ASPIRES
Science and career aspirations: age 10-14

Reversing the 'drift' from science: What factors encourage/ discourage young people from aspiring to science careers?

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Abstract

This paper is the first reporting of findings from the second phase of the ASPIRES project, a 5 year, longitudinal study of children's science and career aspirations from age 10-14. Building on the initial survey of over 9,000 primary school children (Y6, aged 10/11), the paper introduces findings from the most recent survey of pupils from this cohort, now they are in secondary school (Y8, age 12/13). Survey findings are supplemented with analyses from interviews with parents and children (170 respondents in phase 1, phase 2 ongoing).

As found in the first survey with primary school children, the majority of young people aged 12/13 report that they find their school science lessons interesting, like their science teachers, and hold generally positive views of scientists and science careers. However, compared to age 10/11, children aged 12/13 are now less likely to aspire to become a scientist and do less science activities in their spare time.

In light of these findings, the paper asks: why is liking science not enough to foster aspirations for a career in/from science? And why do science aspirations appear to be waning as children get older? The paper identifies key factors that shape how the majority of children come to see science careers as 'not for me'.

Introduction

There is international concern over persistent low rates of participation in post-compulsory science - especially the physical sciences. It is also well rehearsed that within particular STEM areas, women and students from working-class and particular minority ethnic backgrounds are under-represented. For instance, in the UK, students on physical sciences degree courses are more likely to be young, white, male and middle-class (Smith 2011).

A considerable body of evidence now exists that, compared to other school subjects, science is failing to engage young people (Jenkins & Nelson, 2005; Lyons, 2006; Osborne & Collins 2001; Sjøbeg & Schreiner, 2005). Yet, student interest in science at age 10 has been shown to be high and with little gender difference (Murphy & Beggs, 2005) – although stark gender differences emerge as children get older. In the UK, research has shown that the point of decline begins in the final year of primary school when students are aged 10/11 (Murphy & Beggs, 2005). Indeed, an overwhelming body of accumulated evidence points to interests in science being formed by age 14 (Ormerod & Duckworth, 1975, Tai et al, 2006, Lindhal, 2007, The Royal Society, 2006).

Our research examines the development of children's science and career aspirations during the crucial 10-14 age range. However, we recognise that childhood aspirations cannot be used to accurately predict future adult careers. As discussed elsewhere, we also understand that children's aspirations can change considerably over time and that children often hold multiple, sometimes contradictory, aspirations at once (Archer et al., 2010). For all these reasons we treat aspirations with care. However, we do see a value in examining aspirations as socially indicative phenomena which provide a mechanism for unpicking the complex ways in which social identities, inequalities and contexts interact to shape the range of possibilities that children come to see as 'for me'/ 'not for me'. Moreover, an analysis conducted by Tai et al (2006) of data collected for the 1988 US National Educational Longitudinal Study, showed that by age 14 students *with* expectations of science-related careers were 3.4 times more likely to earn a physical science and engineering degree than students *without* similar expectations. This effect was even more pronounced for those who demonstrated high ability in mathematics, with 51% being likely to undertake a STEM related degree. Such data demonstrate the importance of the formation of career aspirations of young people long before the point at which many make the choice about which subject to pursue post-16.

In this paper we report on the latest data emerging from the ASPIRES project , a five year longitudinal study of children's science and career aspirations age 10-14, funded by the Economic and Social Research Council (ESRC). In particular, we report on survey and interview data from Y6 and Y8 pupils relating to their views of school science, career aspirations, perceptions of science careers, factors driving subject choice, the role of families and gender.

Study details

The ASPIRES project is funded by the UK's Economic and Social Research Council as part of its Targeted Initiative on Science and Mathematics Education. It is a 5-year, longitudinal study exploring science aspirations and engagement among 10-14 year olds. It includes a quantitative online survey that is administered children in three phases: once when they are in the last year of primary school (Y6, age 10/11) and then twice when they are in secondary school, at age 12/13 (Y8) and age 13/14 (Y9). Alongside the survey we are conducting longitudinal interviews with children (at the same times as the survey, i.e. in Y6, Y8 and Y9) and with parents (once when their children are in Y6 and once when they are in Y9).

