“Doing” Science Versus “Being” a Scientist: Examining 10/11-Year-Old Schoolchildren’s Constructions of Science Through the Lens of Identity

LOUISE ARCHER, JENNIFER DEWITT
Department of Education and Professional Studies, King’s College London, London SE1 9NH, United Kingdom

JONATHAN OSBORNE
Stanford University School of Education, Stanford, CA 94305, USA

JUSTIN DILLON, BEATRICE WILLIS, BILLY WONG
Department of Education and Professional Studies, King’s College London, London SE1 9NH, United Kingdom

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ABSTRACT: The concern about students’ engagement with school science and the numbers pursuing the further study of science is an international phenomenon and a matter of considerable concern among policy makers. Research has demonstrated that the majority of young children have positive attitudes to science at age 10 but that this interest then declines sharply and by age 14, their attitude and interest in the study of science has been largely formed. This paper reports on data collected as part of a funded 5-year longitudinal study that seeks to determine how students’ interest in science and scientific careers evolves. As an initial part of the study, six focus group discussions were undertaken with schoolchildren, age 10–11, to explore their attitudes toward science and interest in science, the findings of which are presented here. The children’s responses are analyzed through the lens of identity, drawing on a theoretical framework that views identity as an embodied and a performed construction that is both produced by individuals and shaped by their specific structural locations. This work offers new insights into the manner in which students construct representations of science and scientists. © 2010 Wiley Periodicals, Inc. *Sci Ed* **94:**617–639, 2010

Correspondence to: Louise Archer; e-mail: Louise.archer@kcl.ac.uk

INTRODUCTION

The issue of students' engagement with science has been a topic of enduring interest in the science education community for the past three decades. Major reviews have been conducted by Ormerod and Duckworth (1975), Gardner (1975), Schibeci (1984), and Osborne, Simon, and Collins (2003). Yet very little work has been conducted on what views young students hold about science—particularly not from a qualitative perspective that understands learning as tied to processes of identity construction (Holmes, 2000). This work offers, therefore, new perspectives on an enduring issue for the field.

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 United Kingdom, research has shown that the point of decline begins in the final year of elementary school (Murphy & Beggs, 2005). Indeed, Ormerod and Duckworth (1975) devote a whole chapter of their review on attitudes to science to the considerable body of work, which shows that interest in science is a product of student experiences by age 11, drawing on work conducted as early as 1874. This has been confirmed more recently by the longitudinal analysis of National Assessment of Educational Progress (NAEP) data between 1988 and 2000 conducted by Tai, Qi Liu, Maltese, and Fan (2006). Further recent evidence that children's life-world experiences prior to 14 are the major determinant of any decision to pursue the study of science comes from a survey by the Office for Public Management (OPM) for the Royal Society (2006) of 1,141 science, engineering, and technology (SET) practitioners' reasons for pursuing scientific careers. It found that just over a quarter of respondents (28%) first started thinking about a career in science, technology, engineering, and mathematics (STEM) before the age of 11 and a further third (35%) between the ages of 12 and 14. Likewise, a small-scale longitudinal study that followed 70 Swedish students from grade 7 (age 12) to grade 11 (age 16) (Lindahl, 2007) found that their career aspirations and interest in science were largely formed by age 13. Lindahl concluded that engaging older children in science would become progressively harder.

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 at high school and then college. Thus, we would contend that effort could be productively expended by (a) understanding what are the formative influences on student career aspirations between the ages of 10 and 14 and (b) attempting to foster and maximize the interest of this cohort of young people, particularly girls, in STEM-related careers.

Our approach to exploring students' engagement with science is grounded in notions of identity—an understanding that sees the lack of interest in school science as a product of the mismatch between popular representations of science, the manner in which it is taught, and the aspirations, ideals, and developing identities of young adolescents. Indeed there is a large body of work that would indicate that students' sense of self-identity is a major factor in how they respond to school subjects (Head, 1985; Schreiner & Sjøberg, 2007) and research has drawn attention to the ways in which identities (and inequalities) of gender, social class, and ethnicity can impact on students' engagement with science (e.g., Brickhouse & Potter, 2001; Calabrese Barton & Brickhouse, 2006; Carlone, 2004; Carlone & Johnson, 2007; Mickelson, 1990; Springate, Atkinson, Straw, Lamont, & Grayson, 2008). Our theoretical approach draws on feminist poststructuralist (e.g., Butler, 1990; Francis, 2008), critical sociological (e.g., Bourdieu, 1990) and postcolonial (e.g., Bhabha, 1990; Hall, 1992) theorizations of identities and inequalities of gender, social class, and ethnicity.

Drawing across these bodies of work, we understand identity (and hence, gendered, classed, and racialized identities) as both embodied and performed constructions that are both produced agentically by individuals *and* shaped by their specific structural locations (e.g., Archer, 2003; Archer & Francis, 2007). Identities are understood, therefore, as discursively and contextually produced (i.e., produced through practices, relationships and interactions within specific sites and spaces)—and as profoundly relational. For instance, "masculinity" is necessarily produced in relation to "femininity" (and vice versa). That is, a sense of self is constructed as much through a sense of what/who one *is not*, as much as through the sense of who/what one *is* (Said, 1978). Importantly, notions of identity are multifaceted and complex, being shaped in relation to intersecting axes such as gender, ethnicity, and social class, which can generate powerful notions of what is/not appropriate or normal for "people like me"—which in turn can profoundly shape individuals' educational choices and trajectories (Bourdieu & Passeron, 1977). Hence we suggest that children's interest and engagement with science will be shaped by their social structural locations and the specifically classed and racialized masculine/feminine identities that (are produced within such locations and that) they see as desirable and constitutive of the self (for instance, the notion of "laddish" masculinity among working-class boys is employed later in the analyses).

This paper seeks to explore then how such research-informed approaches can help to understand and address key challenges in enhancing participation, engagement, and achievement in science and mathematics, in particular to address differences linked to socioeconomic status, gender, and ethnicity. In particular, the paper represents an attempt, at the start of our project, to set out potentially useful concepts to work with, and to map key avenues for exploration over the next 5 years.

Study Design and Sample

The data for this paper come from an ongoing 5-year longitudinal study (funded by the U.K. ESRC Special Initiative on Science and Mathematics Education) that aims to develop an understanding of the processes underlying the formation of young people's aspirations and their engagement with science. Data for the larger project will consist of a quantitative survey (to be administered to approximately 9,000 students at age 10 and subsequently at ages 12 and 14) and qualitative, longitudinal tracking of 60 pupils and their parents over 4 years. To inform the design of the quantitative survey, six focus group discussions were conducted with 42 students drawn from four schools in the London area. These schools (detailed further below) were purposively selected to provide a sample of boys and girls from a range of backgrounds, representing a spread of socioeconomic status and ethnic diversity. The fundamental aim of these group discussions was to gather data on the topic and participants' perceptions and understandings. Thus, in selecting our sample, we sought to recruit a selection of students from a range of backgrounds and types of school. Such research seeks to develop a deeper understanding of its central focus exploring not only what participants think but why they think it (Kitzinger, 1994). As such, the goal is not necessarily to produce data that can be generalized to larger populations, but rather to explore the range of attitudes, values, and beliefs that are held, and the strength of feeling and reasons underpinning these views and beliefs. While previous research suggests that data saturation is achieved after three to four discussion groups, generalizing to a wider population must always be undertaken with caution (Vaughan, Schumm, & Sinagub, 1996) particularly as we make no claim about the representative nature of our sample. Essentially, discussion groups seek to expose what Schutz and Luckman (1973) have termed "intersubjectivity"—the collective description of everyday reality and its variation. The data emerging from such work provide a valuable tool for representing the world as it is perceived by the group and their interpretation of experience.

