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Research Papers in Education

ISSN: 0267-1522 (Print) 1470-1146 (Online) Journal homepage: http://www.tandfonline.com/loi/rred20

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To cite this article: Louise Archer, Julie Moote, Becky Francis, Jennifer DeWitt & Lucy Yeomans (2016): Stratifying science: a Bourdieusian analysis of student views and experiences of school selective practices in relation to 'Triple Science' at KS4 in England, Research Papers in Education, DOI: 10.1080/02671522.2016.1219382

To link to this article: http://dx.doi.org/10.1080/02671522.2016.1219382

RESEARCH PAPERS IN EDUCATION, 2016
http://dx.doi.org/10.1080/02671522.2016.1219382

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Stratifying science: a Bourdieusian analysis of student views and experiences of school selective practices in relation to 'Triple Science' at KS4 in England

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ABSTRACT

Currently, science in England is distinctive at General Certificate of Secondary Education (GCSE) in comparison to most other subjects, in that there is a notable stratification of award routes. The most prestigious of these, 'Triple Science' (the route for entry for three separate science GCSEs), is championed by English government and industry, but has received scant critical academic attention to date. Drawing on data collected via a national survey of over 13,000 Year 11 students aged 15/16 years and in-depth longitudinal interviews conducted with 70 students from this cohort (from age 10 to 16), we discuss how most students have little if any choice over which science 'option' they take at GCSE. Drawing on Bourdieu's concept of pedagogic action, we unpick how students are 'channelled' into making the 'right' choices and come to accept their allocation as legitimate. We explore how selective practices around Triple Science create and perpetuate social inequalities, producing different patterns of student identity, aspiration and attainment. In particular, we discuss the identification of Triple Science as 'for the clever' and problematise its relationship with the science 'pipeline'. We conclude by suggesting potentially more equitable ways forward for science education, reflecting on implications for post-16 participation.

ARTICLE HISTORY
Received 28 September 2015
Accepted 12 June 2016

KEYWORDS
Triple Science/Science; GCSE; Bourdieu; inequality

Introduction

Science education has long occupied a position of prominence on the English policy agenda. This is in no small part due to wider policy concerns that more needs to be done to improve (increase and broaden) levels of participation in post-compulsory science, which is seen as vital for national economic competitiveness. Indeed, internationally, governments and industry have been calling for, and substantially investing in, attempts to improve rates of post-compulsory science participation, particularly at degree level (e.g. AAUW 2010; HM Treasury 2011; House of Lords 2012).

In England, the introduction of the National Curriculum in 1988, meant that all students (regardless of gender, social background or the type of school attended) were now required to study science as a core subject to the age of 16 (prior to this, many girls did not study science to age 16 and those that did tended to study biology, rather than the physical sciences e.g. see Byrne and Brodie [2011]). Since then, concern has shifted to post-compulsory science participation where, despite decades of

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initiatives, rates and patterns of participation remain remarkably constant. In particular, women, working-class and particular minority ethnic groups remain underrepresented, notably in the physical sciences and engineering (e.g. Smith 2010, 2011). The majority of interventions aimed at improving post-compulsory science participation have focused on trying to attract more students into science, for instance by making science more 'fun' or interesting, or by highlighting the attractiveness of different science careers (Archer and DeWitt 2016). Yet recent research has shown that such approaches may be misguided as most students report finding science interesting and that many students may be put off by the notion that science qualifications primarily only lead to careers in science (Archer and DeWitt 2016). Hence we ask, might this focus on individual level student attitudinal factors be missing an important part of the science participation 'puzzle'?

In this paper, we explore the potential role that structural factors, notably current stratifying practices in Key Stage 4 (KS4)[1] Science in England, may also play in producing these patterns of participation. In particular, we draw on qualitative and quantitative data from Year 11 students (drawn from a larger longitudinal study of young people's science and career aspirations, age 10–18), to explore students experiences, and the implications of, their 'choice' of GCSE science award route.

The rise and rise of Triple Science?

There is currently a somewhat baffling array of GCSE (the public examinations that are sat in a range of subjects about the age of 16) and equivalent science qualifications that can be taken at KS4[2] in England.[3] The different options have undergone various changes, both in format, content and nomenclature over the last decade, and include statutory and non-statutory elements, spanning from the more traditionally academic (e.g. Double Award; Core and/or Additional Science GCSEs; GCSEs in all three single sciences, often referred to as 'Triple Science'; Further Additional Science, GCSE Single Award in Combined Science, and more) to more applied and vocational options (e.g. GCSE Additional Applied Science; GNVQ Science, BTEC Firsts in Applied Science, and OCR Nationals). Thus, while there is a statutory requirement for all students to study some science up to the age of 16, there is considerable variation in what this might entail in practice.

The 2006 curriculum reforms introduced an entitlement to take Triple Science from 2008 for higher attaining students. Although not an official course title, 'Triple Science' is a popular, widespread terminology that refers to students studying Biology, Chemistry and Physics as separate subjects at GCSE, i.e. counting as three GCSEs. Although Triple Science refers to GCSEs in the three single sciences of Biology, Chemistry and Physics, students studying for Double Award Science ('Double Science') and for Core/Additional awards in Science (which we refer to as Double Science in this paper, for ease) are also required to study a combination of all three sciences, albeit counted as the equivalent of two GCSEs. Despite the distinctiveness of the new Triple Science route – it marks not only a change from previous practice but also sets science apart from most other GCSE subjects in terms of structure – the introduction of Triple Science has been met with a surprising lack of academic and policy attention. Indeed, it seems to have almost slipped in relatively unnoticed and has become an established, and mostly unquestioned, part of the GCSE 'furniture'.

The 'Triple Science' route was introduced as an entitlement for higher attaining students, to enable them to study science in greater depth and breadth:

> … from September 2008 all 14-year-olds achieving level 6 at key stage 3[4] would be entitled to study a Triple Science GCSE course, covering physics, chemistry and biology. The policy view of the Department for Children, Schools and Families (DCSF) is that Triple Science is not for everyone and should be for those students who achieve level 6 or above and would benefit from the course. (Fairbrother and Dillon 2008, 65)

Although as discussed further below, the eligibility requirements for entry onto Triple Science has since become much vaguer and more diffuse in practice.

Since its introduction, there has been a steady growth in the numbers and proportion of students submitted for Triple Science. For instance, there has been a marked growth since 2006, when 5.6% of the cohort took Triple Science, to 2013/2014 when approximately 26% of all students taking science

took Triple Science (DfE 2014). This growth in Triple Science entry has been matched by a decline in the proportions of students taking the dual award (69% of the cohort in 2006, compared to 55% in 2013/2014). As the regulatory body, the Office for Standards in Education, Children's Services and Skills, Ofsted (2013) notes, 'as entry numbers have risen for the separate sciences, numbers for additional science have declined' (para 64), with 'a notable shift towards core science and additional science qualifications'.

Attainment and progression data suggests that students on Triple Science tend to do well. For instance, the Ofsted (2013) Maintaining Curiosity report states that:

> The proportion of students making the expected three levels of progress in the separate sciences is 85% for biology, and 83% for chemistry and physics. But for core science, that figure drops to 60%, and is 61% for additional science […] The conclusion is that making good progress is more likely through the separate science route and the chances of gaining higher grades are also greater. (Ofsted 2013, Para 68)

However, it might also be argued that these patterns in attainment are not unexpected given a selective intake of higher attaining students on to Triple Science.