Phase 1 Survey and Interviews (with Y6 pupils, aged 10/11 years)

The first **survey** was administered to a sample of over 9,000 10-year-old students in England. Over 10,000 students completed the questionnaire between October and December 2009. Following data cleansing (including removal of students who were not actually in Year 6 from the sample), 9,319 students remained in the sample for analysis. Students from 279 schools completed the survey.

This sample represented all regions of the country and was roughly proportional to the overall national distribution of schools in England by attainment and proportion of students

eligible for free school meals. 248 state schools and 31 independent schools participated in the survey.

Of the students who completed the survey there were: 50.6% boys, 49.3% girls; 846 (9.1%) in private schools, 8473 (90.9%) in state schools; 74.9% White, 8.9% Asian (Indian, Pakistani, Bangladeshi heritage), 7.5% Black (Black African, Black Caribbean), 1.4% Far Eastern, 7.8% mixed or other. N.B., because the study focuses in part on the impact of ethnicity on students' aspirations, schools with higher populations of ethnic minority students were deliberately over-recruited to ensure sufficient numbers for analysis.

The survey itself covered topics such as: aspirations in science; attitudes towards school science; self-concept in science; images of scientists; participation in science-related activities outside of school; parental expectations; parental school involvement; parental attitudes towards science; and peer attitudes towards school and towards school science.

We also conducted 170 **interviews**, with 78 parents and 92 children age 10/11 (Year 6), drawn from 11 schools in England. The students and parents who were interviewed were recruited from 11 elementary schools in England, representing a range of social/economic contexts, including multiethnic urban, suburban and rural schools. In terms of geographic location of the schools, there was: 1 in the Midlands, 2 in the Eastern region, 2 in the South East, 4 in London and 1 in the South. Nine of the schools were state primaries and two were private/independent schools. Students came from a broad range of socioeconomic classes and ethnic backgrounds.

Potential schools were sampled from the list of 279 schools who responded to the Phase 1 survey as part of the wider study[i] (see also DeWitt et al, forthcoming). A sampling frame was constructed to represent six target categories of school (e.g. 'multiethnic urban/inner city schools'; 'working-class suburban'; 'predominantly white, middle-class suburban schools'; 'independent single sex') to ensure a range of school contexts and populations and prospective schools were purposively sampled from within these target categories. Schools that agreed to participate were then sent parental consent letters for distribution to all children in Year 6 (age 10).

Phase 2 Survey and interviews (with Y8 pupils, aged 12/13 years)

5634 Year 8 students completed the phase 2 questionnaire between September and December 2011. Students from 69 schools completed the survey. These schools represented all 9 Government Office Regions in England and comprised a range of attainments at Key Stage 3 science (from 2008) and a range of FSM eligibility. In addition, the sample was roughly proportional to the overall distribution of schools in England in terms of attainment (though with fewer in the middle band and more in the second lowest band0 and proportion of students eligible for FSM. 58 maintained schools and 11 independent schools participated in the survey. As a way of thanking participating schools, each of the 69 schools received a report summarising the data from their students.

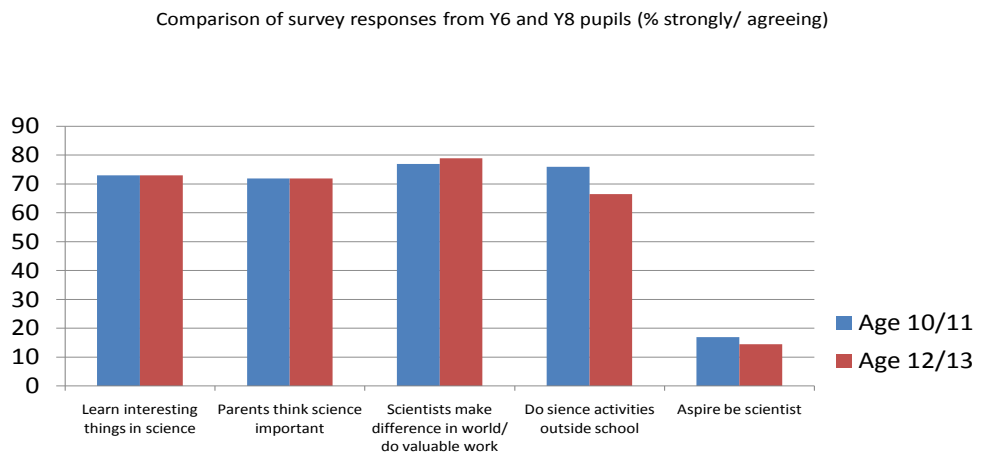
Of the 5634 students who participated in Survey 2, 2251 (40.0%) were boys and 3358 (59.6%) were girls. (25 students did not provide their gender). 5226 (93%) attended state schools and 408 (7%) attended independent schools. 645 of the 5634 students who