Students were sampled from four schools. Potential participating schools were approached from an existing list of school contacts held by the research team in relation to the criteria of attaining at least one affluent, independent school, at least one urban multiethnic school, and at least one small and one large state primary in the London area. The resultant participating schools were the four who agreed to our invitation. Consent forms were issued to parents' of children in Year 6 at each school, and discussion groups were conducted with the 42 students who returned consent forms. As detailed below, these discussions were conducted with single-sex groups in two schools, where numbers allowed, and as mixed-sex groups in the other two schools.

Pseudonyms have been assigned to the participating schools. "Inner City Elementary" (1 × girls group with two White Irish and four Bangladeshi girls, 1 × boys group, one Black African and five Bangladeshi boys) is a small urban elementary school situated in an area of high social deprivation with a large immigrant population (particularly from Bangladesh, Pakistan, and Africa). Most of the students attending the school are eligible for free school meals, and many do not speak English as their first language. "Private Elementary" (1 × group seven boys, 1 × group seven girls; pupils all White apart from one Asian boy) is a large selective, fee-paying school (admitting children from age 3–16). It is located in an affluent area of the city, and the majority of the children attending the school are from White British backgrounds. "Roman Catholic Elementary" (1 × mixed-sex group, seven students from one White, one Arabic, one mixed-heritage, and four Black African backgrounds) is a large, popular (oversubscribed) school located in an inner city area of considerable deprivation. The main pupil groups are those from White British and Black African backgrounds, and the majority of those attending are baptized Catholics. It is a publicly funded faith school (receiving additional support from the Catholic Church). "Urban Elementary" (1 × mixed-sex group, all nine students in the group were members of the lunchtime science club, all from South Asian—specifically Bangladeshi and Pakistani backgrounds) is a large innercity school in which almost all students come from minority ethnic backgrounds (the largest group being those of South Asian descent), and a very high proportion speak English as an additional language. An above average proportion of students are eligible for free school meals. All the pupils in the discussion groups were largely representative of the ethnic and socioeconomic profile of their respective school populations.

For the purpose of the discussion groups, a set of questions was developed that formed a loose structure for exploring these young students' views (discussion areas included: students' views on science, scientists, and their school science classes; out-of-school interests and leisure pursuits; aspirations for the future (and influences on aspirations). Students were assured of the confidentiality of the data, and each group lasted for approximately 1 hour. The discussion groups were conducted by the second author (a White American woman, denoted as "Int"/Interviewer in data extracts) and were digitally audio-recorded and transcribed. In line with the study's conceptual approach outlined earlier (in which identities and the social world are understood as discursively constructed), data were analyzed discursively using a Foucauldian analysis of discourse approach (Burman & Parker, 1993). This approach involves looking for the resources and repertoires that are employed within participants' talk and which are drawn on in (and are constitutive of) their identity constructions. These are then analyzed as practices of power (and are interrogated to the extent that they are both constitutive of and constituted by/within particular regimes of power). In this paper, this analytic process was undertaken by the lead author, who searched the data iteratively to identify key themes and identity practices and performances by the young students. Transcripts were initially broadly coded according to each of the main discussion topic areas (e.g., "reasons students enjoy science at school," "out of school interests," "views of scientists") and the content of these was then subcoded thematically (iteratively testing out emergent themes across the data set to establish "strength" and prevalence). These coded themes were then subjected to a more theoretically informed analysis (to identify practices of power and gendered, classed, and racialized discourses and identity practices/resources) to unpick the constructive elements (and the wider discourses that are evoked) within respondents' talk.

"DOING" VERSUS "BEING"

Our analysis of the role of identity within children's constructions of science is broken down into two major themes, namely "doing science" and "being a scientist." These were not specific questions within the interview protocol but were identified within the analysis of the data as two broad, common structuring discursive distinctions within the children's talk. As will be argued later, the importance of this conceptual distinction is that it explains these young students' ability to both reportedly enjoy science (most did) and to yet not want to continue with science in their future careers—to "become" a scientist (most did not). Our analyses thus highlight a key dilemma, namely that children can report enjoying science (e.g., they may find it fun, exciting, important, and interesting), but they may still choose not to study it at higher level. As we shall argue, these two areas were comprehensively infused with issues of identity and were circumscribed by social class, ethnicity, and gender, such that some options, even at this age, are beginning to be ruled out as not only undesirable but even "unthinkable," whereas other possibilities are understood as desirable only under certain conditions.

"DOING SCIENCE": *SAFETY VERSUS DANGER*

Under our major theme of "Doing Science," our data largely echoed what is known from the existing literature, namely that student interest in science at age 10 tends to be relatively high with little gender difference (Murphy & Beggs, 2005; Pell & Jarvis, 2001). Most of the children who took part in the discussion groups reported enjoying science at school. This enjoyment was predominantly framed in terms of the practical mastery of "doing" science, namely the "hands-on" elements of practicals and experiments, a preference that has also been noted in other work (e.g., Solomon, 1980; Osborne & Collins, 2001). We found across the discussion groups that the children's attachment to this form of "doing" science was framed within a discourse that we have termed "danger vs. safety," in which "real" science is constructed as "dangerous" (and exciting) and is placed in tension with school science (particularly elementary school science) due to the latter's concern with "safety."

Boys and girls both associated science with explosions and bangs, as one girl put it, "pouring liquids to make, like, an explosion."

Int: . . . So if you had to explain what science is to somebody who'd never heard of it how would you explain it?
Boy: Bangs.
Int: Bangs?
Boy: Just to say it could hurt your ears.
Boy: It's interesting and you won't know what's going to happen next.

(Inner City Elementary, boys)

While both boys and girls were likely to find this flamboyant and explosive nature of science interesting and engaging, there were suggestions of orientations that were differently gendered to this evocation of danger. For instance, one girl's rationale for not wanting to continue with science in the future was, "I don't want to get my head blown off by chemicals" (Inner City Elementary, girl). Indeed, girls were considerably less likely than boys to cite their interest in science as due to "explosions" (Jenkins & Nelson, 2005).

It was also notable that considerably more boys than girls spent time discussing the "dangerous" nature of science, which was juxtaposed with the restraints they felt were imposed by their schools in terms of "safety." As one boy at Inner City Elementary explained, "science is the dangerous kind of experiments and in school we don't do that stuff."