The growth in Triple Science entries from 2006 to present is perhaps also unsurprising given that it has been accompanied by a strong positive advocacy discourse in England from successive governments, industry and many science education policy organisations. Indeed, it is difficult to find many dissenting or critical voices in the public sphere (cf. Osborne 2008). Organisations such as the Campaign for Science and Engineering (CaSE) were quick to signal their unbridled support for Triple Science when it was introduced. For instance, in a BBC news report from 2009, spokesperson Hilary Leevers explained CaSE's supportive position on Triple Science, saying:

> We are delighted that entries into Triple Science GCSEs are increasing and by such large amounts […] CaSE has long campaigned for Triple Science to be available to all students and … we are pleased and relieved to see that students are flocking to it. (BBC News/Harrison 2009)

The Confederation of British Industry (CBI) also strongly welcomed Triple Science, arguing that an entitlement to study it does not go far enough. Rather, the CBI has called for all young people who attain 'good grades' in science at age 14 to be automatically enrolled on the course. Their support for Triple Science is based on their desire to increase the proportion of student studying science at A level, drawing on DfE data suggesting that three quarters of Triple Science pupils achieving the highest grades progress to A Level science subjects, while only 59% of Double Science pupils achieving the highest grades progress to A Level science subjects.

Successive English governments have also signalled their support for Triple Science, for instance, in a 2013 speech as the then Minister for Schools, Elizabeth Truss MP, set out the government's hope that the percentage of students studying Triple Science will continue to grow:

> In just a few years (since 2009), the number of young people in state schools [in England] entered for Triple Science GCSEs has doubled. In 2005, just 5.3% of students in state schools were entered for Triple Science. Last year, that figure was 23.4%. We would still like to see that percentage rising much higher.

This support continues under the current administration, with Triple Science being seen not only to fit but also to exemplify what the current Minister for Schools, Gibb (2015) refers to as 'the government's commitment to academic rigour'. To this end, the government funds a Triple Science Support Programme (TSSP)[5] [in England], which also seeks to promote and support the uptake of Triple Science, for instance providing funding to eligible schools to pay for Continuing Professional Development to help support the implementation of Triple Science. In sum, Triple Science has been widely welcomed in England by government, industry and science education organisations – and has largely escaped much critical attention from wider educational researchers. But does this mean that Triple Science is necessarily a 'good thing'?

Who takes Triple Science?

As noted earlier, Triple Science was introduced as an entitlement for higher attaining students (defined as those achieving level 6 at KS3, roughly equivalent to grade 'B') in the 2006 reform. Since then, the entry criteria for Triple Science have become somewhat vaguer and more diffuse in practice and (as we shall argue later) there appears to be considerable variation between schools. However, there is a general policy push for schools to not only operate selective entry onto Triple Science, but also to encourage more students to pursue it. For instance, one of the continuing professional development sessions currently offered by the Science Learning Network (a main provider of professional development to science teachers) is listed as: 'Identifying and inspiring your students in Triple Science (RP781)'. The course text explains:

> Using data from KS3 can help you identify students who are suitable for Triple Science. This course will help you effectively identify appropriate students from data. You will examine ways to motivate students, enrich their Triple Science learning and investigate STEM career resources that you can use to inspire students to study science.

In other words, we would argue that there remains a strong discourse around Triple Science in which schools are encouraged to offer the route selectively to higher attaining students (although the boundary markers of attainment may vary in practice).

Irrespective of the grade criteria for eligibility to study Triple Science, figures suggest that there is also considerable variation in the student profile of those who take the award. For instance, the DfE (2014) figures show that more boys than girls took Triple Science GCSEs in 2014 – although this gender imbalance has become less prominent over time and is now approaching parity. Homer et al.'s (2013) analysis also shows that students who are eligible for free school meals (FSM)[6] are under-represented on Triple Science, which compares with Double award, where they are proportionally represented, and other applied routes, where they are over-represented. Likewise, a Sutton Trust report published in June 2015, analysed the GCSE performance of those students who were in the top 10% of attainment at the end of primary school. They found that, of these children, pupils who had received FSM were significantly less likely to be taking Triple Science at GCSE compared to their peers.

DfE 2012 data shows that 84% of state schools offered Triple Science GCSE, but recent findings by the RSA (2015) suggest that there is considerable variation between which types[7] of state schools offer Triple Science, with students in deprived neighbourhoods being much less likely to attend schools that offer the route. For instance, the RSA analysis found that there are six authorities in which more than one third of schools did not offer Triple Science. In four authorities, fewer than 15% of students took Triple Science – predominantly areas with higher levels of deprivation. In more deprived areas, such as North East Lincolnshire, half of secondary schools do not offer Triple Science compared to a number of more affluent, South Eastern areas, where all schools offer Triple Science. The report links the variation to the government's 'accountability regime', which encourages schools to engage in strategic 'games' to maximise the GCSE points scores per student.

In other words, we suggest that the relative lack of academic engagement with the phenomenon of Triple Science is surprising given that it stands out as a highly selective KS4 GCSE route. In this paper, we hope to contribute to addressing this gap, through a consideration of the views and experiences of young people aged 15/16 (who are in the eleventh grade or year of schooling, termed Year 11, or 'Y11') and their accounts of 'choosing' and studying either Triple or Double Science routes at GCSE. Specifically, we ask: How do young people experience and construct their 'choice' (or not) of GCSE science route? And what are the identity and other implications (for social justice and widening participation in science) associated with participation on Double or Triple award routes for different groups of students?

Theoretical lens

In this paper we apply a Bourdieusian analytic approach to understanding the stratification of KS4 science and, in particular, the social justice implications of the selective processes surrounding access to Double/Triple Science.

Bourdieu's theory of social reproduction (e.g. Bourdieu 1984, 1986, 1990; Bourdieu and Wacquant 1992) proposes that it is the interaction of habitus and capital within field that produces practice (social life). Habitus refers to the socialised, internalised, interconnecting set of dispositions that guide our thoughts and actions. Habitus interacts with capital (economic, social and cultural resources) and is mutually co-constituting with field (Bourdieu 1990). That is, dispositions within the habitus find their expression through field and can influence, for instance, the extent to which a student may feel that science is 'for me' (or not). Field determines the value of capital (the resources that a student may have) – and the deployment of capital (through interactions with habitus) will generate particular relations of privilege/subordination.

Bourdieu was interested in how institutions, such as schooling, play a role in the reproduction of inequalities. In this paper we draw on his notion of *pedagogic work/pedagogic action* to understand the ways in which schools can shape and guide students' 'choice' of science route at GCSE. Bourdieu proposed that pedagogic action is the 'work' undertaken by institutions to impose the cultural arbitrary (e.g. the taken for granted 'culture', normative assumptions and power relations within an institution or field – the dominant notion of 'how things are'). In this respect, pedagogic action generates symbolic violence:

> All pedagogic action (PA) is objectively symbolic violence insofar as it is the imposition of a cultural arbitrary by an arbitrary power. (Bourdieu and Passeron 1990, 5)

Pedagogic action involves a process of socialisation, or 'inculcation', which produces durable dispositions within the habitus to accept the system as legitimate and authentic. That is, social actors come to understand the cultural arbitrary as 'natural', 'fair' and 'the way things are'. As Bourdieu explains, pedagogic action is a relatively long-term process and is rarely achieved instantly, it 'must last long enough to produce a durable training ie habitus, the product of internalisation of the cultural arbitrary capable of perpetuating itself after pedagogic action has ceased' (Bourdieu and Passeron 1977, 31).

We thus use the concept of pedagogic action in this paper to explore how/whether students come to see the selective processes around access to Double or Triple Science as 'the way it is' and if so, how these actions may produce dispositions that hide or obscure underlying social inequalities. Bourdieu suggested that particular processes are needed to establish pedagogic authority – hence we explore in our analyses the technologies that schools apply around applicability criteria for selection/entry for Triple Science and which maintain the pedagogic authority of the school to decide who studies which course (e.g. the threat of being 'bumped down to Double Science').

