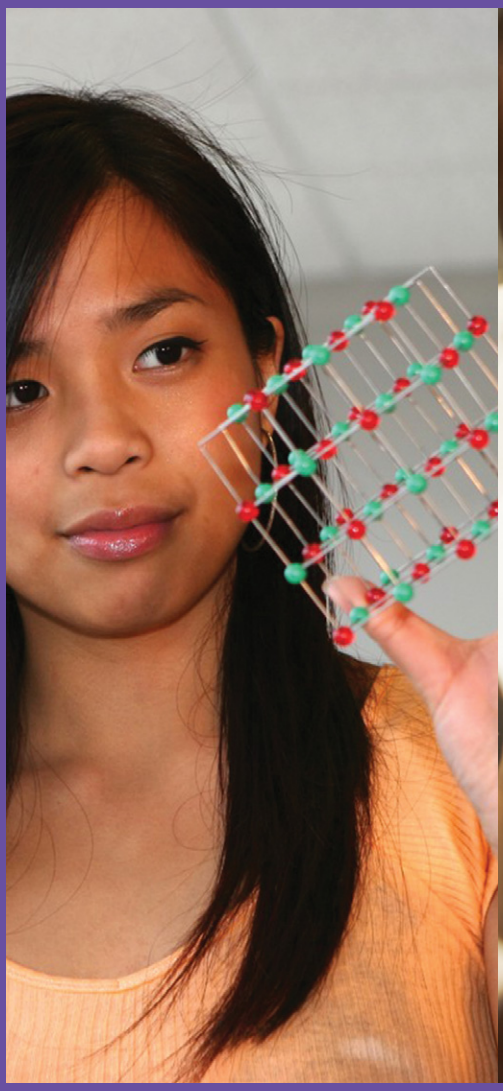
A summary report by Iain Springate, Jennie Harland, Pippa Lord and Anne Wilkin
National Foundation for Educational Research

Why choose physics and chemistry? The influences on physics and chemistry subject choices of BME students

The Institute of Physics and the Royal Society of Chemistry
November 2008



IOP Institute of Physics

RSC Advancing the Chemical Sciences

About the IOP

The Institute of Physics is a scientific membership organisation that is devoted to increasing the understanding and application of physics. It has an extensive worldwide membership and is a leading communicator of physics with all audiences from specialists through government to the general public. Its publishing company, IOP Publishing, is a world leader in scientific publishing and the electronic dissemination of physics.

www.iop.org

About the RSC

The RSC is the largest organisation in Europe for advancing the chemical sciences. Supported by a worldwide network of 44 000 members and an international publishing business, our activities span education, conferences, science policy and the promotion of chemistry to the public.

www.rsc.org

The study

The study was overseen by a steering group from the Institute of Physics and the Royal Society of Chemistry. It comprised:

Saher Ahmed, IOP
Sarah Dickinson, RSC
Katharine Hollinshead, IOP
Sean McWhinnie, RSC
Tajinder Panesor, IOP

Acknowledgements

The research team would like to thank all the school and university staff who helped us to set up the interviews and focus groups with young people. We are also very grateful to the young people themselves for giving up their time to be interviewed, and for telling us about the influences on their decisions to study chemistry and physics.

We would like to thank the Institute of Physics and the Royal Society of Chemistry for their advice and support throughout the project. Finally, we would like to thank Julie Thompson, Carol Wilkin and Sarah Harland, who made significant contributions to the research.

The Royal Society of Chemistry would also like to acknowledge a contribution from the HEFCE-funded Chemistry for our Future programme towards the costs of this study.

Contents

Foreword

We are delighted to present the findings of this second joint report by the Institute of Physics (IOP) and the Royal Society of Chemistry (RSC), which examines the factors underlying the subject choices of ethnic-minority students. The IOP and the RSC are committed to working on diversity issues and have increasingly worked together on a number of projects.

The first joint IOP and RSC report on the participation of ethnic-minority students in chemistry and physics presented a statistical overview of the passage of students in a number of ethnic groups through the educational pipeline. The study showed that the different ethnic groups displayed different patterns of attrition from science. However, by the end of the chemistry and physics pipelines, individuals in all ethnic-minority groups were less likely to be studying chemistry and physics respectively than individuals in the white majority.

Patterns of attrition from science subjects are unlikely to be down to ethnicity alone because, for example, socio-economic class will also play a significant role. However, there is no doubt that ethnicity does play a part. This new report presents the findings of research to explore the various factors that affect subject choice and to compare the relative effects of these factors on the different ethnic groups. The picture is a complex one and it is very difficult to come to any firm conclusions about exactly why one group displays different traits from another.