Boy 1: It's like a lot of *real* stuff, like the real scientists they do like chemical work—we just do like (inaudible)
Int: Mm, okay.
Boy 2: We do like the boring safe things, but they do experiments which are dangerous

(Urban Elementary, Science Club, mixed group)

Girl: They [Scientists] do more dangerous stuff than we do in school.
Boy: That's what I was going to say, I was going to say that in school we kind of . . . . We can't really go past the boundaries because it's too dangerous. Sometimes it gets frustrating because you know that nothing's really going to happen to you. But the school, obviously they want you to be safe and it kind of is annoying.

(Roman Catholic Elementary, mixed group)

The boys at the Private Elementary agreed, bemoaning that they are not allowed to do "really big experiments. . . like using acids and stuff" because "it's a lot safer at school."

It is interesting to note in these extracts how "real" science is already being constructed in gendered terms. While, among the sample of 10-year-old children, both boys and girls reported enjoying doing science, we can see here how they are starting to articulate a dominant discourse in which "grown-up" science is constructed in masculine terms: as "dangerous," risky and potentially unpredictable (and hence, by implication, exciting and innovative). While the children do not consciously use the language of gender themselves, feminist theorists have discussed how such attributes are clearly gendered and are aligned with masculinity (Francis, 2000; Francis & Skelton, 2008). The distinction between "grown-up" science and school science (which, drawing on feminist poststructuralist theorizations of gender, becomes positioned through a binary opposition as "immature," "not real science," as "safe" and as feminized) also suggests that those boys and girls who are attracted to this discourse of science perceive that there is an identity gap that will be have to be endured or negotiated if they are to continue with science. That is, the children identify a disjuncture between an attractive, desired vision of "real" science and a less attractive version of school science that must be pursued to become a scientist in the future. The overlaying of gender onto this disjuncture creates an additional identity conundrum—namely that an engagement with a "feminized" form of science is the necessary path to achieving (a more desirable, higher status) masculinized identification.[1] One boy at a Private Elementary also

[1] The conceptualization of gender that we use does not treat gender as tied to particular sexed bodies, i.e., girls can identify with, desire and engage in performances of masculinity and vice versa with boys and femininity. Although dominant social power structures mean that boys tend to perform masculinity more consistently than girls and that these performances tend to be judged as more "authentic" (and vice versa with girls and femininity).

provided some indication of the identity work that he undertook to try to navigate this disjuncture, adding the justification that "well, if you think about it all good scientists have to start off at this stage." It seems, therefore, that while these young children may not have comprehensive or detailed knowledge of what a future career in science might entail, they are tacitly learning from an early age that it is associated with masculinity.

As illustrated above, many boys positioned their elementary schools as spaces in which science is infantilized and "made safe" (see Skelton, 2001, on the dominant feminization of elementary schools). The "safe" elementary school was juxtaposed against the fantasy of secondary[2] schools as placed where more desirable and "real" ("dangerous") science might take place. A number of children, especially boys, talked about their keen anticipation of secondary school as allowing them to (literally) "play with fire, like Bunsen burners" (Inner City Elementary, boys), "when we get to secondary school we might be able to use fire" (Roman Catholic Elementary, mixed group; see also Urban Elementary, Science Club, mixed)—an expectation often fulfilled and well captured by the eponymous article of Delamont, Beynon, and Atkinson (1988): "In the beginning was the Bunsen Burner." The frisson of danger associated with secondary school science generated a sense of excitement and anticipation ("in secondary school it's more dangerous," "it's better because they trust you with more dangerous chemicals, stuff like that"; "dangerous stuff like explosions, mixing acids together, seeing what different chemicals do to each other").

It appears from these initial data that the boys have constructed a close (anticipated) alignment between popular masculine identities and secondary school science. While in some ways this is encouraging (because these students are imagining that they will become yet further engaged with science at secondary school), it also introduces the risk that they will be disappointed if the science they are presented with at secondary school fails to live up to their fantasy of danger. Indeed, evidence suggests that while secondary school science may initially contain some of these exciting elements, it quickly becomes more theoretical, demanding more writing than practical work (Osborne & Collins, 2001). Given the dominant popular equation of writing with "feminized" forms of learning (Skelton & Francis, 2008), it might be reasonable to assume that these boys' disillusionment with the demise of the practical/spectacular nature of science will be even more pronounced.

One possible policy response might be to suggest that secondary school science be reformed in ways that would emphasize and play up its "dangerous" potential. This echoes wider educational policy initiatives in the United Kingdom, United States, and Australia that have arisen from the debate about boys' underachievement, in which attempts have been made to increase boys' engagement and attainment in particular areas (especially those that are "feminized," such as English/literacy) by making them more "masculine," and hence attractive to boys (e.g., schemes that use football to increase the appeal of literacy). Such approaches have attracted considerable feminist critique for playing into gender binaries, for reinforcing dominant (hegemonic) forms of masculinity and for having negative implications for not only girls but also "other" boys (not all boys identify with dominant forms of masculinity). Moreover, as we discuss further later, the conceptual binary that we have identified within the children's talk between "doing science" and "being a scientist" would suggest that enjoyment of (and indeed, competency in) school science does not straightforwardly translate into the sense that one wants to (or could) "be" a scientist. In other words, increasing a pupil's enjoyment of "doing" science will not necessarily translate into their uptake of a science identity.

[2] Secondary schools in the United Kingdom take children from ages 11–16 or 11–18. There are comparatively fewer middle schools.

Doing Science Outside School: "Being Naughty" or "Being Good"?

As we have so far discussed, most of the schoolchildren we interviewed felt that the science they practiced in school bore little or no relation to the science practiced in the "real" (grown-up) world. Indeed, criticisms of the gap between school science and "real" science are not new—and calls continue to be made to increase the "real-world" relevance of science to better engage young people (e.g., Calabrese Barton, Ermer, Burkett, & Osborne, 2003).

In the discussion groups, we asked the children whether they ever practiced science outside of school and found that many talked about performing their own "experiments" at home. This might be seen as a heartening endorsement that not only are these children interested in science in school but they are incorporating this interest into their leisure time. However, we also identified some distinctly classed and gendered patterns within these accounts of "doing science at home," which might help explain some of the different, distinctive patterns of engagement with science that emerge in older samples of students. That is, the different ways in which these 10-year-old children engage with science in their leisure time may be indicative of some of the processes that feed into their differential likelihood to attain well and continue with science in the future. We have identified a distinction between those students who described their out-of-school science activities as informal and as part of having fun and being mischievous (*being "naughty"*) and those students who practiced science in a more formalized way, relating to recognized school science curricula, and whose activities we would interpret as feeding into the larger project of working on developing/enhancing their "good pupil" identities (*being "good"*). The following extracts exemplify the responses of those who talked about doing science out of school as something fun and "naughty"—the children are talking about what they like to do in their leisure time and if they ever do any science at home:

Boy: like at home going out and getting Coke, and then getting salt, going to my enemy's house, and then I put salt in the bottle, then like shake it up and it will fizz up, and then I will knock on the door, they'll open it, I open it—and that's it!