Methods

The Aspire2 project is a 5-year study funded by the UK's Economic and Social Research Council. It follows on from the previous Aspires study, which investigated children's science and career aspirations from age 10–14, with the present study extending tracking of this cohort from 14–19 years old. The Aspires2 study comprises a quantitative online survey of the cohort and repeat (longitudinal) interviews with a selected subsample of students and their parents, in order to generate both a breadth and depth of data. This paper reports on the first phase of the Aspires2 study, comprising a survey and interviews with students age 15/16 years old (Year 11).

The survey collected a range of demographic data (including gender, ethnicity, measures of cultural capital[8]) and covered topics such as general aspirations, aspirations in science; subject preferences, attitudes towards school science (differentiated for Physics, Biology and Chemistry); post-GCSE choices, images of scientists, self-concept in science; perceptions of own and others' gender identity; participation in science-related activities outside of school; parental attitudes towards science; peer attitudes

towards school and school science; careers education and work experiences. It builds on previous surveys, the development and validation of which have been described elsewhere (e.g. Dewitt et al., 2013), as have the findings from the first three surveys, conducted when the cohort was aged 10/11, 12/13 and 13/14 (DeWitt & Archer 2015; Dewitt, Archer, & Osborne 2014; DeWitt et al. 2011). These papers also provide further detail on the reliability and validity of the survey instrument, as well as the specific items.[9]

The survey data reported in this paper was collected from students in Y11 (age 15/16 years). This included a nationally representative survey of schools, completed by 13,421[10] students in England, who were recruited from 340 secondary schools in England (296 state schools and 44 independent). The state schools represented the range of different types of school that students in England can attend free of charge. The sample represented all regions of the country and was roughly proportional to the overall national distribution of schools in England as measured by attainment and proportion of students eligible for FSM. Of the 13,421 students who completed the survey, 46.7% were male and 53.3% were female. Students were asked to self-categorise their ethnic background on the surveys via a double-level question. Overall, students fell into the following (self-reported) ethnic categories: White, 75.9%, Asian 9.7%, Middle Eastern 0.9%, Black 3.7%, Chinese/East Asian 1.5%, Mixed/Other, 4.8%. 3.4% of students preferred not to answer. 132 interviews were conducted in this phase with 70 students and 62 parents (all of who had been previously tracked since students were at primary school, age 10/11. Interviews lasted between 30 min and 1 h (for students) and up to 1.5 h (with parents). Interviews were conducted by the authors, three of whom are white, middle-class female academics (two British and one North American) and a white female middle-class PhD researcher and white middle-class female research administrator. The majority of interviews were conducted by Author 2. Interviewees were invited to choose their own pseudonyms. Interview topic areas broadly mirrored the survey areas, in order to explore students' meanings, understandings, experiences and identities in more depth. Interviewers probed responses to encourage participants to explain their views and to reflect on the potential sources or influences on their views. Brief field notes were taken after each interview. A complete copy of the survey and/or interview questions is available on request.

All interviews were digitally audio-recorded and transcribed. In line with the study's conceptual approach outlined previously, data were analysed using a discourse analytic approach (Burman and Parker 1993) that is informed by feminist post-structuralism. Initial coding and sorting of the data (on key topic areas, themes and by responses to particular questions) was undertaken by Author 1 using the NVivo software package, with other authors providing a check on reliability of coded extracts in relation to the specified codes. The lead author searched the coded extracts to identify key themes in relation to students' constructions of Double/Triple Science, their 'choices' and their own identifications in relation to Double/Triple Science. These were then tested and refined through successive phases of coding and analysis, iteratively testing out emergent themes across the data-set to establish 'strength' and prevalence (Miles and Huberman 1994). These coded themes were then subjected to a more theoretically informed analysis (in line with the stated Bourdieusian conceptual framework) to identify classed (and other) implications.

Findings

Who is taking Triple or Double Science?

Forty-six per cent of our survey sample reported that they were taking Triple Award, 37% Double award, 5% applied routes and 4% BTEC. 7% did not know what route they were taking. This sample contains a considerably greater proportion of students taking Triple Science compared to the national picture for 2014 figures (Triple = c.26%, Double = c.55%), presumably reflecting either/both the greater likelihood for schools that offer Triple to participate in a survey of science but also the greater likelihood that schools would select their Triple Science students to participate in the survey.

Table 1. A summary of students taking Double and Triple Science by SES background.

SES	Double Science (%)	Triple Science (%)
Class 1	34	55
Class 2	42	34
Class 3	40	37
Class 4	40	35
Class 5	39	24

Table 2. Students taking Double/Triple Science by ethnicity.

	Double (%)	Triple (%)
Black	42	43
Asian	34	54
White	38	45
Chinese	21	66

Table 3. Students taking Double/Triple Science by set.

	Double (%)	Triple (%)
Top set	26	69
Middle set	55	20
Bottom set	42	10[a]
No set	20	71

[a]This percentage seems surprising – but we suggest it may reflect students who attend selective/high attaining schools, in which the 'bottom set' may be relatively high attaining in national terms and almost all students are entered for Triple Science. It is also possible that some respondents may have not known what set they were in and/or were providing fictitious answers.

Broadly in line with national 2014 figures, our sample recorded roughly similar proportions of girls and boys studying both Double and Triple award routes, with 36% of boys and 38% of girls taking Double and 47% of boys and 46% of girls taking triple.

Due to the difficulties of assigning social class among a student sample, we used two different measures to ascertain the social background of our students – a measure of cultural capital and a measure of SES. Our analyses by cultural capital suggested that more socially advantaged students (those with medium, high and very high levels of cultural capital) were more likely to be taking Triple than Double, whereas students with low or very low cultural capital were more likely to be taking Double than Triple. For instance, whereas of students with very low cultural capital, 42% took Double and 22% were taking triple, the same figures for students with very high cultural capital were 24% Double and 71% Triple.

Our analysis of participation by SES (using the NS-SEC categories) revealed that our most socially disadvantaged students (class 8) are almost three times less likely to study Triple Science compared to the most advantaged (class 1; Table 1):

Looking at our data by ethnicity, we found that Black students are equally likely to be taking Double or Triple Science but that Asian and White students are more likely to be taking Triple. Chinese students are around two and a half times more likely to take Triple than Double Science (Table 2).

In other words, the social profile of those taking Triple Science appears to be skewed towards those from more advantaged social backgrounds. Students in top sets and those in schools that do not set for science are also much more likely to be taking Triple than their peers in middle and lower sets (Table 3):

We now use the qualitative data to try to shed light on how students understand and experience these 'choices' and the implications for students' identities. We argue that, on the whole, most students do not have a 'choice' of science route at KS4 – either their choice is explicitly proscribed by the school or they are implicitly steered and channelled, through concerted pedagogic work, into making the 'right' choice. We propose that Triple Science, and the pedagogic work that creates and sustains it, can be understood as a technology for the reproduction of inequality, that is, the practice of selective

science routes at GCSE promotes and sustains social inequalities because (1) it functions as a filter for the STEM pipeline (2) it produces symbolic violence, through the association of the Triple Science route with 'cleverness' (3) it creates and reinforces differential cultures on the different routes (e.g. 'excellence' versus 'normality') (4) schools have a differential (inequitable) ability to offer the Triple Science route. In sum, we suggest that the policy and practice of Triple Science is incommensurate with attempts to widen participation in post-compulsory science because it is premised upon notions of elitism.

'Not really a choice': schools' pedagogic work to channel students into Double and Triple routes

In our surveys, 61% of Triple students and 58% of Double Science students reported that they had no personal choice of which route they took and that their school had decided for them. The figure was similar for applied science routes (58%) but lower for other science routes (36%).