The hope is that the information in this report will provide clues to how studying chemistry and physics to a high level can be made more attractive to some groups of students.

Christine Davies
IOP Diversity Committee chair

Paul Walton
RSC Diversity Working Group chair

1: About the study

1.1: Introduction

In 2006 the Royal Society of Chemistry (RSC) and the Institute of Physics (IOP) commissioned a statistical study of the representation of ethnic groups in chemistry and physics (Elias *et al.* 2006). This investigation revealed a "leaky educational pipeline", whereby at each stage of decision making – from GCSE through to postgraduate study – certain ethnic minority chemistry and physics students were disproportionately lost to other subjects and career paths.

A complex picture of retention and attrition among the different ethnic groups was shown:

- Indian and Chinese students showed a strong preference for chemistry and physics A-level but were under-represented at undergraduate and postgraduate level.
- Black Caribbean students were under-represented in chemistry and physics at both A-level and degree level.
- Pakistani and Bangladeshi students were under-represented at degree level compared with their relative numbers in A-level.
- At postgraduate level, ethnic minority students were less likely than their white peers to study for a PhD in chemistry or physics, despite being more likely to go on to further study in other subject areas.

The findings of the study suggested that subject decision making among black and minority ethnic (BME) students might have been influenced by factors distinct from those affecting white students. For instance, the influence of family and perceptions about job status and security might have been more salient factors in ethnic minority students' subject choice. The fact that certain ethnic groups were under-represented in chemistry and physics might have been self-reinforcing and have discouraged BME students from further study. This was clearly a less prominent issue for majority white students. Wider factors associated with access to higher education might also have played a role (Gorad *et al.* 2006, Purchell *et al.* 2008).

1.2: Aims of the research

The aim of the more recent study was to investigate the factors affecting the decisions of under-represented ethnic groups to study physics and/or chemistry at A-level and/or at university, and to discover any differences between the different ethnic groups; A-level and undergraduate students; students of physics and chemistry; and the sexes.

The under-represented groups that were targeted for the research were British nationals from black African, black Caribbean, Bangladeshi, Pakistani, Chinese and Indian backgrounds to correspond with the groups used in the 2006 report. The following areas were explored:

- the influence of family on BME students' subject choices, attitudes towards further study in physics and chemistry, and careers in physics and chemistry;
- the extent to which peer groups influence the subject choices and career decisions of ethnic minority students with regard to physics and chemistry;
- the idea of under-representation being self-reinforcing (i.e. whether young people from ethnic groups are influenced by the lack of non-white role models in physics and chemistry);
- what other factors are significant in ethnic minority students' subject choices and career-related decision making with regard to physics and chemistry;
- the relative weight placed on the different factors in students' decision making;
- when the influences on subject and career choice are perceived to be most powerful;
- what students feel can be done to make physics/chemistry-related further study and careers more attractive, and what would influence them or help them to stay in the "pipeline".

1.3: Methodology

There were two strands to this qualitative study:

- **Strand 1** Up to 24 focus groups were to be held with A-level students. Each group was to be composed of students from a single ethnic minority and a single sex. The aim was to sample equal numbers of students studying physics and chemistry, and these would be supplemented by individual interviews where appropriate.
- **Strand 2** Individual telephone interviews with up to 24 physics/chemistry undergraduate students were to be held, including those with an interest in postgraduate study. The aim was to include four individuals from each of the six ethnic groups covered by the original survey, including at least one male and one female, and to sample equal numbers of students studying physics and chemistry.

"This investigation [in 2006] revealed a "leaky educational pipeline", whereby at each stage of decision-making...certain ethnic minority chemistry and physics students were disproportionately lost to other subjects and career paths."

2: Information about the sample

"Individual interviews rather than focus-group work were selected because they were considered to be better suited to this strand of the project."

The research sample comprised 125 individuals studying physics and/or chemistry, 103 of whom were A-level students and 22 of whom were undergraduates.

The demographics of the sample are shown in tables 1 and 2, where it can be seen that:

- Black African and Indian students were the most prevalent in the sample; black Caribbean students were the least.
- There was an even balance between males and females. (This reflects the current situation in A-level and undergraduate chemistry, where there is almost parity between the sexes, but it is not a true representation of the gender split in physics, where about 20% of A-level and undergraduate physics students are female.)
- Overall, 38% of the individuals sampled were studying physics, 79% were studying chemistry and 18% were studying both.