completed Survey 2 also completed Survey 1. (We plan to increase this percentage in survey three by using the National Pupil Database to more accurately identify target schools).

Phase two interviews are still ongoing at the time of writing (scheduled for completion July 2012), but to date we have re-interviewed 85 of the original 92 pupils.

Headline findings

Although children age 12/13 still like their science teachers, find their school science lessons interesting, say their parents think it is important for them to learn science and hold generally positive views of scientists, compared to age 10/11 (primary, Y6), children aged 12/13 (secondary, Y8) are less likely to aspire to become a scientist and do less science activities in their spare time than was found in the phase 1 survey.



1. **Most Y6 and Y8 children like school science**

We found that in both the first and second surveys, children report enjoying their science lessons. Y8 pupils rated science as their fourth most popular subject (the most popular being Design and Technology, then English and Mathematics).

Similarly high proportions (over 70%) of pupils in Y6 and Y8 agree that they learn interesting things in science. Around 80% of Y8 pupils also agree that they have enthusiastic science teachers and that their teachers care if pupils understand the lessons and expect them to do well.

68% of Y8 pupils like their science teacher and 82% believe if they study hard they will do well in science (with 69% of students feeling that they do well in the subject). Only 19% say

that they find science difficult. Our provisional impressions from the follow-up interviews currently being conducted with Y8 pupils confirms this view – with most students saying they enjoy science classes in secondary school as much as, or more than, in primary school.

2. **Children tend to have positive views of science careers**

In line with findings from Y6 pupils, Y8 children express largely positive views of science and science careers. For instance, 73% agree that science is generally useful for their futures and 70% feel that science is useful for getting a good future job. Y8 children also seem to have positive views of careers in science, with 79% believing that scientists do valuable work and the majority agreeing that scientists are respected by society (62%) and make a lot of money (63%).

3. **Although children like science – science careers are not popular**

We were struck that, despite liking science, less than 17% of Y6 pupils agreed that they would like to become a scientist in the future. By Y8 this percentage has fallen further, to 14.5% , although other STEM careers are more popular, such as engineering (25%), inventor (26%) and doctor/medicine (35%). When asked to rate a sample spread of future career options, the most popular aspirations among Y8 pupils were: sports/athlete (39%), arts/actor/dancer/singer (53%) and business (the most popular, at 62%)[ii].

4. **Perceived usefulness for future careers is the most important factor in subject choice**

We found that despite liking school science, only 43% of Y8 children agreed that they would like to study more science in the future. When asked to identify the most important reasons for choosing subjects to study in the future, over three quarters (76%) identified the

usefulness of a subject for their future careers as being the first or second most important factor. Only a fifth thought that 'how well I do in the subject' would be the most important consideration when making subject choices, with less than 15% citing liking/ enjoyment of the subject as the key reason.

This suggests that one of the reasons that children's interest in science does not translate simply into aspirations to study science further or to pursue careers in science may be that they do not see science qualifications as transferable or useful for a wide range of careers.

Indeed, it was notable in the interviews that Y6 children (and parents) tended to see science qualifications as only leading to a narrow range of careers - notably, scientist, science teacher or doctor.

5. **Secondary school children (Y8) do less science activities out-of-school than primary school children (Y6)**

We found that as they get older, science appears to feature less in pupils' out of school lives. For instance, in primary school around one third of children said that they 'never' read science-related books or magazines. This rose to nearly half of children (47%) in the Y8 survey.

Over one third of Y8 children say they 'never' do any science activities out of school and never look at science related websites. Around a fifth never visit a zoo, science centre or museum and never watch science-related TV programmes. Less than one in ten Y8 children look at science related websites once a week. In other words, science seems relatively

peripheral to the daily lives of children – and becomes more so with age. As one parent interviewee put it, “I suppose in everyday life you don’t really get that much to do with science” (Jane2, mother).