(Inner City Elementary, boys)

Boy 1: I fill up a balloon and like blow it up on people.
Int: How is that science?
Boy 2: Because we can see how the H_2O blows up and . . .
Int: Oh so it's a water balloon?
Boy 1: . . . and causes an explosion and all that.
Boy 3: H_2O is water.
Girl 1: I've got this set and it's called (inaudible) and you do experiments with it.
Int: Okay, uhuh.
Girl 1: And like you like stick all the different (inaudible) the little powder bits in like a balloon and then it all blows out (inaudible)
Int: Oh cool yeah.
Girl 2: I use my "Grow my own Crystals" kit.
Int: You use your what?
Girl 2: Grow your own crystals.
Int: Oh yeah, yeah. What about you?
Boy 4: Um, sometimes I get some balloons when I'm bored, and like rub it on my jumper or rub it somewhere, and stick it on my head.

(Roman Catholic Elementary, mixed group)

There were numerous accounts across the groups (mostly, though not exclusively, voiced by boys) where students talked excitedly about practicing science in terms of creating "explosions." As one boy from Inner City Elementary put it, "Science can be really fun, if you're being naughty." Indeed, putting Mentos (chewable mint sweets) into Coca Cola to make it fizz and explode was mentioned as a popular pastime among many of the boys we talked to (and indeed one of the girls at Roman Catholic Elementary). These activities clearly engaged the children and form part of the spectacular and "risky" vision of science that they were attracted to, as discussed earlier. As also illustrated in the above extract, the two girls mentioned more formalized engagements (e.g., the crystal growing set) than boys. The gendered aspect of this "naughty" engagement with science can be read as part of the young boys' performances of "laddish" masculinity, a contemporary form of popular masculinity. "Laddish" masculinities are the subject of considerable interest and interrogation within the gender and education literature and have been identified as an international phenomenon (Francis, 1999; Jackson, 2002). While laddishness is usually discussed with reference to older samples of boys and young men, it has also been noted as an important identity practice/discourse within elementary pupils (Renold, 2005; Skelton, 2001)—albeit in a more immature form than its adult manifestation. "Laddishness" derives from the notion of the "lad"—a young man who performs a gender-traditional (or monoglossic, Francis, 2000) masculinity, who engages in hedonistic practices (such as drinking, womanizing), is confident, "cheeky," "cocky," mischievous and entertaining (enjoys "having a laugh," "back chatting" teachers). The identity of the lad is oppositional to that of the studious "geek" or "nerd"—the lad is not studious or conscientious, he engages in public displays of "not working" and keeps any effort or school work strictly "under cover" (Frosh, Phoenix, & Pattman, 2001). As the literature suggests, laddish identities are not homogeneous (boys may perform some aspects but not others; laddish identities are not constant or consistent) nor are they solely restricted to boys (see Jackson & Tinkler, 2007, on the rise of the "ladette"). However, in the United Kingdom they do constitute a popular and pervasive discursive reference point and resource within many boys' (and girls') identity constructions.

While the children cited above do not embody the excesses of laddish identity, their youthful exuberance for the "naughty" and fun side of their informal engagement with science does point to the allure of such identities. Their talk suggests again (as in the preceding section), that for some boys, the most popular, fun, and accessible aspects of science are those aligned with hegemonic masculinity. Moreover, the nascent laddishness hinted at within the children's accounts (albeit framed here as being mischievous) would suggest that this popular engagement with science through hegemonic masculinity will not necessarily translate into later formal academic engagement with science. This is because laddish performances of masculinity tend to be predicated on a distaste for schoolwork, which becomes more trenchant with age. Thus, our point is that, while these children's accounts of a joyful engagement in out-of-school science can indeed be valued in their own right, this form of engagement may not necessarily extend to a continued formal educational engagement with science.

In contrast, some children (but particularly—though not exclusively—those from more "middle-class" backgrounds) talked about more formalized engagements with science outside of school—a discourse that we have characterized as "being good." These children described reading reference books, owning microscopes, and playing with science sets (such as the experiment set and the "grow your own crystals" set mentioned by the girls in the preceding discussion extract and the magnet set commented on later). One boy (at Inner City Elementary) described helping his uncle who worked in a laboratory. These children also talked about trying to replicate experiments conducted at school when at home. For instance, a boy at Inner City Elementary talked about how he had dissected a flower at home and a boy at Roman Catholic Elementary explained "when we were in Year 5 someone mentioned salt water and see how long it would dissolve or something, so I went home and tried it." The joy of learning about and practicing science was clearly something they took pleasure doing in their time at home:

> Boy: Well I look up books for experiments and sometimes look stuff up about the ozone layer etc. So it's much more different from school than I learn at home. But it's also quite fun.
>
> (Private Elementary, boys)

> Boy 1: I've got a magnet set at home.
> Int: Mm, okay yeah?
> Boy 2: I've got a magnifying tele- . . . it's a microscope that you connect to the computer, and you can see everything like snowdrops.
>
> (Urban Elementary, Science club, mixed group)

While these children also describe their out-of-school science activities as fun, there is a discernibly different feel to the form of their engagement, as compared to the "naughty" explosions outlined earlier. These children's engagement with science at home reflects a greater use of "cold" (formal, official) knowledge (Ball & Vincent, 1998), such as reference books and educational sets. This access to and comfort with cold knowledge has been found to be more common among the middle classes (Ball & Vincent, 1998). These activities, such as consulting reference books, replicating experiments taught at school, working with adults, using microscopes and educational sets, and so on, are more structured and closer in content and form to the formal learning that takes place within schools. As such, we would hypothesize that such practices are more likely to translate into cultural and educational capital (Bourdieu, 1986, 1990). That is, they contain a clearer potential to facilitate the children's attainment and progress in school science and to nurture and feed into the children's self-identifications (and indeed their teachers' assessments of them) as "good students." Indeed, we might even read these instinctive engagements with out-of-school science in light of sociological theorizations of classed parenting and childcare practices, which have been linked to the production of classed patterns of educational advantage and disadvantage. Working-class family practices tend to be associated with the "accomplishment of natural growth" (Lareau, 2007), in which children's development is not the subject of excessive intervention (to which we might map on those children's instinctive and unstructured engagements, epitomized by the "Mentos in Coke" explosions, which tended to be conducted by children playing among themselves, rather than under adult supervision or tutelage). In contrast, middle-class families have been associated with more interventionist and structured approaches, a "concerted cultivation" (Lareau, 2007) of their children, often through an orchestrated program of educational "enrichment" activities (Vincent & Ball, 2007) that aim to develop a range of skills, interests, and capabilities within the child—which in turn help foster "success." In this respect, we might read the "being naughty"/"being good" distinction in informal science practices as another field in which distinctions are germinating with regard to later patterns of achievement and engagement with science (see also Gladwell, 2008, regarding the significant advancements noted after the summer vacation period for middle-class U.S. students compared to their working-class peers).[3]

As the following extract from the girls at Private Elementary illustrates, middle-class parents are more likely to utilize their cultural capital to generate opportunities for structured learning at home, such as buying books, science sets, and resources and seeking additional information from schools to enable them to support their children to do "proper" experiments at home.