2.1: Strand 1: A-level sample

Focus groups were chosen as the approach that was most likely to identify the key perceptions of the respective ethnic groups and to access any influences that might predominate in specific ethnic groups. Individual-level data were collected through initial proformas and individual activity during the focus groups. This approach allowed the use of individual case-studies to illustrate group data, where appropriate, in the analysis and reporting.

Schools that had large proportions of BME pupils were targeted for the research. Participating schools were asked to distribute a short proforma to physics and chemistry A-level students in years 12 and 13. These contained enough information about individuals to allow the research team to identify and select a sample to participate in the focus groups. It also allowed the students to give consent for their involvement. Pupils were offered a £10 HMV voucher as an incentive to participate. Overall, 11 schools were actively involved in the study.

The schools were spread across five of the nine Government Office Regions (see appendix 1) and included a mixture of secondary schools, sixth-form colleges and further-education colleges (see appendix 2). The majority of the participating institutions were coeducational, apart from one all-boys school and two all-girls schools.

The bulk of the data came from 17 focus groups involving 80 pupils. Additionally, 23 individual interviews were held. The sample of A-level students is detailed in table 1.

2.2: Strand 2: undergraduate sample

Individual interviews rather than focus-group work were selected because they were considered to be better suited to this strand of the project. This was partly due to the relatively small numbers of students who fulfilled the specific criteria, and also because these personal interviews afforded an opportunity to look at individual case-studies and to ask students detailed, specific questions about influences and future aspirations.

Selected universities were asked to distribute a short e-mail proforma to undergraduate physics and chemistry students, which enabled the research team to identify and select the target sample, as well as allowing the students to give active informed consent for participation. Students were offered a £10 HMV voucher as an incentive to participate. Overall, 30 physics departments and 28 chemistry departments agreed to distribute the proforma. This generated 595 responses, from which 22 candidates who fitted the criteria were interviewed.

Table 2 details the undergraduate cohort. These students were spread across different stages of a degree and consisted of seven first-year, six second-year, seven third-year and two fourth-year undergraduate students. They included students considering or planning postgraduate studies in physics or chemistry.

Table 1: Demographics of the A-level sample

Ethnic group	Total	Sex		School year		A-level subject(s)		
		male	female	12	13	chemistry	physics	physics and chemistry
Black African	22	11	11	4	18	17	2	3
Black Caribbean	6	2	4	3	3	4	2	0
Indian	30	15	15	14	16	12	7	11
Pakistani	19	8	11	9	10	18	1	0
Bangladeshi	13	9	4	11	2	4	3	6
Chinese	13	7	6	6	7	9	2	2
Total	103	52	51	47	56	64	17	22

2.3: Parental occupations of the sample

Both the A-level and the undergraduate students were asked to supply information about the occupations of their parents/guardians. This was then classified into occupational groups using the National Statistics Socio-Economic Classification (NS-SEC) using the simplified method (Office for National Statistics 2005), which enabled information about the socioeconomic status of the participants to be determined.

Overall these data suggested that there was a range of parental occupations spanning both highly skilled occupations (e.g. doctors, accountants) and lower skilled occupations (e.g. shop assistant, factory worker). The parental occupations of those undertaking A-levels were compared with those of the undergraduates, and no significant differences were found between the two groups.

However, there were differences in the parental occupation profiles between the different ethnic groups. The range of parental occupations (for those who provided this information) in each ethnic group is detailed below:

- **Bangladeshi** The majority of parents were either not employed or employed in lower-skilled jobs.
- **Black African** Most parents were working in higher occupational groups, although there was a significant minority in lower-skilled occupations. Where there was more than one parent, both tended to be employed.
- **Black Caribbean** The majority of parents were working in higher occupational groups, although there was a minority in lower-skilled occupations. Where there was more than one parent, both tended to be employed.
- **Chinese** Most parents were working in higher occupational groups, although there was a minority in lower-skilled occupations. Around half of the households had only one parent who was employed.
- **Indian** The occupations of the parents were varied, with just less than 50% being employed in higher occupations and the rest being employed in intermediate or lower-skilled occupations. Just under half of the households had only one parent who was employed.
- **Pakistani** These parents were most commonly employed in higher occupations, or running their own small business. Most households had only one parent who was employed.

Table 2: Demographics of the undergraduate sample

Ethnic group	Total	Sex		Undergraduate subject(s)	
		male	female	chemistry	physics
Black African	3	2	1	2	1
Black Caribbean	2	0	2	2	0
Indian	6	3	3	4	2
Pakistani	5	3	2	3	2
Bangladeshi	2	1	1	2	0
Chinese	4	2	2	0	4
Total	22	11	11	13	9

3: Choices and influences

"While some individuals were studying physics or chemistry at degree or A-level with the aim of a career related to physics or chemistry, most saw the subjects at A-level as a stepping stone towards a specific career path."