6. Families strongly influence children’s (science) aspirations

Although most families still appear to value their children learning science at school (over 70% of Y6 and Y8 children agree that their parents think it is important for them to learn science at school), Y8 pupils are less likely to agree that their parents think science is interesting (Y6: 59%, Y8: 55%). Although there was an increase (from 39% in Y6 to 50% in Y8) in the percentage of children reporting that their parents would be happy if they became a scientist, this is still quite low if we consider that almost half of children felt that their parents would be nonplussed (or even unhappy) with them pursuing a career in science.

% Y6 and Y8 Pupils agreeing/ strongly agreeing

We think that a contributory factor may be that many families do not possess much ‘science capital’ (science-related qualifications, knowledge, understanding and contacts)[iii]. Hence as science gets ‘harder’ in secondary schools, families may feel less confident in their scientific knowledge and/or may be more ‘honest’ with their children in expressing the limits of their interest and/or understanding. Interviews with Y6 pupils and parents indicated that science capital can be an important facilitator of children’s science aspirations – but it is unevenly spread across society. Families that possess higher amounts of science capital are disproportionately likely to be middle-class and children from these families are more likely to hold science aspirations.

Our emergent findings from the Y8 interviews suggests that for a number of children, family influence seems to increase with age, with children becoming even more likely to take up family views about the types of career that are regarded as 'for me/us'. These aspirations are often classed and gendered.

We explain this through the interaction of science capital with family *habitus*[iv]. We use 'family habitus' to capture family dispositions, attitudes, values and everyday practices (a family's 'feel' for the world and its sense of self, the notion of 'who we are', 'what we do' and 'what is usual for us'). This interaction influences the likelihood of a child expressing science related aspirations, with science aspirations being more 'thinkable' for middle-class children compared to working-class children (Archer et al., 2012).

It is not merely family attitudes and values that reinforce children's perceptions of particular sorts of career as being 'for me' (or not for me). Everyday family practices also play an influential role. Our analyses suggest that children's perceptions of the appropriateness, desirability and feasibility of particular types of career can be regularly reinforced at home through everyday activities and family conversations. For example, nurturing careers were particularly popular among the Y6 interviewees and many of these girls recounted how in their daily family lives they had many opportunities to practice (and develop expertise at) nurturing. They also described receiving regular praise from family members which reinforced these activities as something that the girls are 'good at' and/or have a 'natural aptitude' for. For instance, Charlie described how her parents praised her ability to look after younger family members ("my mum and dad ... they go 'oh you're so good with babies') and Celina described how her parents made the link between her caring roles and later potential careers ("They think i'd be great with children because I help my sister when she's sad and I like play with her a lot").

The interaction of family *habitus* with a lack of family science capital could also contribute to views of non-science options as more 'normal'/'natural' career choices. Provisional, impressionistic findings from ongoing analysis of the phase 2 interviews (with children aged 12/13), seems to indicate that families are becoming even more influential in shaping some children's aspirations, with these children increasingly gravitating to (strongly classed) family 'scripts' when refining and reforming their future aspirations (e.g. Laylany, a white working class girl, aspired to be an architect at age 10/11, but at age 12/13 was contemplating a career in the food industry because, as her mother puts it "we are all in food"). In other words, as children get older, the family's feel for 'what do people like me/us do' can become more powerful and influential on children's aspirations.

7. Popular views of science as 'brainy' may discourage many children from seeing science careers as 'for me'

We found that science careers are strongly associated with cleverness, with over 80% of children in both surveys agreeing that scientists are 'brainy'. We also found in our interview sample that many girls and boys who aspired to science careers tended to see themselves (and were described by their parents) as 'clever'. Pupils who liked science but who did not consider it a career 'for me' were more likely to self-describe and/or be described by their

parents as ‘normal’ or ‘middling’ students. In other words, most children seem to see careers in science as only for the exceptional (‘brainy’) few.

