relig_Strong	-0.529	1	0.539	0.589	-41.1	0.109	-89.1	3.182	218.2
Rec_Relig_VStrong	-2.812	1	0.026	0.06	-94	0.005	-99.5	0.715	-28.5
Rec_destiny_true	-1.113	1	0.086	0.328	-67.2	0.092	-90.8	1.172	17.2
Constant	0.106	1	0.948	1.111					

Appendix 7 Thematic analysis of interviews

Codes to themes

Codes	Issues discussed/KWIC	Themes identified
God	Metaphors	
Existence Invisible hand Authority Design	Author and Finisher All and All Alive Believe Chairman Do and undo Destiny Director Faith Favour Grace General overseer He exists Invisible Hope Resort Living Spirit / Ultimate/ Authority	1. Faith in the unseen who controls the world and me
Protection Provider Healer	Angels Guide He provides Miracles Protector	2. He guards me 3. He provides for all my needs 4. He heals my body of disease
Source (of life and knowledge) Inspiration Creator	Breath Creator of scientist Inspiration My creator Source of all knowledge	5. Source of life and all knowledge
Guide	Guide Sense of direction Conscience	6. Sense of direction in the world
Heritage and experience	Inherited from parents/youth Experience faith	7. All were born into and experienced faith
Hierarchical rationality Complement God's creation	Checkpoint to science Foundation First/Faith before science Hand in hand/ Convergence Conflict Evolution Supreme God created scientific knowledge	8. Coexistence of science and God

Religion		
Trend Competition Exploitation	Alarming departure Debased Criminality of minds Exploitation Discrimination Psychology Competition	9. Concern over present day practices
Faith Choice Regions	Choice Christianity Islam Pagans Church North South Prayers	10. Belief systems and mode of worshipping God
Growth	Technology is used to grow and spread belief	11. Technology as propagator of religious doctrine, practices and activities

Science		
Visible	Destiny in your hands Everything Faith in actions/activity Ingenuity Our life	12. Faith in what is physical, what has been proven to work
Better life	ATM Better place Better life Improved life Quality of life	13. Artefacts have made the country a better place to live
Medicine Cure Provider Protection Prevention	Children/immunization Protection Cancer Prevention Disease Safety Solution Ingenuity Cure Health Infertility Medicine Processed food/preservatives Polio	14. Advances have brought solutions to many health problems
Legacy	Encountered from youth Exposure	15. Experienced from youth

	Yet to be fully exploited Luck	
Communication Propagation Friendship	Communication Facebook Internet Propagates Social Network Twitter Telecommunication/GSM	16. Technology has made communication cheaper, faster and easier 17. Technology has promoted friendship across regions
Catastrophe Crime	Mistakes Junk food Murderous impact Fake drugs Fraud Safety <i>Yahoo Yahoo</i> (internet fraud) Pornography (internet) Humans are bad not science	18. The two faces-can make or destroy
Sectors Progress	Education Employment Health Telecommunications Transport	19. Areas of life science has made positive and remarkable impact

Science and unity	Issues discussed/KWIC	Themes
Leadership	Corruption Self/greed Vision Power abuse Religion	20. Issues militating against a united country
Scientific progress	Communication	21. Factors capable of enhancing unity among various groups

Themes and explanatory quotes

Themes	
1. Faith in the unseen who controls the world and me	Yes I can't see God but I know how he works most times ... God is the overall. He is like a general overseer; let me put it that way. Without God I don't think science will be able to offer any protection - P6
2. He guards and guides me	for me a guide He helps to keep me sane whereby I want to keep within acceptable moral standards within what is humanly possible for me -P3
3. He provides for all my needs	as a human ... for me being alive up to this very minute is part of the role that God plays in my life ... providing everything my need, everything I ask for I get it -P5
4. He protects from disease	Yes, he protects me against diseases though but still what I said you have to help yourself for God to help you. I believe science really helps when it comes to the medicine -P4
5. Source of life and all knowledge	He controls everything I do. He is actually my breath -P10