Of the 70 students that we interviewed, the majority were taking Triple Science (42/70), with most of these (71%, $n = 30$) saying that this decision had been made by their school (cf. 12 who said it had been their own choice). Twenty-three students were studying Double Science, with roughly equal numbers saying it had been the school's decision ($n = 13$) or their own choice ($n = 10$). Two students were not taking GCSE science (e.g. BTEC) and three were unclear either what course they were taking or whose decision it had been.

The overwhelming majority of students taking Triple Science indicated that they were happy with their allocation:

> The school told me I was doing it … I felt all right about it. I mean I do like science. (Bill, Triple Science, school's decision)

> The school chose for us, but I would have chosen that anyway. (Poppy, Triple Science, school's decision)

Only one student (Louise) lamented that taking Triple had been the 'worst decision of my life' (Louise, Triple Science, own choice), largely because she had selected the course on a purely pragmatic basis (believing that because the course started a year earlier, in Year 9, it would be 'easier' because the examinations would be more spaced out) but had found this not to be the case in practice.

Students taking Double Science also largely suggested that they were either happy, or at least did not disagree, with the school's decision:

> We just knew that we had to do it and it wasn't really discussed. It was just you're doing it and no one really disagreed with it. (Millie, Double Science, school's decision)

However, a number of students who had been allocated to Double science later reflected that, given the choice, they would rather have done Triple Science and now regretted their allocation/choice:

> Um, yeah probably. I would've changed all of the options apart from PE […] it [doing Triple Science] would've been on the top of the consideration kind of list. (Ghost, Double Science, school's decision)

> The school decided that [allocation to Double Science]. But if I had a free option and one of them was to choose Science, I probably would have because I know it does help you a lot in future life. (Chloe, Double Science, school's decision)

Such regrets tended to surface particularly as students came to the end of Year 11 and began to formalise their post-compulsory aspirations and plans. For instance, Josh had discovered a love of Physics over the course of the past two years and had now decided that he wanted to take the subject at A level. He hoped his decision would not affect his ability to be accepted on to (and to do well in) A level Physics:

> I wish I did triple, but … … back then, I don't know, I just didn't pick it. But then I'm sure it won't affect me that much. Cos if I'm doing Physics at 6th Form, afterwards [then] I [will] learn stuff like that anyway. (Josh, Double Science, own choice)

Likewise, Luna now worried that her choice not to take Triple might impact on her aspiration to study for a criminology degree:

> I was worried about that when I was looking into universities because it said like for Criminology courses it's good to have a science. (Luna, Double Science, own choice)

As these students lamented, the 'choice' of Double versus Triple (either at Year 8, age 12/13, or Year 9, age 13/14) had come too early, before they had sufficiently formed their aspirations and future plans. That is, they now felt unprepared and disadvantaged by this early 'streaming', but in particular, felt that particular post-compulsory science-related routes were potentially closed down to them.

Typically, schools identified students on the basis of attainment and informed them which route they had been allocated. On the whole, students accepted their lack of choice:

> I would have been made to do it (Double) even if I didn't want to do it, cos we're in the second set […] Yeah it [choice] depends how good you're doing. (Alan, Double Science, school's decision)

I didn't have a choice … it depends on your sets, really. (Raza, Double Science, school's decision)

Although almost all schools seemed to operate some sort of attainment-based criteria for allocating students to either Double or Triple routes, the required level of attainment varied between schools. In some cases, students reported that there were well publicised explicit grade requirements (e.g. getting a B, or equivalent, in science in end of KS3 tests). But in a number of schools, students reported that Triple Science students were selected either on the basis of being in a particular 'top' number or proportion of students, or that all of the top set were automatically entered for Triple Science:

> Well you have to get three Bs or above in your mocks to be like eligible. And so that means that the school would let you do it, and then I decided that I did want to do it. (Hannah, Triple Science, own choice)

> We got told … we got a letter sent home about the 30 highest achieving students or something in Science and you got put forward to do it and if you didn't want to you obviously said you didn't want to, but I just said yes I'll do it. (Brittney, Triple Science, school's decision)

There is a group of say like 25 I think doing it. (Millie, Double Science, school's decision)

> What the school do is if you're in set 1 then you take Triple Science unless you're in set 1 but you're struggling. Again in set 2 … if you're in set 2 or below you take Double Science, unless you're like in set 2 and really the top end, then you'll take triple. Yeah the school will sort that out at GCSE. (Tom4, Triple Science, school's decision)

> It's for the higher sets, like some students were just automatically given it. (Clay, Triple Science, school's decision)

Largely, students seemed to accept their school's pedagogic authority to decide who should be allocated to which route. In some cases, students suggested that someone who had been allocated to Double might be able to put forward a case to be considered for changing to Triple, although in general this was not felt to be a very common practice:

> Well the school gave everyone like a letter, like 'We've put you down for Triple Science, but if you have issues talk to your teachers'. But I don't think anyone's gone from Triple Science to Double Science in our year, but some people were given Double Science and said 'No I'm willing to put the work in to do Triple Science.' (Kate, Triple Science, school's decision)

A couple of students reported that they had been selected by the school, or identified as eligible to take Triple, but had chosen to take Double. These students explained their reasoning as being that it meant having one less subject option in their GCSE choices:

> My Science teacher wanted me to do triple, but I went for double… Because like if you did triple you get one less option, and I really wanted to do my options. (Heather, Double Science, own choice)

> Yeah, I think because doing Triple Science took up a whole other option, so I think I already had the other things that I wanted to do. (Luna, Double Science, own choice)

As Fairbrother and Dillon (68) discuss,

> Some high-achieving students turn down the chance to do Triple Science using options time, arguing that they want to retain a broad range of subjects on which to base decisions at the end of key stage 4. If they decide they do want to continue with science to AS and A2 levels, they reason that good grades in core and additional science will give them a sufficiently good foundation.

However, as noted above, a number of Double Science students in our sample did come to 'regret' their allocation, as they worried that it might hinder their emergent post-compulsory plans.

However, the 'choice' of Double or Triple was not solely based on attainment or student interest. As detailed by the RSA (2015) report, different schools have very different capabilities to offer Triple Science in the curriculum. In independent and more affluent schools, Triple Science was the norm and was offered within normal curriculum time to the majority of students. However in other schools, it was offered as an extra-curricular activity for a comparatively small group of students because the school could not accommodate it within the usual timetable.

> The Triple Science [students], they have to go every Tuesday and Thursday after school. (Laura, Double Science, school's decision)

This made it a much less attractive option for some students. For instance, Alan explained that even if he had the choice, he would not choose to take Triple:

> Cos in triple you have to stay in after school like an hour almost three times a week or more. [Int: Why?] Because they can't fit it all in the school lessons. (Alan, Double Science, school's decision)

Likewise, Mactavish talked about how his choice (to take Double Science) had been influenced by the fact that at his school Triple Science classes are provided out of the regular school day, as after school classes. Unsurprisingly, the students most affected by this differential provision were located in schools serving less affluent communities. In this respect, parallels might be drawn with Gillborn and Youdell's (2000) analysis of the 'rationing' of education that occurs within schools, in which different groups of students receive different curricula, typically reinforcing social inequalities, with working-class and minority ethnic students tending to be located in less prestigious 'bands' and courses.