8. **Science is (still) seen as masculine**

Although our survey of Y8 pupils found that a higher percentage of girls, than boys, rate science as their favourite subject, this interest is not borne out in science aspirations. The gender breakdown of Y6 children who aspired to become a scientist was 20% of boys and 13% of girls. In the Y8 survey, these percentages fell to 18% of boys and 12% of girls. Over half of all Y6 parents interviewed perceived science careers as masculine which, we suggest, may reflect why fewer girls espouse science aspirations or imagine a future for themselves within science. As two of the parent interviewees explained, science is “always seen as … geeky men” (Shelley, mother) and as a career, “its not very girly ... its not a very sexy job, its not glamorous’ (Ella, mother). In contrast, 64% of Y8 girls surveyed aspired to a career in the arts.

We suggest that popular perceptions of science careers as masculine sit uneasily with girls’ notions of ‘normal’ (and desirable) femininity. Consequently, while many girls report liking and being interested in science, it does not feature within their aspirations. For instance, Danielle described science as one of her favourite subjects at school, but reflected “its really interesting, I love it, but don’t only geeks do it?” Interviews with Y6 pupils showed that the most popular non-science aspirations among girls were for ‘nurturing’ jobs (e.g. teacher, childcare), ‘girly’ and glamorous jobs (e.g. actress/dancer/ singer/ beauty) and active jobs (e.g. professional sportsperson/ trainer).

Of course, some girls in our study do aspire to science careers. But our analysis so far suggests that either these girls undertake considerable identity work to ‘balance’ their science engagement with performances of ‘normal’ (popular) femininity – or (more often) they eschew ‘girly’ femininity in favour of a highly academic (‘bluestocking’) femininity (see Archer et al., forthcoming a). As one of our Y8 interviewees explained

> “I would say there are like two types of people that are into science – either there are the really like geeky people...or there are like people who are like me who aren’t like geeky but they have a knack for it ... I play the guitar and do rowing and obviously the girly stuff that other normal girls do”.

Both of these identity repertoires require considerable effort but provisional findings emerging from the Y8 interviews suggests that the more ‘feminine’ forms of engagement may be particularly difficult for girls to sustain.

Conclusions

Our findings show that Y8 pupils tend to express positive views of their science lessons and science teachers. They also seem to hold positive views about science careers in general and report parental support for learning science at school. Yet science careers are not popular aspirations and few children see a career in science as being 'for me'. We identified that a contributory factor is the widespread lack of science capital among families, whereby science is not experienced as a normal or high profile aspect of most families' daily lives. Consequently, in these families, science is not an obvious or 'thinkable' subject or career choice and is not perceived as a transferable qualification. We also found that popular views of science careers as 'masculine' and 'clever' play a part shaping the majority of children's views of science careers as 'interesting... but not for me'. Our work indicates the need to increase children's and families' science capital and to raise awareness of the diversity of careers that STEM qualifications can lead to. This means we need to carefully question what messages children are receiving about science careers and post-16 science qualifications. For instance, are these reinforcing or challenging associations with 'cleverness' and masculinity and stereotypes of science as a specialist and narrow field? This would also extend to monitoring STEM interventions, suggesting the importance of ensuring that these are inclusive of gender, social class and 'ability' range (in terms of both content and participants).

Summary of recommendations for increasing participation:

- Increase science capital among families, children and teachers.
- Science educators to work with schools to increase teachers' and pupils' awareness of the breadth and diversity of careers from science – supporting teachers to integrate this awareness into mainstream teaching.
- Alert families to the value of science qualifications in the labour market – conveying the message that science 'opens doors' and 'keeps options open' (as opposed to narrowing them).
- Challenge popular perceptions of science as for the 'clever'.
- Challenge perceptions and cultures which associate science with masculinity – support children in learning how to deconstruct popular stereotypes.
- Diversify post-16 science pathways
- Ensure STEM interventions cater for the diversity of young people – not just those groups who tend to pursue STEM post-16.

Further Reading

Ten Science Facts and Fictions: The Case for Early Education about STEM Careers (ASPIRES Project/ Science Council, November 2011).

Archer, L., DeWitt, J., Osborne, J., Dillon, J., Willis, B. & Wong, B. (2010). 'Doing' science versus 'being' a scientist: Examining 10/11 year old schoolchildren's constructions of science through the lens of identity. *Science Education, 94*(4) 617-639.

