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"I'm being a man here": Urban boys' performances of masculinity and engagement with science during a science museum visit

Abstract

It is widely recognised that there is a need to increase and widen participation and engagement in post-compulsory science and informal science learning spaces, such as science museums. Urban young people from working-class and minority ethnic backgrounds are a key target group in this respect. While there is a growing understanding of the intersection of femininity with class, ethnicity and science learning across formal and informal settings, there has been very little work on how masculinity may play a role in urban boys' science (non)participation and (dis)engagement. This paper analyses the performances of masculinity enacted by 36 urban, working-class boys (from diverse ethnic backgrounds) from two schools during school science museum visits and explores how these performances relate to science identity and engagement. We identify three main performances of masculinity that were enacted by boys on the visits ('laddishness', 'muscular intellect' and 'translocational masculinity'), and trace the differing implications of each for boys' science engagement. We consider the power implications of these performances, notably the extent to which hegemonic masculinity is normalised within the science museum space, the ways in which this normalisation is co-constitutive of the boys' performances of masculinity and the implications of the boys' performances of masculinity for other students (notably girls and less dominant boys). The paper concludes with implications for research, policy and practice regarding how to promote equitable participation and science learning within informal science learning contexts.

Keywords: Gender, masculinity, science learning, museums, capital, Bourdieu, identity

Participation in science learning in formal and informal settings

A group of 12 to 13 year old boys are using a 'hands-on' interactive in a science museum gallery. Almost all the boys from this class have gathered together to use this large, multi-part interactive, while the girls in the class work in smaller groups on other interactive exhibits around the gallery. The boys are shouting, laughing and spurring each other on, not least because the interactive only works if a number of people work together to move pieces around a large system. Jason asks if Kane wants to go somewhere else because he wants to try another exhibit, but Kane tells him 'not yet'. Daniel is with the group and is shouting 'come on, come on'. Jason almost leaves the group, saying 'I'm going to do something else, this is too addictive', but then Jason shouts at Ryan 'come on you're weak, hurry up'. As Ryan returns to the group at the basin he checks with Jason – 'Jason, was there bare [many] coming out when I did it?' Lucy (a museum facilitator) arrives and makes an attempt to facilitate, asking whether they have tried other exhibits, and what they think this is like in everyday life. This is ignored by the excited boys. Jenny (another museum facilitator) makes two announcements trying to get the group to meet up, and eventually has to go over to the boys to break up the excitement. The boys shout that they want to do one more, ignore her for quite a while. When she grabs the basket to stop them, they start throwing beads at one another. Jason says 'that was fun' as they walk away. As they meet with the rest of the group Jason and Sam throw beads at Hannah, who along with her friend Grace, had been watching the boys on the multi-part interactive but never joined in.

Understanding how students engage with science learning opportunities inside or outside school classrooms is not straightforward. As the above example suggests, opportunities to engage with and learn about science can be interpreted and used differently depending on time, context and the young people involved. Taking the view that learning is a sociocultural process (Rahm, 2010; Vygotsky, 1978), how, what and why students learn in any given space will vary by student identity, social position and context, with potentially considerable variation across social axes such as gender, social class and ethnicity. In this paper, we focus on the ways in which gender identity, but specifically masculinity, may relate with student engagement and learning in the context of science. We understand 'engagement' as involving a number of aspects, including: a meaningful (emotional) connection between the person and the activity, object, experience or role; 'the sense that the context will offer relationships that support and value their unique selves' (Nasir & Hand 2008: 145); an investment of energy by the actor and their purposeful (intensive and/or extensive) participation in the situation. Also of core importance are 'students' feelings of competence and mastery in a social context, as well as their sense that the context will offer relationships that support and value their unique selves' (Nasir & Hand 2008: 145). In particular, we are interested in the interplay of (gender) identity and learning, in line with work that suggests that students will feel more engaged and will learn more when they perceive a linking, or

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congruence, between their own identity and the learning setting (Nasir & Hand 2008). As Nasir and Hand (2008) also discuss, comparatively little is known about 'the features of out-of-school settings that support a sense of connection to those settings for learners (ibid., 145-146), hence our study seeks to contribute to understandings of how gender identity may mediate learners' sense of connection to settings such as science museums, exploring how engagement and learning may be opened up, or closed down, by particular configurations of gender within a science museum setting and the ways in which these interact with students' own performances of gender.