Girl 1: And when my parents went to parents evening they managed to get a web site where you can like make sherbet and make (inaudible) and dissolve things, and it's really interesting doing that.
Girl 2: Well I think it's good cos we can, because we like made lava lamps . . . well ones that only work once. It was really funny cos they're quite easy to make. But she just showed us how to make it and how it worked with olive oil and stuff.
Int: Oh wow.
Girl 2: And then it's really easy to make at home.

(Private Elementary, girls)

One of the girls also talked about how "I experiment with lots of little things at home." She described a science book she owned that she was working through at home (because "I can do science but I can't do it perfectly"), which enabled her to "make experiments at home, like how to make putty."

It was notable that it was only in the private (fee-paying) school that pupils mentioned explicit parental involvement in this way. This may indicate one of the many potential "small acts" and everyday practices that, over time and in sum, can help to foster higher levels of achievement and engagement with science among particular social groups.

Indeed, the potential importance of out-of-school interests and activities has been flagged elsewhere (Kelly, 1981; Ormerod & Duckworth, 1975; Woolnough, 1994). Mendick, Moreau, and Epstein (2009) conducted a survey with 560 Year 10 pupils from three comprehensives and 100 second year mathematics undergraduates in two universities and found that 40 Year 10 students rating themselves as "very good" at mathematics displayed a different and distinctive relationship to mathematics within popular culture. That is, they were "much more likely to play tetris and chess and to do sudokus and cryptic crosswords than other students" and were "most likely to carry on with maths" when it became optional at age 16. Indeed, it was notable that among our sample that the few children who embraced a potential future identity as a scientist linked this identity to their interests and activities at home (as opposed, for instance, to their interests or achievement at school):

Boy 1: I want to be um an inventor or . . .
Boy 2: Scientist.
Boy 1: . . . yeah scientist . . . or possibly an archaeologist.
Int: Ah, and why do you think you might want to be those things?
Boy 1: Because mostly at home I make inventions and stuff.

(Private Elementary, boys)

[3] The other distinctions at work within the students' constructions of their out-of-school science activities is the focus of forthcoming work, in which we explore the higher propensity for South Asian students in our questionnaire sample to undertake science activities at home.

"BEING A SCIENTIST": THE SCIENTIST AS OTHER

We have so far explained that while the majority of 10-year-olds we talked with enjoyed "doing" science, the seeds of later distinctions and patterns of attainment and uptake of science are already becoming evident. In this section, we explore the limits of this boundary of "doing science" and the problematics of its translation into "being a scientist" (i.e., the taking up of a science identity). We will suggest that the main issue at stake here is the potential to construct and inhabit an intelligible science identity—one that is valued in and for itself, that is congruent with other aspects of a person's identity, and that is also (seen to be) judged by others as being of worth.

Underlying our understanding of the reasons why an enjoyment of "doing" science may not translate into wanting to "be" a scientist is the argument that this disjuncture is particularly likely to occur where science, as an identity discourse, is experienced as clashing with popular hegemonic forms of masculinity and femininity. Given that the latter are often intensely held identities, evoking strong emotional attachments, and experienced as profoundly personal identity constructions, it is unsurprising that they effectively "trump" the viability of a science identity. For instance, a boy in Roman Catholic Elementary school agreed that he found science "fun" but could not countenance becoming a scientist because, for him, it is "football and wrestling always"—an expression of the evident allure of hegemonic masculinity. Indeed, football and wrestling do not even have to achieve the status of being distinctive career goals—their mere possibility is sufficient: "I don't want to be a wrestler—its just something that I like, that I might want to be a wrestler. I might not." Girls also voiced highly gendered discourses in which they resisted the idea of becoming a scientist because "I don't want to touch too many dead things" and "I wouldn't like to see people like, their things and everything.. yeah and I'm not really into these science like skulls and ears and stuff" (Inner City Elementary girls). While a substantive literature already exists pertaining to the gendered construction of children's aspirations and subject choices (Francis, 2000; Kelly, 1981; Lightbody & Durndell, 1996; Whitehead, 1996), we suggest that to understand the doing/being disjuncture further it is useful to look in more depth at the content of the children's constructions of scientific identities and the ways in which these are not only gendered but are also inflected by social class and "race"/ethnicity.

Science as "Hard"/"Brainy"

Science was overwhelmingly constructed as a "hard" (difficult) subject that required and demands application. However, the hard or difficult nature of science was something that many of the students reported as attractive. For instance, the boys at Inner City Elementary complained of their frustration with a teacher's attempt to make science "simple," arguing that this rendered science less interesting.

Boy 1: She [teacher] knows a lot but it's boring.
Int: Ah, the way she's teaching it?
Boy 2: She doesn't put emotions in it.
Boy 3: She tries to make it simple but she makes it **so** simple that she tells us all the stuff you already know.
Boy 2: Exactly.
Boy 1: It's not interesting.
Boy 3: We like it when it's so complicated we try to think it out with our brains, but she's always like "I'm making it simple. If I do any simpler it would be cheating" and I'm like "We don't want to cheat, so make it harder." We want to test our brains.

As the last comment above illustrates, these boys enjoyed the challenge of science as a "complicated" subject that requires students to use their "brains." Indeed, the terms "brain" and "brainy" were highly prevalent across all the children's transcripts (e.g., "it gets your brain going," Inner City Elementary boy), which we would interpret as reflecting the status associated with subjects such as science, that are closely aligned with notions of intellectual rigor. This link (between the "braininess" of a subject and its social status) was made explicitly by the girls in the Private Elementary, who answered the question of what makes science fun saying "when we learn like the really brainy things, like the things you don't learn if you're in a state school." These constructions are gendered and classed (being read as middle class and as masculine; see Harding, 1986) and hence are more likely to "fit" with middle-class students' everyday notions of desirable masculinity and femininity, being especially appealing for middle-class boys. As one boy at the independent elementary school explained, what he liked about science was "when you learn stuff that you can like sound cool with."

Children imagined that the science they would encounter in secondary school would be even harder and that this would be "a good thing" because it would require them to "use our brains more."

Boy 1: But we've got to use our brains more. There are going to be a lot more harder questions and harder experiments to do
Int: Uh huh. Do you think that's a good thing? A bad thing? Neither one?
Boy 1: I think it's a good thing

(Roman Catholic Elementary, mixed group)

Although the notion of science as "testing your brain" was seen as attractive, one boy suggested that it can make your brain "kind of tired" with the risk that "you just get confused."

The discourse of "science as hard" has been noted within other studies as a prevalent popular discourse, reproduced by students and teachers alike (see Carlone, 2004). However, while studies, such as Carlone's, with older students have drawn out how this discourse of "science as hard" collapses into a discourse of "scientist as naturally clever/intelligent," this link was not immediately evident within these children's accounts. While "being a scientist" was in some instances linked with being intelligent ("I think their [scientists"] intelligence makes them good at their job"), the "brainy-ness" of science was configured in a complex relationship with effort and ability. These younger students argued that one need not be naturally "clever" to be good at science, even though it is a "brainy" subject. Rather, they felt that interest, application, effort, and "concentration" were more important (for instance, the Science Club children suggested ways of improving in science: "Just depends if you like it or not and whether you concentrate," "Try and keep an open mind," and "Don't learn about just like certain subjects and topics, learn about all different topics").