It was also notable that students' choices (of Double or Triple routes) had also been influenced by their respective levels of cultural capital. For instance, students with higher levels of cultural and science capital (Dawson, DeWitt, Seakins, and Wong 2015) seemed more likely to opt for Triple Science. In particular, these students' parents had advised them about the transferability and status of Triple Science (as an 'enabling' choice) and, in some cases, exerted considerable influence to ensure their child took Triple Science:

> [I chose] Triple Science because my dad, he just knows best basically … Um, because afterwards I'd be better off. I'd have more knowledge. I'd have three subjects instead of kind of two … (Victoria, Triple Science, own choice)

> … she didn't want to do Triple Science …, I said well you've still got to do Triple Science. There was a coat she really wanted, sort of like a leather jacket. It was quite expensive and I said if you pick Triple Science I'll buy you that, but you have to pick Triple Science and never, ever tell me that you don't like it. You have to enthuse about it and you have the coat, and it was the best £60 or whatever it was I ever spent I think. (James, Victoria's Father, medium science capital)

As James went on to explain, if she had not taken Triple 'it would make it difficult for her to pick one of those Sciences at A levels … I didn't want her to close down too many paths between 14 and 16 for when she did her A levels'. As discussed elsewhere, we conceptualise this kind of knowledge as a form of cultural capital, which we have previously found to be linked to post-compulsory science aspirations and student science identity (Archer et al, 2015). This compares with the, on the whole, less socially advantaged (working-class and/or lower science capital) students reported above who described now 'regretting' their Double Science allocation. In this respect, we might understand more socially advantaged students as being able to make 'better' (more informed, strategic and enabling) choices, thus reproducing social inequalities.

Making the 'right' choice

A number of students reflected that, where students were offered a choice of GCSE science route, schools seemed to engage in considerable work to either explicitly, or implicitly, channel students into making the 'right' 'choice'. For high attaining students in state schools with more affluent demographics and independent schools, this was often described as a seamless 'coming together' of messages and influences which rendered Triple Science the most 'obvious' and 'natural' choice.

> It just seemed like an obvious choice. There was more, like more lessons in Science and I enjoyed it, so and a lot of friends were doing it as well, so yeah it just seemed like the best option. (Hailey, Triple Science, own choice)

Among middle and lower attaining students, this channelling was described as a matter of being told or encouraged by schools to understand that they would not be able to cope academically with the demands of Triple Science:

> I think maybe it's been encouraged like that, so like people who are less clever felt like they weren't able to take the Triple Science GCSE. But I think if they are really interested in it they would have taken it anyway. (Bethany1, Triple Science, own choice)

> They gave us an option to do Triple Science, but they did obviously say it's pretty difficult because you have to do all three. (Mactavish, Double Science, own choice)

> I think because at the time I liked PE and I liked Art, so it was either pick … I could do Triple Science, but I didn't really … I was getting a C grade and everyone who's doing triple seems like they're getting like As and stuff like that. (Dave, Double Science, own choice)

Indeed, many students who were taking Double Science justified the school's allocation practices by suggesting that they would not be able to 'cope' with Triple Science;

> I didn't know what it was about, and I don't think I could have handled it as well… Cos some of like the most smart people … the smartest people in our year does it … like do it, and they still find it hard. So if they find it hard, like imagine what … it would just be like twice as hard for me I guess. Cos when I was offered it it was like Year 9 or 10, I didn't really like Science at the time. (Celina, Double Science, own choice)

> I don't think I'd be able to handle Triple Science – I think I'd sink in it. (Cheeky Monkey, Double Science, school's decision);

> Triple Science is too hard […] I wouldn't have done it. I'd have failed it, so there was no point. (Danielle, Double Science, own choice)

> I think that would have been a bit too much for me (Lucy, Double Science, school's decision).

Of course, these students may be correct in their self-evaluations – they might well have struggled academically on a Triple Science course. However, it is also notable that the students voicing these concerns were more often than not from working-class backgrounds and were generally not particularly low attaining students. For instance, despite feeling that Triple would have been 'a bit too much for me', Lucy had achieved a grade B and had been placed in the top set. Likewise, Danielle has always enjoyed science (it has long been among her favourite subjects) and by age 16 aspired to take Physics at A level, yet she simultaneously ruled herself out of Triple Science, imagining 'I'd have failed it'.

We interpret this channelling, and the process through which particular students come to understand Triple Science as either 'for me' or 'not for me', as produced through pedagogic work, whereby decisions and outcomes are made via a combination of school institutional processes, parental and family capitals (including impact on pupil prior attainment), and pupil 'habitus'. Within this mix we found that schools are especially key facilitators of social reproduction through the mechanisms of selection which constrain and influence students' 'choice' of award route. As Bourdieu explained, pedagogic actions produce durable dispositions in the habitus which, as exemplified by the above extracts, mean that students come to see the school's decisions as 'right' and 'natural', and even self-select onto the different option routes accordingly. Indeed, this pedagogic work largely seemed to be very effective, with most students coming to share the school's view regarding which route would be the most 'appropriate' for them. As we discuss next, we see these self-selections as strongly inflected by social class and suggest that they might be understood as a form of symbolic violence, enacting the 'hidden injuries of class' (Sennett and Cobb 1977) upon Other students, through the construction of Triple Science as the 'elite', high status route, which Other students are encouraged to understand as being 'not for the likes of me'.

We now consider how the elitism of Triple Science is established and maintained, through (1) its construction as 'for the clever' and (2) the production of different 'cultures' of identity/habitus and learning between the two routes.

'Only for the clever': The symbolic violence of Triple Science

> I didn't want to do *just* Science. I wanted to do *Triple Science*. (Kelsey, Triple Science, own choice)

> Because if you pick triple it means you like Science a lot and you're very good at it. (Jake, Double Science, own choice)

Overwhelmingly across the students' interviews, Triple Science was constructed as the desirable, high status option, with participation in Triple Science signifying being 'smart', 'clever' and 'good at science'. These associations were exemplified by the selective (attainment-based) nature of entry onto Triple science and because the content of the course was widely seen as being more 'difficult' than Double Science. This 'difficulty' was viewed as a good thing by Triple science students, making the course more elite, desirable and 'interesting':

> It's a bit more difficult and it's a bit … I don't know. It's just more difficult, a bit more interesting. I don't really know why. (Brittney, Triple Science, school's decision)

The students who had taken Triple Science also seemed to overwhelmingly take up and reproduce these notions of privilege, applying them to themselves, for instance identifying themselves as 'clever'/'good at science'. This fed into a relational construction of those who take Double Science as being 'not clever'/'bad at science'. A number of Triple students suggested that the allocation of students on to Double or Triple represented a justified, 'natural' ordering of intelligence:

> I think to do triple you need to be clever, because there's a lot to learn. Like we had like, we had to hit a certain grade at the end of Year 8 to be able to study Triple Science and that's with a lot of schools they do that. (Louise, Triple Science, own choice)

In this respect, students taking Triple Science seem to buy into the discourse of their own cleverness. We interpret participation in Triple Science as operating as a marker of distinction (Bourdieu 1990), that is, it both creates, and is interpreted as reflecting, particular social relations of privilege and subordination. Consequently, Double Science is rendered a 'spoiled' identity:

> I wouldn't say I'm that bad at Science that I would need to take double. I'd say I'm like good enough to take triple … and I think it's more useful to do triple instead of double. (Mitchy, Triple Science, school's decision)

In order to assert and justify their own elite positioning, TTriple Science students often constructed those taking Double Science as being 'bad at science' (as opposed to just seeing these students as, for instance, being 'less interested' in science). The double/triple distinction was also naturalised into particular bodies – it was seen as a reflection of a natural order, what 'should' happen:

> Um, well the school kind of said to the people who should do double you should do double and everybody else it [the choice] was up to you. But they expect us to do triple, but I would've wanted to do triple anyway. (Samantha, Triple Science, school's decision)

Samantha's talk exemplifies how these distinctions can become solidified and justified through the process of misrecognition (e.g. Bourdieu and Passeron 1990), in which the qualities of the dominant are seen to be the justifiable result of their superior skills, aptitudes and qualities, whereas the disadvantaged positions of Others are seen as the result of their own failings, lack of talent, inappropriate attitudes, and so on. Indeed, Samantha's comments echo notions of a divide between the deserving and undeserving – such that only the 'clever' can enjoy (and deserve) the privilege of choice. As noted above, working-class students seemed most likely to internalise messages about who is/is not 'good enough' to study Triple Science which, Bourdieusian terms, is a form of symbolic violence.