Archer. L., DeWitt, J., Osborne, J., Dillon, J., Willis, B. & Wong, B. (2012) Science aspirations, capital and family habitus: How families shape children's engagement and identification with science, *American Education Research Journal,* published on *iFirst* 19 January 2012

Archer. L., DeWitt, J., Osborne, J., Dillon, J., Willis, B. & Wong, B (forthcoming a) 'Balancing Acts': Elementary school girls' negotiations of femininity, achievement and science. *Science Education*

Archer. L., DeWitt, J., Osborne, J., Dillon, J., Willis, B. & Wong, B. (forthcoming b 2013) 'Not girly, not sexy, not glamorous': primary school girls' and parents' constructions of science aspirations, *Pedagogy Culture and Society*.

DeWitt, J., Osborne, J., Archer, L., Dillon, J., Willis, B. & Wong, B. (in press). Young children's aspirations in science: The unequivocal, the uncertain and the unthinkable. *International Journal of Science Education*, available on iFirst http://www.tandfonline.com/doi/abs/10.1080/09500693.2011.608197).

DeWitt et al (2010). High aspirations but low progression: The science aspirations-career paradox amongst minority ethnic students**.** *International Journal of Science and Mathematics Education, 9*(2), 243-271.

ASPIRES Website:
http://www.kcl.ac.uk/sspp/departments/education/research/aspires/index.aspx

[i] Over 10,000 students completed the questionnaire between October and December 2009. (Survey 2 will take place in autumn 2011 and Survey 3 in autumn 2012.) Following data cleansing (including removal of students who were not actually in Year 6 from the sample), 9319 students remained in the sample for analysis. Students from 279 schools completed the survey. This sample represented all regions of the country and was roughly proportional to the overall national distribution of schools in England by attainment and proportion of students eligible for free school meals. 248 state schools and 31 independent schools participated in the survey. Of the students who completed the survey there were: 50.6% boys, 49.3% girls; 846 (9.1%) in private schools, 8473 (90.9%) in state schools; 74.9% White, 8.9% Asian (Indian, Pakistani, Bangladeshi heritage), 7.5% Black (Black African, Black Caribbean), 1.4% Far Eastern, 7.8% mixed or other. N.B., because the study focuses in part on the impact of ethnicity on students' aspirations, schools with higher populations of ethnic minority students were deliberately over-recruited to ensure sufficient numbers for analysis. The survey itself covered topics such as: aspirations in science; attitudes towards school science; self-concept in science; images of

scientists; participation in science-related activities outside of school; parental expectations; parental school involvement; parental attitudes towards science; and peer attitudes towards school and towards school science.

[ii] The gender breakdown of these aspirations for Y8 pupils were: doctor/medicine (Boys 30%, girls 29%); engineering (boys: 45%, girls 11%); inventor (boys 39%, girls 16%), scientist (boys 18%, girls 12%), business (boys 67%, girls 58%), sports/professional athlete (boys 53%, girls 30%), arts, musician, actor, dancer (boys 27%, girls 64%).

[iii] We developed the concept of 'science capital' to refer to the extent of a family's knowledge and familiarity with science. Science capital includes science-related qualifications, knowledge, interest, literacy and contacts. The phase one survey indicated that more positive parental attitudes to science were associated with an increased likelihood of a child expressing science aspirations. More affluent families tend to have more positive views of science.

[iv] We use the concept of family habitus to capture the ways in which families can shape children's understandings of the world and their sense of self. Habitus is shaped by people's experiences, of which family socialisation plays an important part. It encompasses a framework of dispositions that unconsciously shape and guide a person's perceived limits to their choices, i.e. what is felt to be possible/desirable for 'people like me'. As the sociologist, Pierre Bourdieu, writes, habitus provides a practical 'feel' for the world, it frames people's ways of thinking, feeling and being, and encompasses taken-for-granted notions of 'who we are', and 'what we do' and what is 'usual' for 'us'.

We use *family habitus* to refer to the ways and settings in which families operate – as such the concept seeks to go beyond simplistic, conscious forms of identification with science (e.g. attitudes to/liking of science) to also encompass values and everyday practices.' (Archer et al 2012). In other words, the concept of family habitus provides a way to explore how families construct a collective relationship with science and the extent to which this is shaped by their possession of particular sorts of economic, social and cultural capital (resources).