This sentiment (that one does not have to be "clever" to be good at science) was echoed across the discussion groups. While it is encouraging that these 10-year-olds had not reached the point of closing off science as the preserve of the "clever," their discourse also contained contradictory elements, which point to how the dominant adult discourse (of science as for the "clever," that has been found by numerous other studies) might come to be solidified among older students and adults. We suggest that this is encapsulated in their parallel discourse of science as "natural interest," to which we now turn.

Science as "Natural Interest"/Natural Ability

When asked what makes someone good at science, students across the groups overwhelmingly drew on a discourse of "natural interest" ("you have to be interested in all types of science"), arguing that the possession of this "natural interest" (liking and enjoying science) provides the motivation to pay attention, remember facts, and to do well in science classes. It also provides the impetus to engage in more, additional, learning about science.

Int: Do you have to be really clever to be good at science?
Boy: Sometimes when you're like doing something, you can hear like interesting facts, or like really good stuff about science . . . you can remember it and then, cos you heard that, you could get interested in science. And then you would study . . . you would want to know more about science, so you look for more facts and more other stuff about science. And then you eventually . . . you become really good at science

(Inner City Elementary, boys)

Girl: The most important thing a science person must have is they like science—that's the most important thing. And if they like science, they have everything to do with science
Int: yeah?
Girl: They've just got to be able to enjoy themselves and not like say everything's hard, they've just got to try and enjoy it

(Inner City Elementary, girls)

This theme, of liking science and possessing a natural interest in it, at first appears meritocratic: as long as a student is interested and motivated, they can do well at science. However, there were also suggestions that the discourse might, over time, slip into an essentialized, embodied manifestation—that is, the notion that there is a "science person"—the individual who is naturally interested in science and who has a science "mind".

Int: What would you tell them if they wanted to be good at science? How would they do that?
Boy 1: They should learn. They should study on the weekends or after school. Do extra lessons maybe or tell the teacher you don't understand and they will help you.
Girl: Yeah, try experiments, do experiments that they haven't done before.
Boy 1: And share it with the class.
Boy 2: I think that you shouldn't like be that eager to learn science to be very, very good, I think you should just do science like normally in life, and have fun with it and naturally you will graduate in your brain, your mind will go on . . . it will increase in science.

(Roman Catholic Elementary, mixed group)

The last remark in the above extract hints at this notion: one should not be too "eager"; rather science should be undertaken "like normally. . . have fun with it" and this will "naturally" increase both competence and interest in science. The emphasis on "naturalness" contains echoes of popular discourses in which science and mathematics are associated with particular sorts of people, the science person (Carlone, 2004) or the mathematics person

(Mendick, 2006) who has a natural (innate?) ability and interest in science or mathematics and thus does not find it a chore or have to try too hard to learn about science or mathematics. The notion of there being a "science person" was also reinforced by several discussion groups' references to other children in their schools or year groups who were known to be "good at science" or interested in science. Several groups of students mentioned in passing (there was no direct question on the topic) these other children who were known as being "science people." For example, the children at Roman Catholic Elementary talked about a boy in their class who was known for wanting to become a scientist ("that guy loves science"). The private school girls also described a known "science person":

> Int: And do you any of you all want to be scientists when you grow up?
> Girl 1: I think that this boy in our class named [name], I think he wants to be a scientist.
> Girl 2: He's really complicated.
> Girl 1: Mr [name], he gave us a shortcut for this answer, and he [boy] goes for the most complex scientific proper maths ways, and so does his brother.

This was not unique—other groups also made reference to peers who were "known" as interested in pursing science, suggesting that science is already operating here as a marked identity. This is irrespective of the claim that the children also made that anyone can do science if they want. Here the "real," authentic science identity is distinctly embodied by particular individuals (notably "complicated" and "complex" individuals—see next section on "the boffin"), suggesting that while anyone can "do" science, only a few will really "be" scientists and that the identities of these children are popularly "known" from an early age.

The discourse of "natural interest" links closely with the idea of there being a "science person"—someone who is naturally interested in science and who has a "science mind." The research of Mendick et al. (2009) with children and young people highlighted popular constructions of a "maths person" who has a "maths mind." While at one level this construction might seem innocuous, it operates as a powerful embodied discourse that constructs a rigid division, akin to the distinction between "science people" and "nonscience people." While the children in our study do not subscribe (yet?) to such distinctions, their instinctive use of a discourse of "natural interest" might be interpreted as signaling how their current simultaneous construction (of "anyone can do science if they try") may become eclipsed in later years by the discourses of "science as natural interest" and "the science person."

Mendick et al. (2009) argue that the power of the construction of the "maths person" is predicated upon its association with notions of "natural ability." This obviously sits in an uneasy relationship with a discourse of excellence as achieved through effort, although as Mendick et al. note, the two are often voiced together:

> There is a complex relationship between natural ability and hard work, with most people supporting both the idea that you can get better at maths through hard work and the idea that some people are naturally more able to do maths than others.

In other words, they argue that there is a recurrent contradiction between the notions of natural ability and improving through effort and "a recurrent opposition between being a hard worker and being naturally able" (Mendick et al., 2009).

The discourse of "science as natural interest" also links in with dominant constructions of educational achievement as configured through natural ability (Walkerdine, 1988, 1989, 1990; Skelton & Francis, 2008). As a wealth of research has demonstrated, within dominant educational and popular discourse the identity of the "ideal pupil" is popularly constructed as epitomized by "effortless brilliance" (which is configured as male), which is located oppositionally to "diligent" and "plodding" achievement (which is configured as female); e.g., see Francis and Skelton (2005). The prevalence of this binary has been noted internationally as characterizing many teachers' talk. It has also been noted within science classrooms: for instance, boys in the physics classroom studied by Carlone (2004) in the United States, and in the U.K. classrooms studied by Warrington and Younger (2000), were described by their teachers as possessing a greater "natural ability" in science. In contrast, girls were constructed as diligent and hard working but lacking the flair and effortless brilliance of their male counterparts. The researchers noted that all these perceptions were irrespective of actual achievement (i.e., not all "brilliant" boys were achieving highly and even the highest achieving girls were described as owing their attainment to "hard work"). Against this powerful discursive backdrop, it is perhaps not surprising that many girls and young women come to see their identities as inconsistent with dominant constructions of the "real" or authentic scientist, whose identity is associated with "raw" (Carlone, 2004), "natural" talent, interest, and ability.