The frequent elision of Triple Science with 'the top set' was also notable in many students' talk. As Caitlin put it 'the top set is Triple Science'. In this respect, we might interpret Triple Science as not just a pathway for those students who want to study more science but as a key way for students to perform high attainment. Hence, not taking triple is unthinkable for many middle-class students because it is tied to a 'failed' learner identity – not taking Triple would convey that a student 'can't cope':

> Well they sort of say who's less able really, and they suggest they do dual science.[I: Right. So could you have done Double science if you wanted to?] Um … I don't think so really, I think they'd be like 'You're mad' […] It's only really if they think you can't cope. (Joanne, Triple Science, school's decision)

One working-class girl, LemonOnion, who was selected by her school to take Triple Science recounted her initial shock and surprise at the decision, which we suggest may stem in part from her sense that Triple is more often associated with particular (classed) types of 'diligent' learner identities:

> Personally I don't know [how I got chosen for Triple science]. I did question it […] when I got told I was doing Triple science I was kind of really confused. I went up to my teacher and I went, 'Sir, how am I in Triple science? I didn't do any work in your lessons' and he went 'your CAT tests were really good' […] So I was like, so in Year 7, I was already smart enough to be in Triple Science!

However, she negotiates this conundrum (being identified as a 'top' student by virtue of being selected for Triple Science, while also seeing herself as 'not an ideal student') through recourse to a discourse of 'natural cleverness' ('so in Year 7 I was already smart enough to be in Triple Science!'). Aside from suggesting yet another variation in school practice around the application of attainment-based criteria for allocation to Triple Science, LemonOnion's account is also notable for its reproduction of the interpretation of Triple Science as 'only for the clever'.

Despite this strong alignment of Triple Science with 'natural cleverness' within the students' talk, there were also hints that some middle-class families were also deploying considerable economic and cultural resources to enable their children to 'keep up' with Triple Science. For instance, a number of families described paying for additional science tutoring (particularly in 'problem' areas, such as Physics, which many students and parents described as suffering from higher teacher turnover and 'poor teaching' compared to the other sciences):

> [We] didn't learn anything in Physics at all and in the past sort of month we've got a new teacher, so I'm having to learn the whole curriculum all over again really quickly. I've got a tutor outside of school now as well. (Victoria, Triple Science, own choice)

Such practices simultaneously confound and sustain the association of Triple Science with 'cleverness' and 'excellence' – that is, the 'need' for some students to use external tutors suggests that 'natural cleverness' alone may not solely be producing attainment and that the association of Triple Science with the 'best' teaching and learning may also be questionable. Moreover, the deployment of this form of capital can contribute to misrecognition – these students may be achieving well (as per DfE [2014] statistics) but this attainment may, in part, be due to their deployment of privileged resources. Accordingly, it might be suggested that students taking Double Science are being somewhat misled in their acceptance of Triple Science students as being 'naturally' cleverer. As Ball (2003), Whitty (2002) and others have noted in relation to other educational sectors/contexts, the middle-classes commonly colonise elite and prestigious educational routes – and we would suggest that this might be similarly the case for Triple Science routes.

The high stakes of Triple Science – 'they can bump you down to Double'

Positions of status and prestige are rarely secure and can require constant defence and assertion. Indeed, we detected a thread of anxiety and concern among some Triple Science students regarding the threat of being 'bumped down to double'.

We only found one instance among our sample of a student being removed from the Triple Science route (Bobster, a white, working-class boy). As he explained:

> I was doing triple, but I failed my coursework, so they were like 'yeah, you need to go away now'. […] Yeah, it all kind of went a bit bad yeah, so […] It happened last year, yeah, Year 10. (Bobster, Double Science, school's decision)

However, it seemed that the fear of 'failure' was more common and was voiced by a number of students:

> … like if you weren't like meeting their grades then you'd go into I think Double Science, I think. (Colin, Triple Science, school's decision)

> They can bump you down to double. (Gus, Triple Science, school's decision)

For some students, like Kaka and his friends, the fear of being 'bumped down' was a source of acute anxiety:

> Because of our mocks, they basically dropped a bomb on us, they basically said that if you don't get a good enough grade, you're going to be dropped for one of your sciences, so you'll be doing double. So the worst grade would be double. We got worried, because everyone would naturally get worried – we all want to do triple. […] All my friends were scared because they just wanted to get good grades in their test – so that's why everyone worked towards it because they were scared. (Kaka, Triple Science, school's decision)

Kaka implies that in order to retain their positions of privilege, students need to keep performing, and re-performing, attainment in order to remain on the Triple Science award route. And, as Bobster's case suggests, schools do act to reinforce these boundaries. As discussed above, such practices may mask and distort the headlines around the 'success' of Triple Science (i.e. Higher GCSE attainment and progression might be expected if lower attaining students are being routinely removed from Triple Science courses). But our analysis is also interested in how a culture of insecurity can operate as a technology of power. That is, we see the threat/practice of 'bumping off' as serving to exemplify and reinforce the pedagogic authority of the school – the school has the power to decide who can, and cannot, take Triple Science and can decide what sorts of students and behaviours are legitimate, or not. Indeed, as Bourdieu explained, from the outset, the system and those with pedagogic authority within it, are 'designated as fit to transmit that which they transmit' (Bourdieu and Passeron 1990, 20).

In selective schools, independents and state schools in more affluent areas, it was most often the norm for students to take Triple Science. In these schools, students talked about being made to take Double Science as a 'punishment' and/or a shameful, remedial action. Robert's comments were typical:

> Everyone starts off doing Triple Science and then if you do really badly you do Double Science instead. (Robert M, Triple Science, school's decision)

Such examples illustrate the normalisation of Triple Science within elite settings – it becomes the only legitimate option and pathologises anyone who takes double as educational/scientific 'failures' (cf. the discourses of those, such as Heather, white middle-class girl who choose to take Double for reasons other than attainment). In other words, students and schools undertake considerable 'work' to construct Double and Triple routes as being hierarchically related, *not* 'different but equal' options.

'Getting stuck' or 'becoming excellent': the reproduction of inequalities through the different cultures of Double/Triple Science

Analyses of variance and Chi-square tests for independence (with Yates Continuity Correction) using the Year 11 survey data revealed that enrolment in Triple Science was significantly associated with stronger student science aspirations and a range of more positive attitudes to science. For instance, compared to students taking Double Science, those taking Triple Science were more likely to:

- want to study more science in the future;
- aspire to a job that uses science;
- feel that they could be a good scientist in the future;
- express more positive and less negative views of scientists;
- aspire to be scientist and engineer;
- look forward to their science lessons;

find science lessons more exciting and are more positive about the content of their science lessons. In sum, students taking Triple Science exhibited more positive attitudes to science and stronger science identities. Of course, this could be interpreted as due to schools selecting the keenest and most able students to study science. However, we suggest that the different award routes may also produce different forms of student science habitus due to their different practices, status and 'cultures'. Students associated Triple Science with a culture of high attainment, high expectations, more sustained 'pushing', a fast learning pace and a cohesive and distinctive student science identity (recognising themselves and being recognised by others as 'good at science'). It was notable that the few working-class students who were taking triple tended to explicitly compare their attainment with how they imagined their progress

might have been, had they taken Double Science instead. For instance, LemonOnion reflected how they felt this combination of factors had motivated them to try 'harder' than they might have otherwise:

> Yeah cos I think if I was in the like Additional Science and things I don't think I'd have tried as hard. Because the people I'm with in my Science class, they're all like slightly smarter than me and I kind of sit next to them and they just help me with everything. And then when I get it, I'm helping them and I've just understood it more. Whereas all the other classes I think I wouldn't have been pushed as much, cos the work I hear from them guys is really easy and the work we're doing I think I get pushed more because we have to do it at a quicker pace. (LemonOnion, Triple Science, school's choice)

> … triple, I enjoyed a lot and I think that's what has pushed me to become an A*. (Mienie, Triple Science, own choice)

Arguably, the selective nature of Triple Science facilitates high teacher expectations for these students' attainment and their location within a cohort of higher-attaining peers might be expected to contribute further to a sense of identification and self-confidence in relation to one's science 'ability'. But as we shall discuss in the next section, the downside of this is that expectations may well be lower for Double Science students, because of the relational nature of the two award routes.