This study, although focusing in the main on the influence of family and peers on choices to study physics and chemistry, also investigated what other influences affect decisions. This served to contextualise the influence of family and peers, and to highlight those factors that young people see as the most influential in their decision making.

There is a clear hierarchy of influences acting on students' decisions to study physics and chemistry. The factors can be split into three levels of influence:

- **High-influence factors:** enjoyment of physics and chemistry, future ambitions, perceptions of careers with a physics or chemistry degree, and the relevance of physics and chemistry study to life.
- **Medium-influence factors:** the way physics and chemistry are taught, physics and chemistry teachers, images of scientists and the work that they do, and family influences.
- **Low-influence factors:** the difficulty of physics and chemistry, role models, careers advisors and peers.

These influences mirror those found in research that looks at the young population as a whole (Morris 2006). Young people's subject choices are reported to be affected by their interest in and enjoyment of the subject, its potential role in their future career, their perceived ability in the subject and, crucially, their awareness (or, indeed, lack of awareness) of other options. This latter point would seem particularly important for ethnic minority groups, given that families do not necessarily see clear routes into physics- or chemistry-related careers for their children.

In this study there was variation in the level of influence of these factors across the different types of interviewee:

- Certain factors were more influential for some ethnic groups than others – for example, the perceptions of careers with a physics or chemistry degree, which mostly influenced young people away from physics and chemistry.
- Females were more likely than males to be influenced to choose physics and/or chemistry by their enjoyment of the subjects, and to be influenced to drop them as a result of their perceived difficulty.
- Those studying A-level chemistry were more likely than those studying physics to see their study of the subject as a stepping stone to a career outside the subject (e.g. chemistry A-level is a prerequisite for medicine).
- Undergraduates studying physics or chemistry were more likely than A-level students to have positive views of the careers available with a physics or chemistry degree, the relevance of physics and chemistry to life, plus scientists and the work that they do.

3.1: High-influence factors

3.1.1: Enjoyment of physics and chemistry

Enjoyment was one of the most important influences on decisions across all of the ethnic groups, and it appeared to be a slightly greater influence for females than for males. Students were influenced to continue studying physics and/or chemistry if they enjoyed it. Some of the young people suggested that their enjoyment was influenced by their ability in the subject (section 3.3.1).

Many A-level students explained that they enjoyed physics and chemistry but were not continuing with the subjects at degree level. The reasons for this were:

- some students wanted to pursue a more vocational degree (e.g. medicine);
- some said that they would be using their physics/chemistry skills in their chosen degree and would continue to enjoy the subjects as part of their studies;
- some explained that a pure physics or chemistry degree would be too narrow to keep them interested.

Those who had continued to degree level, or were planning to, tended to be those who had a passion for the subject and an interest in exploring it further.

3.1.2: Future ambitions

The future career ambitions of the interviewees was one of the most important decision-making influences across all of the ethnic groups. While some individuals were studying physics or chemistry at degree or A-level with the aim of a career related to physics or chemistry, most saw the subjects at A-level as a stepping stone towards a specific career path. This influence was particularly strong for many of the individuals studying chemistry A-level, because this is a prerequisite for studying subjects such as medicine, pharmacy and dentistry at university. Some students studying physics at A-level commented that they had chosen it because they wanted to go into engineering.

3.1.3: Perceptions of careers with a physics or chemistry degree

The perception of the careers available with a physics or chemistry degree was a key factor influencing black African, Indian, Pakistani and Bangladeshi interviewees. It was slightly less influential for Chinese and black Caribbean students. However, this influence tended to have a negative impact because most of the respondents were not aware of the types of career available with a physics or chemistry degree. Issues include:

- Some interviewees felt that careers available with a

physics or chemistry degree were not well paid and not that interesting, and that there were few jobs available outside teaching, laboratory work and research.
- Some felt that a physics or chemistry degree would limit their options after graduation because the field that they had studied was too narrow.
- Some, while recognising that there were many career options open to them with a physics or chemistry degree, felt that a more vocational degree, such as medicine, would offer a safer career route.

A minority of interviewees had decided to pursue physics or chemistry at university because they were aware that a degree in these subjects would equip them with skills that employers wanted, both in scientific industries and in other fields (e.g. finance). Those with such positive perceptions of careers were much more likely to be undergraduates than A-level students, who were correspondingly more likely to have negative perceptions of potential careers.