Indeed, Mendick (2006) details the considerable identity work undertaken by students in a Further Mathematics (an advanced-level upper mathematics) class to avoid identifying as being "good at maths." She found that students tended to attribute their success in mathematics to their "doing" (diligence, working hard) as opposed to being attributable to "being" good at mathematics. This was particularly the case for girls. Mendick argues that being "good at maths" is "a position that few men and even fewer women can occupy comfortably . . . they persist in constructing the mathematician as something you are or are not 'naturally' " (p. 216)

Scientist as Boffin

Closely related to the preceding themes of "science as hard" and "science as natural interest," we identified the construction of "scientist as boffin." "Boffin" is a colloquial term used in the United Kingdom, Australia, New Zealand, and South Africa, similar to the American notion of an "egghead":

> Boffins are "scientists, engineers, and other people who are stereotypically seen as engaged in technical or scientific research." The word "boffin" (or "boff"—often as an insult) can also be used to refer to any particularly clever person. The closest American equivalent is "Egghead." (Wikipedia, http://en.wikipedia.org/wiki/Boffin)

In U.K. schools, the term "boffin"/"boff" is used generically (it is not just restricted to science) to denote (and often ridicule) high achieving students who are associated with notions of "cleverness" (Francis, 2009). The science boffin is embodied by the popular and familiar stereotypical representation of the brilliant but eccentric scientist, epitomized by his "wild" hair and distinctly marked in racial, age, gender, and class terms as White, old, male, and middle class. In our research, Einstein was most often evoked to capture this representation.

> Boy 1: When I hear science I usually think of this man with a big moustache and like bald here [points to own head] and like with hair all around his head, and then
> Boy 2: Robert Einstein
> Boy 1: Yeah, Robert Einstein. And he's got a flask in his hand and he has this green liquid and he pours it into another bottle another flask that has red liquid and then all of a sudden— caboom!

Boy 2: Chemicals
Girl 1: Like explosions like you know when you like [inaudible]
Int: You mix things up, yeah
Boy 3: He's wearing glasses
Girl 2: Like goggles

(Roman Catholic Elementary, mixed)

Int: What makes someone good at science?
Boy 1: When they know a lot.
Int: When they know a lot? What about you, what were you going to say?
Boy 2: I was going to say the same.
Int: When they know a lot?
Boy 3: When they have big moustaches and they're a scientist.

The notion of the scientist as a brilliant (if eccentric) genius has also been noted in popular stereotypes of mathematicians (Epstein, Mendick, & Moreau, 2010), who observed how often, within young people's views, there is a conflation between being good at mathematics; masculinity; high intelligence; and middle/upper classsness. Moreau et al. (in press) also found that 14/15-year-old school students differentiated between stereotypical representations of mathematicians (who are short-haired geniuses) and scientists, who have long, wild hair ("scientists have crazy hair"). Unsurprisingly, this image was not seen as an attractive or desirable identity by many students, especially not girls who wanted to look "beautiful" instead:

> I wouldn't want to be a scientist because I don't want to find these like dead bodies and bones and . . . ugh! And then I wouldn't like to have big grey frizzy hair . . . because all scientists seem to have these caps on like bald heads and they have like [inaudible] and I don't want to look like that, I want to look beautiful. (Girl, Inner City Elementary)

Such findings chime with other studies, in which elementary and secondary school girls report enjoying science but cannot imagine themselves as scientists (e.g., Baker & Leary, 1995; Jenkins & Nelson, 2005).

We would hypothesize that the dominant popular association of "boffin"/egghead identity with science will be undesirable (and require negotiation) for any girls who are invested in the construction of conventional (heterosexual, gender-traditional) femininities, but racialized and classed discourses of femininity would suggest that this may be especially undesirable or problematic for particular groups of girls whose identities (e.g., as non-White and/or working class) are not typically associated with "boffin" identity. For instance, research demonstrates how popular working-class (especially White working class) discourses of femininity may not sit easily with notions of academic achievement (as compared, for instance, to middle-class discourses around the "blue-stocking") and how some of these constructions draw particularly heavily on certain embodied practices around "glamor" (Archer, Halsall, & Hollingworth, 2007; Skeggs, 1997) and sexuality (Renold, 2005). This is not to say that middle-class girls do not experience tensions in balancing a "desirable" femininity with academic achievement (cf. Reay, 2001; Renold, 2005), but that they have comparatively more discursive resources available to them to navigate this identity dilemma, given the popularly perceived congruence between academic achievement and middle-class femininity. For many working-class girls, a science identity may seem unintelligible (Butler, 1990) and completely incompatible with the versions of femininity that they recognize as culturally desirable and acceptable. In other words, to imagine oneself into a space of being, young people need to be able to "take up a science identity that can be recognized and accessed by others" (Calabrese Barton & Brickhouse, 2006, p. 224).

The interplay between discourses of femininity, sexuality, achievement, and science constitutes a space for analysis that we hope to pursue further as our study develops. Our conceptual starting point is that if high achievement and "effortless brilliance" tend to be constructed as masculine, then high-achieving girls are required to engage in a form of identity work that involves the negotiation of an acceptable form of femininity (see Francis, Skelton, & Read, 2009, in the context of high-achieving students in the United Kingdom). In the case of science, this is heightened further, due to dominant constructions of science as a masculine field. The ability for girls to navigate a successful (achieving) science identity will be overlaid further by social class and ethnic identities—being potentially slightly more congruent for middle-class girls (for whom dominant notions of "acceptable" academic femininity tend to be linked with the suppression of sexuality, Renold, 2005; Renold & Allan, 2006; Skelton & Francis, 2008). Ethnic identities will provide yet another crucial layer, or lens, for analysis. While Whiteness may be aligned more closely with the image of "the scientist" in popular discourse (and hence may be a potentially congruent identity discourse), evidence suggests that the perceived "respectability" and acceptability of a science identity may be constructed differently among ethnic collectivities (e.g., see Archer & Francis, 2007, in the case of the British Chinese). The interplay between race, class, and gender may mean that some families and collectivities may recognize and espouse versions of acceptable or respectable femininity which (for girls or young women at least) may render science as a more acceptable identity (for instance, due to its "status" and the associated discursive repression of sexuality).

Despite the potentially positive associations that might be expected to follow from being identified as highly intelligent by virtue of taking up a science identity, as Epstein et al. (2010) highlight in relation to mathematics, boffin identities reside dangerously close to "geek" (or nerd) identities—a stigmatized social/learner identity that many children seek to avoid. We would suggest that the children's constructions of the scientist as boffin indicate that, as they get older, a science identity will come to operate as a pariah identity (Francis, 2009) within the classroom—only a few students will be willing to "risk" or embrace the identity due to the negative weight that it carries in popular identity terms. Its boffin associations and incongruence with popular/desirable forms of contemporary masculinity and femininity (especially working-class configurations) make it a potentially risky identity, being closely associated with markers of an "uncool" identity.

Francis et al. (2009) argue that if high-achieving pupils are to also be popular (and resist being positioned by their peers as boffins) they have to mobilize certain embodied capitals (notably physical attractiveness and fashion and or style) and conform to performances of dominant (conventional) gender identities (e.g., being sporty for boys and being "girly" and coquettish for girls). Brickhouse and Potter (2001) describe the case of Ruby, an African American girl in their longitudinal U.S. study who had to engage in sustained identity negotiations to balance her achievement and participation in a competitive computing program with an acceptable femininity. Ruby attempted to achieve this by balancing her "masculine" performances of achievement (and achievement in a traditionally male sphere) with her performances of hyperfemininity (e.g., doing modeling and cheerleading). This was not easy, as detailed by her "struggle to construct a livable identity in a competitive computing program in which she desires computing competence but does not desire other aspects of the central image of the computing program" (Brickhouse & Potter, 2001, p. 971). Thus, it seems likely that if an adolescent student is to embrace a science identity he or she must either inhabit the position of pariah (the socially derided "geek") *or* possess the requisite embodied capitals to also convincingly perform dominant heteromasculinity/femininity.