Internationally, widespread concern has been expressed that more needs to be done to increase and widen current patterns of participation in post-compulsory science. Girls, women, minority ethnic and working-class young people remain under-represented across various fields of post-compulsory science, but particularly in the physical sciences and engineering (AAUW, 2010 and Smith, 2010a, b, 2011). Although in media and policy documents the factors underpinning these participation patterns are often framed as a matter of individual 'choice' or 'interest' (e.g. Telegraph 2008), critical approaches have drawn attention to the role of intersecting structural inequalities (e.g. of sexism, racism and social class) in producing these patterns of unequal participation (e.g. Atwater 2000; Baker, 1998; ; Brickhouse & Potter 2001; Calabrese Barton & Tan 2009; Carlone 2003; Carlone & Johnson 2007; Carlone et al 2012; Harding 1998, Haraway 1988; Rascoe & Atwater 2005). Similar patterns have also been noted in terms of voluntary participation in informal science learning environments (ISLEs), such as science museums (Dawson 2014; Feinstein & Meshoulam, 2014), where researchers have identified how a confluence of dominant (white, male, middle-class) institutional cultures and social and economic exclusion combine to produce particular patterns of participation and non-participation. Yet, there are still key gaps in our understanding of processes of inclusion and exclusion across formal and informal science learning contexts. Urban young people constitute an interesting target audience in this respect, as they tend to be located at the nexus of intersecting inequalities of ethnicity, class and gender. It is thus both useful and important to achieve a better understanding of urban young people's experiences within different science learning spaces and how and why some find these experiences off-putting, while others find them appealing.

It has been suggested that ISLEs can afford another 'way in' or 'on-ramp' (Russell et al., 2013) to science for students, especially those whose experiences of school science have been largely unsuccessful in engaging them (Russell et al., 2013). Indeed, ISLEs have been positioned as potentially offering 'third spaces' - that is, spaces that can promote science learning and

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engagement through the re-working and refiguring of science in ways that are more relevant and equitable for urban young people (Falk & Dierking, 2010; McCreedy & Dierking, 2013) Tan et al., 2012). The positioning of ISLEs as an alternative 'way in' to science suggests that ISLE practice may potentially be better able to engage students with science than school science teaching (Falk, Dierking, & Semmel, 2013; Stocklmayer, Rennie, & Gilbert, 2010). Indeed, school science has been found to be problematic for 'Other' learners in a variety of ways, not least due to its privileging and normalisation of white, middle-class and male ways of being (Basu, Calabrese Barton, & Tan, 2011; Lemke, 1990; Shanahan & Nieswandt, 2011). But can ISLEs really sidestep these issues simply by virtue of being a different space?

Research shows that the visitor profiles of science museums tend to be socially privileged, comprising predominantly visitors from white, affluent backgrounds (Dawson, 2014; Feinstein & Meshoulam, 2014). Studies also indicate that gender inequalities remain an issue within such spaces, with boys tending to get more attention in ISLEs (Borun, 1999; Crowley, 1999; Crowley, Callanan, Tenenbaum, & Allen, 2001; Dancu, 2010; Ramey-Gassert, 1996). For instance, Crowley (1999; Crowley, et al., 2001) found that in ISLEs, parents pay more attention to boys than girls and engage in more scaffolding of their sons' learning than their daughters'. Moreover, evidence suggests that certain forms of exhibits are not gender-neutral, but attract and retain boys' attention more than girls (Dancu, 2010). In other words, the 'on ramp' and 'third space' potential of many (particularly designed) ISLEs for engaging urban youth may be currently under-developed and constrained by their reproduction of wider forms of uneven social power relations.

Wider research on science engagement and learning in out-of-school contexts suggests that certain kinds of practices – but notably those organised around social justice principles, such as promoting youth agency, reconfiguring what is valued as 'science' and challenging structural inequalities - can successfully engage and support students from disadvantaged backgrounds and support them to develop an identification with science (Barton & Tan, 2010; Barton, Tan, & Rivet, 2008; Medin & Bang, 2014; Rahm, 2010; Thompson, 2014). In particular, students appear to have more successful (engaging, learning) experiences within these spaces when the context and activities align with, value and build upon those aspects of their youth identities in which the young people are already invested. For example, Thompson (2014) describes a girl in her study who values being a young Latina and being able to contribute to her community. Thompson describes how the girl's identity and cultural resources can be leveraged through relevant science engagement and learning experiences, such as her learning about the relationship between

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asthma and smoking which she uses to explain to a family member the importance of not smoking in the house.