3.1.4: Relevance of physics and chemistry study to life

The perceived relevance of physics and chemistry to life was one of the most important influences on the decisions of black African and Chinese interviewees to study physics and/or chemistry, and a slightly less influential factor for the other ethnic groups. Some interviewees felt that there were no practical applications to what they were learning, so they had no real idea of how physics and chemistry are used in the "real world". These students remarked that involving real-life applications and scenarios in the teaching of physics and chemistry would have encouraged them to study the subjects further. Other interviewees were more aware of the fundamental aspects of physics and chemistry, and undergraduates were more likely to have positive perceptions regarding the relevance of physics and chemistry than A-level students.

3.2: Medium-influence factors

3.2.1: The way in which physics and chemistry are taught

The students' experiences of the way in which these subjects are taught varied: some felt that they had experienced poor teaching methods; others felt that they had benefited from good teaching. They particularly enjoyed the practical aspect of physics and chemistry, and they were encouraged to continue with the subjects when there was a significant practical element to their learning.

3.2.2: Physics and chemistry teachers

Physics and chemistry teachers/lecturers were recognised as an influence on young people's decisions to study physics and/or chemistry, and one of the most important influences acting on Chinese interviewees. Some of the students had decided not to continue with physics or chemistry as a result of what they viewed as poor, uninspiring or unhelpful teachers. However, where teachers were seen to be good, the interviewees were often influenced to continue with physics and/or chemistry. The students saw a good teacher as someone who made lessons interesting and presented information in a clear and understandable way, and was also able to inspire students by being passionate about their subject.

While the focus of the comments was on teachers at school who had influenced interviewees to study physics and/or chemistry, it was clear from undergraduates that their lecturers could also play a positive role in inspiring them to continue studying these subjects.

3.2.3: Images of scientists and the work that they do

The images and perceptions of scientists influenced young people in their decisions regarding physics and chemistry. The majority of comments revealed negative perceptions: some interviewees had a stereotypical view of a scientist, seeing them as "nerdy" with "mad hair", wearing labcoats and glasses. Others had negative perceptions of the work of scientists, seeing it as being a dull and isolating job. However, some interviewees held more positive images of scientists, which was often due to work experience where they had seen what scientists do and talked to them about it. Some interviewees also felt that there were positive images of scientists in the media, mentioning posters at school, and television programmes. Such images, wherever they came from, influenced young people to choose to study physics and chemistry. Undergraduates were more likely to have positive images of scientists and their work than were A-level students.

3.2.4: Family influences

Although in the eyes of young people their families were not one of the main influences on their decisions to study physics or chemistry, they did recognise that they had some influence. For a large proportion of interviewees, their families encourage them towards certain subjects and careers. Families were often happy for their children to study physics and chemistry at A-level and often held the sciences at A-level in high regard (as "prestigious", "solid" subjects). However, most discouraged them from studying these subjects at university in favour of more vocational options (e.g. medicine, dentistry). This is attributable to:

- a lack of familial knowledge of the careers available following a physics or chemistry degree;
- a familial perception that studying physics and chemistry would not lead to a job in the same way that other degrees (e.g. medicine) would, and that there were limited job opportunities available with these subjects.

However, despite the importance placed on science by parents (and indeed the public more widely; Research Councils UK 2008), pupils' interest in science appeared to wane during Key Stage 4. "This may mean parental influence is limited in the face of experience" (Morris 2006). Crucially, it has been shown that parents' views of science

"A minority of interviewees had decided to pursue physics or chemistry at university because they were aware that a degree in these subjects would equip them with skills that employers wanted."

" The issue for families was not physics and chemistry, *per se*, but the perception of the careers available after a physics or chemistry degree."

are affected by their own experience of studying science at school (Reiss 2001).

The degree of influence that parents exerted on their children can be categorised into three levels, as follows:

- Parents encouraged their children towards specific subjects and careers, such as medicine, dentistry, law and accounting, and actively discouraged them from other paths.
- They encouraged their children to ensure that they worked towards a good career, with good job security and income, without specifying what it should be.
- They supported and advised their children without influencing them to take any particular direction.

Young people felt that their families saw physics and chemistry as respectable and useful subjects to study at GCSE and A-level, and many young people explained that their parents had encouraged them to study the sciences at school. The issue for families was not physics and chemistry, *per se*, but the perception of the careers available after a physics or chemistry degree. This finding suggests that if families and young people were aware of the range of career options available to them, the quality of such options and the fact that employers are keen to recruit science graduates, this could influence them to consider a physics or chemistry degree.