The Defense of Science as Masculine: ("Fashion and Science Don't Mix")

Drawing on the data from this study, we have argued thus far that taking up a science identity may be undesirable for many groups of young people but may become particularly problematic for girls (especially working-class girls) as they progress through compulsory (and by extension, we imagine, postcompulsory) education. In this final section, we wish to highlight how, in the case of girls' scientific identities, boys do not play a silent or passive role in this process. This is reflective of how discourses are not external, objective structures (that exist "out there" in society) but are active—they are constantly taken up, resisted or embraced, and reworked. The exclusion of girls from a high-status (albeit contradictorily configured) identity and field such as science is part of the patriarchal dividend—a state of affairs from which boys or men may benefit more generally. In this respect, it was not surprising that we found evidence of some boys making their own active investments in reproducing and policing the boundary of science (arguing that it is or should be a male preserve). This is encapsulated in the following extract, in which a group of boys suggest that girls are not "naturally" into science because "fashion and science don't mix." The boys argued that boys are better at science, explaining that the scientists they know are all men ("cos my uncle's a scientist and he's a boy"; Newton, Einstein, and Edison were also cited). One of the boys also suggested that girls "have no confidence" in science, and this was due to their preoccupation with "their nails chipping when they're doing the experiments."

Boy I:	don't think girls would make good scientists or like you know inventors and that, because they aren't usually interested in science mostly. If a girl is yeah, they would become famous like . . . there might be a girl that invented something– is there?
Int:	Mm.
Boy 2:	Yeah yeah. They mostly care about fashion. If they put everything into it, but most girls these days care about fashion and their trousers (inaudible)
Int:	Couldn't [girls] care about fashion *and* science?
Boy 2:	No they wouldn't, because fashion and science don't mix.
Boy 3:	Your nails could get chipped.
Boy 1:	I can add to that. Yeah, if they like . . . in science . . . cos most scientists wear glasses and girls these days care about fashion, and glasses aren't in fashion.

(Inner City Elementary, boys)

The above comments were made by an all-male discussion group, and it was notable that none of the mixed-sex groups produced such accounts, presumably because the presence of girls would potentially have led to such views being challenged. But the above can also be read as part of these boys' everyday performances of "doing boy." This sort of "cartoon sexism" is not uncommon in all boy groups (e.g., see Archer 2002, 2003) and often tells us more about the ways in which boys discursively "jockey for position" with one another (e.g., by articulating controversial or socially "risky" views, or by adopting extreme or hegemonic viewpoints) than about their substantive views on gender equality. What is interesting here, however, is that science is recognized and deployed as a powerful resource for negotiating gendered subject positions. The boys all "know" that science is popularly configured as masculine and as high status and is hence something that, as boys, they would have a vested interest in claiming (as "for boys"). They recognize the ways in which science is popularly positioned as antithetical to femininity, and they are able to draw on dominant stereotypes around femininity to question its viability as an identity discourse for "real" girls (it is rendered acceptable only for unfashionable girls who do not "care" about their appearance, i.e., challenging conventional notions of popular or desirable femininity as compatible with science). This exchange thus alerts us to the issue that if, as educators, we wish to attract more girls into science then we will need to focus our attention as much on popular or dominant constructions and performances of *masculinity* (and the ways in which boys may defend and claim science—and hence challenge and resist such interventions) as we might femininity.

CONCLUSION

In this paper, we have identified and discussed a key dilemma for science education, namely that children can report enjoying science (e.g., they may find it fun, exciting, important, and interesting) but they may still see it as "not for me" and choose not to study it at a higher level (Jenkins & Nelson, 2005). We conducted our analysis of children's discussion group talk through the lens of identity, noting how constructions of science and identity are circumscribed by social class, ethnicity, and gender. We detailed how, even at this young age when children are mostly enthusiastic about science, some aspects of a "science identity" are beginning to be ruled out as not only undesirable but even "unthinkable," and other aspects are understood as possible or desirable only under certain identity conditions. In other words, beneath the broad brush general enthusiasm for science expressed by these children (independent of gender, ethnicity, and social class), we can excavate the germination of (gender, ethnic, class) distinctions that will come to be solidified in later years. Our analytical distinction between "doing" and "being" provided an entry point to understanding and explaining this disjuncture.

The children's discursive demarcation between school science (as "safe") and "real" or adult science (as "dangerous") highlights a real dilemma for educators: reworking school science in a way that would be more attractive to hegemonic masculinity (assuming this is even possible) might increase the interest and engagement of some boys but would be undesirable in that it would alienate girls and other boys and, given the inherent tensions between "laddishness" and schooling, may well be unsuccessful even with its target group. The disjuncture we have identified between "doing" and "being" would also lead us to question the utility of such an approach. Indeed, Osborne and Dillon (2008) have argued, for instance, that what is required is a new vision of science education, not only of what we know and how we know, but also what kinds of careers science affords—both in science and from science—and why these careers are personally fulfilling, worthwhile, and rewarding.

We also suggested that subtle differences between children's nature of engagement with out-of-school science also contain indicators of future distinctions (particularly classed distinctions) in terms of patterns of achievement and engagement in science. This suggests that a focus on reforming school science alone may not be sufficient if we are to broaden its appeal.

Finally, we would suggest that the content of the "being a scientist" construction (in terms of science as hard/brainy; science as natural interest; scientist as boffin) have enabled us to tease out the complex interplay of discourses of gender, sexuality, ethnicity, and social class within children's everyday constructions of science. Our analyses lead us to identify a conundrum in that, in its present form, science appears to be constructed as "too feminized" for (many) boys and "too masculine" for (many) girls. This appears to constitute an impossible position—can science ever appeal to all constituencies as a viable identity? This may point to the need to work with multiple visions of science—a position that in itself suggests a need to disrupt dominant discourses around science and the identity of the scientist. It also impels us to consider how we might bridge the gap between children and young people's everyday identities (those that are experienced as desirable, authentic, and conveying status within their daily fields of interaction) and the identities and messages conveyed by school and "real" science. Our analyses suggest that intelligible gender identity performances within one field (e.g., home, peer culture) may be incompatible with others (e.g., science). In particular, a science identity as it is popularly configured appears unintelligible for some children and young people due to its dominant gendered, raced, and classed configuration.

Our analyses contribute to understanding the complex identity processes that may underlie the deep-seated, often trenchant, resistance that many interventions, designed to increase engagement and uptake of science among young people, have encountered. While many of these interventions have been carefully and thoughtfully designed by a range of appropriate experts and practitioners, evaluative evidence indicates that even the "best" interventions may still be resisted by pupils and/or enjoyed by those involved but make little or no difference to pupils continuing with science (e.g., see Carlone, 2004; Solomon, 1997). It is from this platform that we hope to be able to move forward to identifying how we might be able to interrupt dominant identity patterns of (dis)identification in relation to science in the future.

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