In line with this, various writers have argued that if we are to improve (increase and widen) science participation and engagement, more effort needs to be made to link science with the interests and lives of young people from diverse backgrounds, rendering science more personally and socially relevant and inclusive to a wider social spectrum (Barton, Ermer, Burkett, & Osborne, 2003; Barton & Tan, 2009; Carlone, Scott, & Lowder, 2014; Gonsalves, Rahm, & Carvalho, 2013; Tan, Barton, Gutiérrez, & Turner, 2012). For instance, feminist science educators, such as Barton (2003; 2008) and Gonsalves et al. (2013) have pioneered the development of supportive learning environments where youth can engage in science learning that is meaningful to their lives and 'focuses on and builds upon their prior experiences and interests' (Gonsalves, et al., 2013). This work has focused on investigating how we might develop ways to disrupt the elitism and hegemony of science, enable young people to re/configure science and to support them in relating to science in new ways (Gonsalves, et al., 2013). However, as some of these endeavours have found, whilst out-of-school science contexts, such as ISLEs, may offer useful 'third spaces' that can facilitate more egalitarian forms of science engagement among urban youth, they do not necessarily have the power to disrupt the hegemony of school science which remains the most powerful and authoritative version of what young people see as 'science'. That is, concern continues to be expressed that there may be a limited transfer of benefits from out of school to in school contexts (Gonsalves, et al., 2013).

In this paper we explore the potential of one particular science learning 'third' space, which blends formal and informal learning settings, namely school field-trips to a science museum. Understanding how school students learn science through field trips to informal science learning environments such as museums, science centres, nature parks or zoos, has been the subject of significant interest in science education research. For instance, a review of the literature by DeWitt and Storksdieck (2008) found that school-trips can promote cognitive and affective learning and can provide valuable opportunities for students to explore and encounter science – although the nature of the learning which takes place is strongly shaped by the structure and nature of the visit. That is, well designed and supported school visits to ISLEs can potentially support students learning about and engaging with science when supported through specifically designed materials or staff facilitation.

In this paper, we present data from an intervention developed as part of the Enterprising Science project, a five year research and development partnership between King's College London and the Science Museum and BP. The larger project seeks to understand how urban

young people engage with science with the aim of informing socially just approaches to engaging these students with science in ways that might be both equitable and empowering. This paper explores the relationship between boys' performances of masculinity and their engagement with science during a school museum visit intervention. Specifically, we ask: (1) what performances of masculinity do urban, working-class boys (from diverse ethnic backgrounds) enact during the school science museum visits; (2) how congruent or dissonant are these performances with science identity and engagement? (3) How are these performances supported or constrained by the field and by other students and staff? (4) What are the implications of the boys' identity performances for science identity and engagement – e.g. in terms of who is 'possible' as a science subject?

Masculinity and STEM participation

Understandably, most research on gender and STEM participation has focused on girls and women, reflecting women's acute and persistent under-representation at post-compulsory level (and beyond) in the physical sciences and engineering. Far fewer studies have explored the ways in which masculinity may be implicated in young people's engagement with STEM (cf Archer et al., 2014; Carlone et al., 2011, Carlone et al., 2014; Letts, 2001). Yet despite the relative dearth of work on masculinity within the field of science education, interest in the relationship between masculinity and education has burgeoned in the wider field of gender and education research. This focus on masculinity emerged in the wake of a widespread, international moral panic around boys' 'underachievement' (see Epstein et al. 1988 and Skelton & Francis, 2005 for reviews). For instance, fears have been widely expressed in education policy, the media and academic and popular writing about the 'epidemic' of 'underachieving' boys, for instance in the USA (e.g. Bly 1990; Lidman 2013; Sax 2007), the UK (e.g. Bingham 2013; Paton 2007) and Australia (e.g. Biddulph 1994; House of Representatives 2002). While feminists have critiqued the nature, extent and indeed many of the assumptions underpinning the widespread policy fears about 'boys' underachievement', educational practitioners and policymakers continue to be concerned and vexed by the notion that boys are failing to achieve their educational potential. Within such debates, feminists have highlighted how not all boys are underachieving, but the attainment and post-compulsory participation of some boys, especially white and Black working-class boys, is considerably lower than others (see Skelton & Francis 2005).