As Bourdieu explains, pedagogic action on the habitus produces durable dispositions within students, which we apply to our findings to suggest that participating successfully in Triple Science seemed to involve either confirmation of, or developing a view of, one's identity as a 'science person':

> I used to just have the friends that didn't do triple, so they didn't really understand the stuff I was saying, because they're a year behind us yet now I have like friends from Triple Science so they understand me a lot more […] probably because we got picked at an early age, so we kind of got labelled like that earlier I suppose. (Louise, Triple Science, own choice)

As a corollary, and as discussed in the next section, science identity was seen as more precarious/less authentic for those taking the double route.

In this respect, we argue that participation in Triple Science produces social privilege – not only because of the symbolic exchange value of these qualifications but also because a culture of higher expectations and associated practices (e.g. differential 'pushing') can produce higher levels of attainment. Indeed, it is notable that Louise and LemonOnion evoke a notion that those taking Triple Science are the 'chosen ones', who become symbolically marked as 'clever', high attaining 'science people'. The corollary of this is that those taking Double Science become marked as 'less clever', lower attaining students, and/or those for whom 'science is not for me'.

Triple Science – good or bad for the STEM 'pipeline'?

As discussed in the introduction, organisations such as the CBI have strongly welcomed Triple Science and see it as key to producing the next generation of the STEM workforce. Indeed, one of the main reasons given by students for taking Triple Science was because they already knew that they wanted to progress into post-compulsory science:

> I always wanted to do triple. Um, I preferred the sound of it. Um, and I just thought it would be a good GCSE to have as opposed to double, because I was pretty sure I should want … because at the time I was choosing my GCSEs I was pretty sure I wanted to take a Science for A level, so, um, and when we were talking at options evening they said it would be easier to do triple and then go on to A level. (Thalia, Triple Science, own choice)

Triple Science was undeniably introduced with the policy rationale of servicing the STEM 'pipeline' – but is it actually helpful for improving participation in STEM?

Analysis of our survey data shows that students taking Triple Science are twice as likely as those taking Double Science to aspire to study Biology at A level. They are about 2.5 times as likely to want to study Physics and over three times as likely to plan to study Chemistry at A level. Moreover, multilevel analyses show that, on average, students not taking Triple Science are choosing fewer science subjects at A level (i.e. students taking Triple Science choose more science subjects at A level). In other words, students who take Triple Science do seem more likely to progress into post-compulsory science.

Some Double Science students recognised that, had they taken Triple Science, they might have been more likely to take a science A level. Those Triple Science students who did not previously hold post-compulsory science aspirations also seemed to report a greater propensity to want to study science A level by the end of the course, compared to their views at the start of the course. From this, we might infer that taking a more in-depth, higher status and better resourced award route that is strongly aligned with 'science identity' in turn might make students want to study the subject more:

> Say if we'd just done Physics [as a separate GCSE], then yeah I'd probably want to take it up in like AS Level. (Hedgehog, Double Science, school's decision)

> Well I liked Science enough to take it and I think … I'm glad I did choose it because I am doing some for A Level now, but … well I'm going to … so yeah I think that was probably a right choice for me. (Rebecca, Triple Science, own choice)

In this respect, Triple Science might be seen as promoting participation in A level science. But what about its further link with the post-18 pipeline? Undoubtedly, a number of students who had 'always known' that they would take Triple Science framed their choice in terms of triple being a logical step towards their future science degrees/careers. In some respects, proponents of Triple Science and the STEM 'pipeline' might interpret this as illustrating the success of the route. However, various commentators have also reflected on how the alignment of school science with the STEM pipeline is very problematic (e.g. Osborne and Dillon 2008).

We suggest that the close alignment of Triple Science with the Science pipeline is counterproductive, not least because it dissuades many students from considering post-compulsory science and feeds elitist, narrow constructions of science as being only for the 'brainy' few. Our previous analyses suggest that one of the things that puts many students off taking science after the age of 16 is the assumption that it only leads to a narrow set of careers in science, namely scientist, doctor and science teacher (Archer and DeWitt 2016). Hence, we argue, many students who like and enjoy science are dissuaded from studying it further because they do not see it as relevant to their career aspirations. We also found evidence of this within the Year 11 student interviews, where some students indicated that they had chosen Double Science because they did not aspire to a 'sciencey career':

> Well it was based on the end of last year's exams and they said, they, basically they advised us to go which direction, but you could've swapped if you wanted to, but to be honest I wasn't really looking into a 'Sciencey' career and I want to get like overall better, so I would prefer to get on my like GCSEs two like A* and As than three Bs or whatever, so that's why [happy to do double]. (Georgie, Double Science, school's decision)

> Triple's more like if you're interested in science, and if you see that fit for like your future or something. And then double is just you know normal science now. (Gemma, Double Science, own choice)

Although many of the students in our sample who had opted for Triple Science had been influenced by their cultural/science capital, recognising the benefits and transferability of science, this capital had only been acquired by Louise towards the end of her time taking Triple Science:

> And like we talked to some of the colleges, they said those who had Triple Science are finding it a bit more of an advantage, which I like. (Louise, Triple Science, own choice)

The preference for Triple Award by 'top universities' has been commented on by various organisations (e.g. Success at School, Association for Science Education). Of course, already being on the triple course, Louise is pleasantly surprised by the realisation that Triple Science has a higher exchange value than double in the post-compulsory educational market. But this compares to her Double Science peers, such as Ghost, Chloe, Josh and Luna, reported earlier, who are also starting to realise this, albeit with anxiety/regret.

More worrying still for the 'pipeline', we found evidence that some students (with a considerable interest, aspiration and potential to continue into post-compulsory science), had effectively had these interests and dreams crushed, due to their allocation to the Double Science route. We illustrate this point with the case of Georgia, a white, lower middle-class girl from the south of England. From our interviews with Georgia between the ages of 10 and 13, she had always held a very strong interest in science and had aspired to become a marine biologist. She had a supportive family who also took part

in a range of science-related activities with her in their leisure time. However, by age 14 she seemed to 'lose' her aspiration to become a scientist – the turnaround seemed to derive from her experience in Year 8 of not being allowed to study Triple Science at school. As both Georgia and her mother, Isobel, described in their respective interviews, this decision negatively impacted Georgia's confidence and her science identity. As she explains in her Year 9 interview:

> I was quite gutted that I didn't get Triple Science, but obviously I'm not as good in lessons. [...] Because I was planning on doing Triple Science and then obviously going on and doing a science career, but I didn't get Triple Science, I didn't get picked for it.