There was some evidence that chemistry was regarded differently from physics, with chemistry A-level more often being seen by young people as a stepping stone to other careers (e.g. medicine). Also, the students who had chosen to study physics were less likely to have parents encouraging them towards certain careers and subjects. Arguably, this could have been because chemistry was seen as a more useful subject by families, so the encouragement to study chemistry was greater than that for physics. If this was the case, there is a pressing need to provide information about physics-related careers.

There were some differences in the extent and nature of the influencing factors across the different BME groups:

- The influence of families was stronger for Bangladeshi and Pakistani interviewees than other groups, and weaker for Chinese interviewees;
- Pakistani and Indian interviewees were more likely than other groups to be steered away from physics and chemistry careers through the influence of significant proportions of their families who were in other professions, such as medicine and pharmacy;
- Some black Caribbean and black African interviewees were told by their families that they had to work twice as hard as other groups to overcome disadvantage.

Findings from a recent survey of public attitudes towards science (Research Councils UK 2008) found that Asian and particularly black respondents were more likely than white respondents to describe their secondary science education as "a lot" or "a little" better than other subjects. Given this positive attitude, it is likely that there is untapped potential in the family as an important encourager or influencer for young people, particularly in the Asian population, and it will be important to ensure that parents are aware of the full range of careers available to physics and chemistry graduates.

3.3: Low-influence factors:

3.3.1: Difficulty of physics and chemistry

Academic ability and the perceived difficulty of studying physics and chemistry were also an influence on the choices of the interviewees. Many of the students regarded both physics and chemistry as difficult subjects, and this influenced them not to pursue them. This appeared to be especially the case with females. There were a small number of interviewees who thought that physics and chemistry were easy subjects, and this influenced them to continue with them because they felt that they would do well. There were also some interviewees who acknowledged the difficulty of physics and chemistry but saw this as a challenge, and they were not discouraged from further study by the potential difficulty of the subject.

A recent report looking at the relative difficulty of exams in different subjects (Coe *et al.* 2008) shows quantitatively that, at A-level, the science, technology, engineering and mathematics subjects are not just more difficult on average than the non-sciences but are without exception among the hardest of all A-levels. This is consistent with findings from other research, which shows that, in general, young people studying physics in higher education are more likely than their peers studying other subjects to cite their perceived high ability as a key influencing factor in their study choice (Hobsons Group 2006).

3.3.2: Careers advisors

Careers advisors accessed in or outside school (e.g. via Connexions) influenced some young people to continue with physics or chemistry. Other students had not seen careers advisors, or had not felt that the information that they were given to them was useful.

3.3.3: Influence of peers and role models

Although this was a subtle influence, young people's decision making was found to be informed by that of their immediate peers, and also impacted on by other "influential figures" or "role models". Peers provide a framework within which perceptions of the subjects are explored, created and perpetuated, and it is in this context of trends, fashions and attitudes that decisions are made.

The extent of such influences appears to vary depending on students' personal characteristics, ambitions and enjoyment. In some instances there were also differences across the ethnic groups:

- The influence of peers was rated as being slightly

stronger in comparison with other factors for Bangladeshi students, but particularly low for Pakistani students.

- The influence of role models seemed to be particularly high for Bangladeshi and Indian young people in relation to other factors, but was a particularly low influence for Chinese respondents.
- Peer influence appeared to decline somewhat with age, though older students could still be influenced by their peers and affected by role models and influential figures.
- Most young people studying for A-levels were not aware of any famous physicists or chemists of their time. Undergraduates tended to be more aware. Where role models existed, they had considerable impact. Respondents also cited relatives, peers, older students and family friends as important role models.
- Females studying A-levels were more likely than their male counterparts to report a lack of role models in physics and chemistry.

3.4: Summary of influences

Table 3 summarises the findings of the report to allow comparison of the differences between the ethnic groups.

It is important to note that the influencing factors discussed had varying degrees of impact on decisions, and were often crosslinked and interdependent. For example, enjoyment, and to some extent perceptions of careers with a physics or chemistry degree and the relevance of physics and chemistry study to life (which were rated as being high-influence factors), depended on the quality of the teaching received (which was rated as a medium-influence factor). Similarly, enjoyment was rated as a high-influence factor, while difficulty was rated as a low-influence factor, and we know that these two are often linked.

"Enjoyment was rated as a high-influence factor, while difficulty was rated as a low-influence factor, and we know that these two are often linked."