In this paper we examine working-class, ethnically diverse, urban boys' engagement with science during class visits to a science museum. We suggest that these boys constitute an interesting focus for attention for two main reasons: (i) they tend to be under-represented in

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post-compulsory science but have received comparatively little attention within science education policy and academic writing, and(ii) they are complexly positioned at the nexus of intersecting inequalities, spanning both privilege (e.g. masculinity, and for some, whiteness) and subordination (e.g. working-class, and for some minority ethnic) identities and inequalities which raises challenges for understanding and addressing issues of participation and engagement. In terms of the latter, research suggests that children tend to associate scientists with being male (Baker & Leary, 1995; Buck et al, 2008; Fadigan & Hammrich, 2004) and view science (particularly physical science) as being 'for boys' (Adamuti-Trache & Andres, 2008; Baker & Leary, 1995; Breakwell et al, 2003; Calabrese-Barton & Tan, 2009; Caleon & Subramaniam, 2008; Carlone, 2003; Farenga & Joyce, 1999; Francis, 2000; Jones et al, 2000; Greenfield, 1996, 1997; Fennema and Peterson, 1985). A well-known body of work also exists detailing the strength and prevalence of societal discourses and practices that align science with masculinity and perpetuate the dominance of the scientific field by men (e.g. Harding, 1998, Haraway, 1988). Yet, science participation among young men from urban (particularly Black and White working class backgrounds) remains persistently low. It is important, therefore, to ask - as Thompson does - "which identities are encouraged through curriculum and instruction?" (2014, p. 47).

As noted above, in this paper we explore the relationship between boys' performances of masculinity and their engagement with science during a school museum visit intervention. Specifically, we ask: (1) what performances of masculinity do urban, working-class boys (from diverse ethnic backgrounds) enact during the school science museum visits; (2) how congruent or dissonant are these performances with science identity and engagement? (3) How are these performances supported or constrained by the field and by other students and staff? (4) What are the implications of the boys' identity performances for science identity and engagement – e.g. in terms of who is 'possible' as a science subject? The paper discusses a dilemma for feminist science educators – namely, how to grapple with the complexity of intersecting inequalities so that we can seek to better engage marginalized students, such as urban young men from diverse ethnic backgrounds, while also not playing into oppressive gender relations that may bolster hegemonic masculinity and exclude girls and non-hegemonic boys.

Theoretical background

We draw on three main bodies of theoretical work to explore the boys' experiences of visiting a science museum. First, we utilise Judith Butler's (1990) conceptualisation of gender as 'performance', which we integrate with intersectional approaches (Collins, 2000) that understand gender as 'culturally entangled' (Hesse 2000), that is, intersecting with, and mediated by, other social axes, such as 'race'/ethnicity and social class (Archer & Francis, 2007; Calabrese Barton

and Brickhouse, 2006). Thus, although we foreground gender as an analytic lens within this paper, we do not see it as separable from ethnicity and social class and we attempt, where possible, to acknowledge intersectionality within our analyses, while not losing our primary focus on the boys' (varied) performances of masculinity.

We understand gender and other social identities as being produced through discourse (Anthias, 2001; Burman & Parker, 1993; Gee, 1996). Rather than being the fixed products of biological bodies, gender and other identities are made and performed – they are never finished and hence 'always in process' (Hall, 1990, p. 222), being constituted within and through discourse and relations of power (Foucault, 1978; Weeks, 1981).

As Butler (1990) explains, gender is a relational construct - masculinity and femininity cannot exist independently of one another and only make sense in relation to one another. Gender identity (e.g. masculinity, femininity) is not simply the product of a particular biologically sexed body (or hormones) – although the nature of the body in question can limit and proscribe the range of gender performances that might be judged by others as being authentic. Instead, Butler argues, gender is a socially constructed 'performance': it is produced through discourse and bodily 'acts'. In this respect, gender is not something that we 'are' (or are not) but is something that we 'do' (perform) and continually re-do. In this respect, Butler suggests that gender is a powerful 'illusion' (1990, p. 185/6) – it is not 'real' and yet it has very real effects. Young people's performances of gender can be neatly captured by the terminology of 'doing boy' and 'doing girl'. As Francis (2007) argues, these performances of masculinity and femininity are often diverse and plural, varying across axes of social identity and inequality, such as ethnicity and social class.