Both Georgia and her mother explained in their interviews that Georgia was only 'one mark away' from being admitted on to the Triple Science course. As Isobel reflected in the Year 9 interview, Georgia was bitterly disappointed at the time, but Isobel had decided not to 'fight' the decision because she was concerned that this might be too stressful for both her and Georgia. However, Isobel later shared her concerns that the content of the Double Science lessons was not engaging her daughter sufficiently and that her confidence had been severely knocked:

I think Science, her lessons, she's not enjoyed it, this last sort of year or so.

In other words, students like Georgia – through her allocation to Double Science – had come to realise that science is 'not for me'.

Discussion

In this paper we have attempted to bring to bear some of the problems that we have found to be associated with the current 'stratification' of science at KS4 through the different Double and Triple Science award routes. We have highlighted uneven patterns of participation across the different routes, in which Triple Science students are much more likely to come from socially advantaged backgrounds. We have shown how the notion of students' 'choice' of science route at KS4 is, in most cases, fictitious, with students either being allocated by their school to a particular award route or their 'choices' are achieved through concerted pedagogic action (by schools and to a lesser extent, by some families), in which young people are essentially railroaded into 'choosing' a particular route. We argue that these current practices, in which students are 'streamed' into different science routes at KS4, are unhelpful and deeply problematic (as a practice of 'rationing' education, Gillborn and Youdell 2000) – both in terms of social equality but also for ambitions to widen STEM participation in England.

We propose that the equality case against Triple Science is that elitism and stratification are technologies designed to protect the benefits of the privileged few and, as a wealth of evidence from across educational contexts attests, such processes of distinction are associated with problematic outcomes for most Other students (e.g. Bourdieu and Passeron 1977; Reay and Wiliam 1999). Our analyses point to how students with differing levels of cultural, social and economic capital will experience very different potential science 'choices' at GCSE. We also wish to draw urgent attention to the lack of equal opportunities that are currently evident across the English state school system, in that not all students have the same opportunity to access Triple Science – not only due to the selective entry but also in terms of how Triple Science is differentially provided across schools (e.g. either not being offered or only offered as an after-school class in some schools).

Although girls appear to be reaching near parity with boys in terms of the gender profile of those who take Triple Science, as we have discussed, the stratification of students remains highly problematic in terms of social class and ethnicity. In this respect, we suggest that policy concerns might be usefully broadened to focus on the under-representation of working-class and particular minority ethnic students, alongside concerns with gender. Of course we are not suggesting that Triple Science has not 'solved' the issue of girls' under-representation in science in formal education, merely to be replaced with concerns of social class and ethnicity. Rather, we are arguing that science participation policy and practice needs to pay greater concern to *which* girls (and boys) tend to participate in science (or not) and *in what ways* (e.g. on which GCSE courses). In this respect, we call for a more nuanced approach

to approaching science participation issues, acknowledging the intersection of multiple inequalities. Moreover, it might be noted that figures show that women remain woefully under-represented on A level Physics courses and that this participation varies considerably between different types of school (for instance being much higher in single-sex girls' schools, Institute of Physics 2012) – suggesting that our concerns with the stratification of science at GCSE are also resonant in post-compulsory education.

We argued that the existence of these differential routes (and their differential status) means that Double Science is strongly associated with (and reinforces) the view among young people that post-compulsory science is 'not for me'. We contend that 13/14 years old seems unhelpfully early to be channelling so many (indeed, the majority of young people – given that c.75% of each year cohort do not take Triple Science currently) into the realisation that 'science is not for me'.

There is, perhaps, a particular irony here in that Triple Science was, in no small part, introduced (in the hope of) servicing the STEM pipeline – yet our analysis suggests that it may actually serve to *narrow* the potential pool of future A level science students. Indeed, our wider work suggests that many students are put off post-compulsory science because they see it as 'only for the brainy few' (Archer and DeWitt 2016; Archer, Dewitt, and Willis 2014) and we suggest that the stratification of science at KS4 plays a key part in producing and perpetuating these views and in restricting access to science A levels.

So what might be done to make school science in England (at GCSE and beyond) more equitable and inclusive? We propose that equity and pipeline concerns might *both* benefit from an approach in which students study a common science qualification route at KS4. Coupled with this, we call for a broader vision for school science, in which science is repositioned as an enabling subject with far more open (less restrictive) entry practices at KS4 and KS5. We also echo calls by Claussen and Osborne (2013) to make greater efforts to convey the utility of school science for all students and their future lives (rather than the current dominant alignment of school science with the 'pipeline'). We believe that enabling students to keep their options open and not forcing them into routes that can restrict their later choices, would be far more advantageous and fair.

Of course, opening up science at KS4 also raises questions for the organisation of subject choices and awards at KS5 – an area which, as we have argued previously, we see as urgently ripe for rethinking (Archer and DeWitt 2016). For instance, we would question whether young people (and society) are best served by being encouraged to take a relatively narrow, specialist set of A levels and, in particular, whether current science A levels (with their comparatively restrictive entry requirements/practices) are best placed to foster wider science participation. In sum, we conclude that the practices of stratification in relation to Triple Science are exclusionary and arguably, unfair and counterproductive – and hence deserve urgent policy attention and reconsideration.

Notes

1. The legal term for the two years of school education which incorporate GCSEs, and other exams, in state schools in England, Wales and Northern Ireland.
2. The level of confusion among students and parents is exemplified on the discussion threads of various online chatrooms, e.g. http://www.thestudentroom.co.uk/showthread.php?t=1782763; http://www.thestudentroom.co.uk/showthread.php?t=2172338; http://www.netmums.com/coffeehouse/tweens-teens-581/teens-61/725348-triple-science-gcse-all.html.
3. The other constituent nations within the United Kingdom (Scotland, Wales and Northern Ireland) have their own separate education systems. This paper focuses on England, which is characterised by strong central government control and has a national curriculum (introduced in 1988) but not all schools are required to follow (e.g. independent schools and academies can choose to follow alternatives.
4. Key stage 3 (abbreviated as KS3) is the legal term for the first three years of secondary schooling in state schools in England and Wales (normally known as Year 7, Year 8 and Year 9), when students are typically aged between 11 and 14.
5. E.g. see https://www.sciencelearningcentres.org.uk/cpd/ondemand/5d8d7ea4-49c6-4da4-b46f-84564194a181/identifying-and-inspiring-your-students-in-triple-science/ (accessed 7/7/2015).
6. In England, children from low income families and those in receipt of certain state benefits are eligible for free school lunches (free school meals, abbreviated to FSM). FSM is commonly used in English policy-making and research as a proxy measure for poverty – although it is also widely recognised that this is a problematic,

controversial and very crude measure. E.g. see https://www.tes.com/news/school-news/breaking-views/its-time-scrap-free-schools-meals-a-measure-poverty (accessed 26/2/16).

7. England has a variety of secondary schools that are free for parents to send their children to.
8. Cultural capital was determined by responses to items such as parental university attendance (and leaving school before age 16), approximate number of books in the home and frequency of museum visitation. These items were used to provide an overall indication of level of cultural capital.
9. The majority of questions used a Likert scale to elicit attitudinal responses. Interview topic areas include constructions of self (in and out of school, interests, learner identity, self-efficacy); experiences of school; experiences of and views on school science; teachers and other subjects; aspirations and the future; formation of aspirations; influences on choices; processes of post-16 decision-making; imagined future subject choices; gendered constructions of self and others; extra-curricular activities; images of scientists; achievement and popularity; careers education experiences and views on the usefulness of science.
10. This is the number of responses remaining after data cleaning (i.e. after removal of duplicate and incomplete responses).

Disclosure statement

No potential conflict of interest was reported by the authors.

Funding

This work was supported by Economic and Social Research Council [ES/L002841/1].

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