Table 3: Summary of findings by ethnic group

Ethnic group	Most important factors	Family influences	Peer influences	Sample
Bangladeshi	Perceptions of careers Future ambitions Enjoyment	Greater influence than for other groups generally	Role models a slightly greater influence than for other groups generally Peer influence similar to other groups generally	15 individuals 2 focus groups 6 interviews
Black African	Enjoyment Future ambitions Relevance of subject Perceptions of careers	Similar influence as for other groups generally Families told them they must work twice as hard as others to overcome discrimination	Role models a similar influence as for other groups generally Peer influence similar to other groups generally	25 individuals 3 focus groups 8 interviews
Black Caribbean	Enjoyment Future ambitions	Similar influence as for other groups generally Families told them they must work twice as hard as others to overcome discrimination	Role models a similar influence as for other groups generally Peer influence similar to other groups generally	8 individuals 8 interviews
Chinese	Enjoyment Future ambitions Relevance of subject Teachers	Lesser influence than for other groups generally	Role models a lesser influence than for other groups generally Peer influence similar to other groups generally	17 individuals 2 focus groups 9 interviews
Indian	Enjoyment Future ambitions Perceptions of careers	Similar influence as for other groups generally Certain careers viewed very positively by families, and many family members were in such careers	Role models a greater influence than for other groups generally (but mostly in careers unrelated to physics and chemistry) Peer influence similar to other groups generally	36 individuals 5 focus group 8 interviews
Pakistani	Perceptions of careers Enjoyment Future ambitions Family	Greater influence than for other groups generally Many family members were in certain respected professions (e.g. medicine)	Role models a similar influence as for other groups generally Peers a lesser influence than for other groups generally	24 individuals 5 focus group 6 interviews

4: Conclusions and recommendations

"Some... undergraduates explained that the subject that they chose to study was their decision to make, and they made an independent decision regardless of their parents' views."

4.1: Conclusions

This study has drawn out some of the factors that influence young people from ethnic minority groups to move away from the study of physics and chemistry. While the main issues reported by young people were consistent across all groups, there was some variation in the nature and extent of the factors influencing the different ethnic groups:

- The influence of family was greater for Bangladeshi and Pakistani interviewees and less for Chinese interviewees than the other ethnic groups.
- The influence of peers was less for Pakistani interviewees than the rest of the ethnic groups.
- The influence of role models was greater for Bangladeshi and Indian interviewees and less for Chinese interviewees than the other ethnic groups.
- Some black African and black Caribbean interviewees were told by their families that they would have to work twice as hard as other groups to overcome disadvantage.
- Indian interviewees thought that a particularly strong influence from their families was that certain careers were viewed particularly positively (e.g. medicine and law), and they were encouraged towards such careers.
- A particular influence on Pakistani and Indian interviewees was that many members of their families were working in certain respected professions, such as medicine and pharmacy.

The timing of decisions

While a small number of the respondents had decided at a young age to pursue careers such as medicine, most suggested that they did not make firm decisions about subject choices until the deadline for decisions. This suggests that there are opportunities for interventions to influence young people towards physics and chemistry in the lead up to GCSE options and to the UCAS deadline. However, given that this study suggests that the major reason for drop-off relates to degree choice and is underpinned by thinking about careers, then interventions in years 12 and 13 that relate to careers available with physics or chemistry may be most useful. Additionally, general information about possible careers that a physics or chemistry degree might lead to is also likely to have an influence if made available at an earlier stage.

Reaching the end of the pipeline

There were some differences between undergraduates in physics or chemistry and those studying the subjects at A-level. While enjoyment was a key factor behind decisions at A-level and degree level, there were indications that those who continued with physics or chemistry at degree level were those who had a passion for the subject(s) and wanted to pursue it/them further.

The research also suggested that, relative to A-level students, physics and chemistry undergraduates had more positive perceptions of careers in physics and chemistry, a greater understanding of the relevance of physics and chemistry, and more positive images about scientists and their work. This was not surprising given that these were among the reasons given by A-level students why they had chosen to study physics and/or chemistry. However, it was not always clear to what extent these perceptions had been developed while at university, and to what extent they were reasons for choosing to study physics or chemistry at university. However, for some undergraduates, these factors were key to their decision to continue with one of these subjects at university.

The families of some of the undergraduates supported them in their decision to continue studying physics or chemistry, while others had tried to persuade them to study something else. Some of these undergraduates explained that the subject that they chose to study was their decision to make, and they made an independent decision regardless of their parents' views. Others had fallen back on the subject that they enjoyed the most when they had been rejected for their first choice of degree subject (such as medicine, which parents had encouraged them towards).