	<p>Knowledge comes from God –P1</p> <p>Whatever the scientists are practicing today ...God did it before. It was out of God's creation ...God inspires them –P10</p>
6. Sense of direction in the world	...there are times ... there are some acts you want to carry out you have a kind of conscience ... something will drop in your mind and remember what the implications will be if you go this way –P7
7. All were born into faith/experience work of God	because He is a living God and He is invisible, we are taught from our youth to have faith in whatever we are told about God, because He lives, we believe He can do and undo, so if somebody is sick, if you pray for the person with faith, we just believe God will heal such a person –P2
8. Coexistence of God and science	<p>Compatible in the sense that should I say God doesn't teach us to be foolish –P6</p> <p>when you are working on that of science, when it's time for you to go and talk to God, God, I pray that, this thing, give me more knowledge on this, let me be able to work on it and God will say Amen to that and you go back to it and you still get the actual result –P12</p>
9. Belief systems and mode of worship	... we have Christians and Moslems, pagans. Christians they believe in one source: Jesus. Muslims they believe in another source: Allah, while pagans most of them are idol worshippers and some are just neutral. So it's the way you take it I believe it's from the foundation... our ancestors... once you are born into it that is the way you take it as while some they are born into it and then they divert to another thing. Like some Muslims, they are born into a Muslim family and along with time passing by, they move into Christianity – P.8
10. Concern over present day practices	The way people have used religion as a means of exploitation it has become a negative thing now. That's the way I look at it, in the church some 20 years back if you forget your wallet in the church somebody will find it they will announce it you will be expected to come up with proof of ownership. But people come into the church now because they know you have lost your guard. Under the guise of religion. They have come to exploit you –P1
11. Technology as a propagator of religious doctrine and activities	<p>like those days, the Quran and all the forms of Hadith you get then in books but now you can download them go to Islamic website you get them instantly you must not be taking the whole Quran or the whole book -P12</p> <p>we can now preach through networking, we can now communicate the gospel through science using your laptop you can e mail somebody like send him a word –P4</p> <p>... like if you want to carry out your belief or you want people to know about your belief or religion ... it is still through the means of science which is internet, radio, television ... all that –P8</p>
12. Faith in what is physical, what has been proven to work	for me to protect myself from a particular disease like HIV ...but I go ahead and have sex with someone that is HIV positive without any protection, I will get the HIV no matter the prayer I conduct no matter what I do –P.8.
13. Artifacts have made the country a better place to live	<p>yes science has made our lives much better</p> <p>in terms of the polio vaccination, science has helped in that one, at least the case</p>

	<p>of those case we usually have of polio</p> <p>Before now, in the banking industry you cannot withdraw if it is not your bank. You have to go to your branch. But technology has made it easier that you don't need to go to your branch you can withdraw anywhere. That's technology –P9</p>
14. Advances have brought solutions to many health problems	<p>even in medicine or pharmacy there is hardly a disease now that science has not come up with a drug or a solution to even for HIV/AIDS that people are still saying they don't have, they have covered some mileage in arriving at solution to that extent science has done very well. And even in area of reproduction before infertility was purely a spiritual thing in Nigeria but now people now go from IVF to ICSI which is an advanced form of assisted reproductive technology, so it has helped –P3</p>
15. Experienced from youth	<p>when growing up we were told if you were vaccinated you will be protected against some diseases, like cholera and so on –P2</p> <p>There are so many brands of paracetamol, but I rest my faith in Panadol because I grew up to know Panadol ... it is only Panadol that works for me –P1</p>
16. Technology has made communication cheaper, faster and easier	<p>let me use telecommunication as a case study. In those days before the advent of GSM in Nigeria, when you want to make call, you had to go and queue up at NITEL, ...I remember in those days if somebody gives birth in the village and you want to go and tell someone in the city you have to travel like maybe sometimes a day's journey ...Like now under some seconds you have passed information across it saves your time it saves your money –P7</p>
17. Technology has promoted friendship across regions	<p>when I was serving (NYSC) I had a friend from the north and I am from the West here ... (with) advent of telecommunication ... we communicate now and ordinarily I have not been to the north before but now I can say I have a friend from the north –P7</p>
18. Two-faces: Can make or destroy	<p>but there are some religions who have used science to cause more harm than good for instance creation of nuclear weapons or mass destruction weapons and actually using it on their fellow human being –P6</p>
19. Areas of life science has made positive and remarkable impact	<p>...science is our life right now, science is our life right now, sincerely –P8</p> <p>...science has really helped in communication, even the use of mass media that's really enough science has done so many things -P6</p> <p>even in medicine or pharmacy there is hardly a disease now that science has not come up with a drug or a solution to even for HIV/AIDS that people are still saying they don't have, they have covered some mileage –P3</p>
20. Issues militating against a united country	<p>I am comfortable being called a Yoruba man as against being seen as a Nigerian... .. again let's not forget again that corruption, people have voted money for things to impact certain societies the monies were withdrawn but those things were never delivered -P3</p>
21. Factors capable of enhancing unity among various groups	<p>but now that there is telecoms he has a phone you have a phone, you talk he is from the north you are from the south now you are friends you are very good friends –P7</p>