Overall, key factors in reaching the end of the pipeline would appear to be a passion for physics/chemistry and positive perceptions about the relevance of the subjects and careers related to them. This again illustrates the importance of providing information to ethnic minority students and their families about careers relating to physics and chemistry, and ensuring that their experiences of studying physics and/or chemistry at school are enjoyable (e.g. good teachers and practical elements in the courses).

4.2: Recommendations

The policy recommendations are based on the findings of this study and of the earlier work on the representation of ethnic groups in chemistry and physics (Elias *et al.* 2006). Each recommendation is followed by an indication of the key stakeholder(s) most appropriate to take it forward.

Enjoyment of physics and chemistry

- Focus on increasing the enjoyment of young ethnic minorities studying physics and/or chemistry at school, especially females, and illustrate the relevance of the subjects to everyday life. Appropriate intervention for school pupils might include the provision of opportunities for (exciting) practical work in universities, science centres and industry where at the same time students would have the opportunity to

meet working physicists and chemists to discuss with them their work in context. Such opportunities should be provided regularly, not as one-offs. Teachers play a vital role in enthusing students, so providing teachers with continuing professional development opportunities to revitalise their enthusiasm and interest in physics or chemistry is also essential.
Learned Societies, Funding Councils, QCA

Careers information

- Provide comprehensive information to young people and their families regarding the range of options available to physics and chemistry graduates, the quality of such career options, the demand for such graduates by employers and the potential financial rewards. This is particularly important for Bangladeshi, Indian and Pakistani families and young people.
Learned Societies, Connexions

Role models

- Highlight role models who show ethnic diversity among those people employed in physics- and chemistry-related careers. This is particularly important for young Bangladeshi, Indian and Pakistani people.
Learned societies

Appendices

Appendix 1: Location of participating schools

Government office region	Number of schools in sample
East Midlands	1
London	3
South East	1
West Midlands	4
Yorkshire and Humber	2

Appendix 2: Types of participating school

Government office region	Number of schools in sample
community	3
foundation	2
independent	1
sixth-form college	4
further-education college	1

References

Coe R, Searle J, Barmby P, Jones K, Higgins S 2008 *Relative Difficulty of Examinations in Different Subjects* CEM Centre, Durham University.

Elias P, Jones P and McWhinnie S 2006 *Representation of Ethnic Groups in Chemistry and Physics* London: Royal Society of Chemistry and Institute of Physics.

Gorad S, Smith E, May H, Thomas L, Adnett N and Slack K 2006 Review of widening participation research: addressing the barriers to participation in higher education (www.hefce.ac.uk/pubs/rdreports/2006/rd13_06/).

Hobsons Group 2006 *School-leaver Recruitment Review 2006: Target Group Report – Subject Chemistry* London: Royal Society of Chemistry.

Morris M 2006 Pupil subject choice in schools: a product for the Economic and Social Research Council (www.esrcsocietytoday.ac.uk/ESRCInfoCentre/Images/ESRC_pupil_subject_sheet_tcm6-17691.ppt.

Office for National Statistics 2005 *The National Statistics Socio-economic Classification User Manual* (www.statistics.gov.uk/methods_quality/ns_sec/downloads/NS-SEC_User.pdf).

Purchell K, Elias P, Ellison R, Atfield G, Adam D and Livanos I 2008 Applying for higher education: the diversity of career choices, plans and expectations (http://www.hecsu.ac.uk/hecsu.rd/documents/futuretrack2006/June07_%20FuturetrackReport_KP.pdf).

Reiss M J 2001 How to ensure that pupils don't lose interest in science *Education Today* **51(2)** 34–40.

Research Councils UK and the Department for Innovation, Universities and Skills 2008 *Public Attitudes to Science 2008: a Survey* (www.rcuk.ac.uk/sis/pas.htm).

A report prepared for the Institute of Physics and the Royal Society of Chemistry

Why choose physics and chemistry? The influences on physics and chemistry subject choices of BME students

For further information about the report, please contact:

Institute of Physics
76 Portland Place
London W1B 1NT
UK
Tel: +44 (0) 20 7470 4800
Fax: +44 (0) 20 7470 4848
E-mail: diversity@iop.org
Web: **www.iop.org**
Registered charity no. 293851

Royal Society of Chemistry
Burlington House
Piccadilly
London W1J 0BA
UK
Tel: +44 (0)20 7437 8656
Fax: +44 (0) 20 7734 1227
E-mail: sciencepolicy@rsc.org
Web: **www.rsc.org**
Registered charity no. 207890