	<p>But thank God for technology these days that makes the youth to relate with themselves some don't even care if it's Moslem or pagan, so far they just relate with themselves -P8</p> <p>I think the use of science, the use of technology has helped in unifying people no matter where you come from or where you are from it brings about friendship relationship ... the use of Facebook I think it has added a lot of things, a lot of positivity in people's understanding -P7 (in P8)</p>
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Appendix 8 Interview consent form

The place of Science in Nigeria

The scientific worldview is informing modern common sense, but so are other traditions such as culture and belief. I am researching the language of science as a common place across Nigerian communities divided naturally by culture and belief.

I, _____, agree to take part in this qualitative study exploring science, culture and belief in Nigeria. This study is being conducted as part of Mr. Bankole Falade's PhD study at the London School of Economics and Political Science and is one of a series of data elicitation methods deployed to capture the topic both in common sense and in practice.

I understand that, as a participant in this study, I will be interviewed by Mr. Falade and will be tape recorded and transcribed. I also understand that participating in the study may involve talking about:

- How I engage with science and my understanding of its role in my life and my community
- How I engage with religion and my understanding of its role in my daily life and my community.
- My understanding of the role of science in the life of the nation (health, transport, communication, etc). Has it made our lives better? Am I worried about its direction and scope?
- My understandings of the ethnic and religious diversity of Nigeria.
- My understanding of the relationship between science and my religious/ethnic affiliation.
- My appreciation of the role of science across the diversified communities
- My appreciation of the role science can play in bridging these diversified communities.

I understand that the interview will take about 30 to 40 minutes and will occur at a time that is convenient for me.

I understand that my name or any identifying information will not be shared with anyone and will never be linked to quotes, publications or reports of this study.

I understand that I am under no obligation to agree to participate in the interview. I understand that I can refuse to answer any questions I choose and that I can stop the interview at any time.

I understand that Mr. Falade and his supervisors at the LSE are the only people who will have access to my complete interview. I understand that tape recordings of my interview will be kept in a secure site until they are destroyed.

I understand what this study involves and I agree to participate. I have been given a copy of this consent form for my own records.

Signature

Date

If you have any questions or concerns about this study, please contact:

Appendix 9 Taiwan PUS 2012

2012 Taiwan Survey: Survey of the Citizens' Understanding, Interest, and Concerns in Science and Technology

This study is funded by National Science Foundation in Taiwan. The purpose of this survey is to find out your understanding, interest and concerns in science and technology. The survey includes four sections: basic information, sources of information and interest, understanding of science, and perspectives on issues related to science and technology in society.

This survey sampled from 2000 citizens from the age of 18 to 65 years old. Through your valuable input, we hope to understand how Taiwanese citizens think and feel about science-related issues.

Your input is very important to us. Please provide your valuable opinions. Your answers will only be used and analyzed for the purpose of research. They will remain confidential. Please feel comfortable answering these questions. We appreciate your participation.

Research Center for Promoting Civic Literacy
National Sun Yat-sen University

Please note that this document was translated for the purpose of research. It was not administered.

D12. Imagine yourself standing in front of a waterfall and staring into a waterfall like the Niagara

Falls, what comes first to your mind? (Cue card 46)

- (01) You will be fascinated by the beauty of this natural spectacle.
- (02) You will be thinking of how much electricity this waterfall could produce.
- (03) You will think of how to set up a visitor center for people to enjoy nature, and to generate employment for others and income for yourself.
- (04) You will be thinking of how unimportant you are in the natural order of things.
- (05) Other, please specify _____ °



- Niagara falls (Source: <http://www.baike.com/>)