Hence, we do not consider masculinity (or femininity) to be homogenous but rather we see social identities and inequalities as intersecting (Crenshaw 1989) with gender, ethnicity and social class (to name but three potential dimensions). Like gender, we treat ethnicity and social class as non-biological, non-essentialised social constructions (or performances). For instance, we are guided by the work of Stuart Hall (e.g. 1992, 1996) which reminds us that 'race' is an ideological, not a biological, construct – an unstable identity that is 'constantly being transformed by political struggle' (Omi & Winant 1986, p68). Like gender, we understand ethnicity (and indeed all social identities and inequalities) as forever 'in process' (Hall 1990, p222). From this perspective, ethnic (and other social) collectivities ('groups') are 'imagined' (Anderson 1991, p.6) and always in a process of 'becoming' as the boundaries are constantly negotiated and contested (Anthias & Yuval-Davis 1992). Moreover, we see intersections of ethnicity, gender and social class as co-constitutive and generative. That is, gender is mediated by ethnicity and social class

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such that performances of, for instance, 'black working-class masculinity' are not simply additive (or the 'sum' of three constituent 'parts'). Rather, we would understand such performances as complexly 'entangled' (Hesse 2000) – containing elements that contain echoes of particular ethnic, gender and class identities and inequalities but which are also creative performances in their own right, which become 'more' than the 'sum of their parts'. Put simply, just as a cake may be constructed from ingredients such as eggs, flour and butter, through its assemblage and the process of its production, it becomes more than the sum of its ingredients and becomes recognisable in its own right. Likewise, two people with the same ingredients to hand, will not produce identical cakes – while there may be some recognisable similarities, each cake is still unique.

We also draw on the work of Connell (e.g. 1987, 1993) to help us theorise masculinity. In particular, we utilise Connell's notion of hegemonic masculinity, which denotes 'those dominant and dominating modes of masculinity which claim the highest status and exercise the greatest influence and authority' (Skelton 2001, p. 50). Hegemonic masculinity is discursively organised around the subordination of others, notably women and gay men (Connell 1993). That is, hegemonic masculinity seeks to maintain its position of dominance by excluding, marginalising and denigrating less powerful social groups and by attempting to present itself as the only 'normal' or 'natural' way to be male.

Studies have examined a range of popular, contemporary performances of hegemonic masculinity among school boys, focusing in particular on notions of 'laddishness' (e.g. Francis 1999; Jackson 2006). 'Laddishness' draws on Willis' (1977) classic study of 'the lads' (a group of working-class boys who resist and reject schooling. Their performances of masculinity are organised around displays of 'hardness', having a 'laugh', showing sporting prowess, objectifying women, being disruptive and generally resisting (or making a public show of not engaging in) school work. Another key performance that has been identified is that of 'muscular intellect', which involves confident, arrogant displays of knowledge and 'intelligence', which has been noted particularly among some high-achieving middle-class boys (see Mac An Ghail, 1994; Redman & Mac an Ghail 1997; Francis et al 2010).

Not all performances of masculinity are equally powerful or hegemonic, and not all boys will perform hegemonic masculinity. Intersections of ethnicity and class can structure these possibilities in powerful ways – for instance, research discusses how some South and East Asian boys may find it harder to enact performances of hegemonic masculinity that are widely recognised as such, due to dominant discourses associating South and East Asian masculinity with 'passivity' (e.g. see Archer & Francis 2007; Gillborn 1990). Equally, not all performances of

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hegemonic masculinity will necessarily be 'successful' – for instance, they may be resisted or contested by others and the authenticity of the performances may be called into question. In this respect, the production of masculinity might be likened to an 'ideological battlefield' (Edley & Wetherell 1995: 17), in which boys may engage in struggles over particular masculine symbolic resources, while performing masculinity to one another (and others) - but with varying outcomes. Moreover, the ways in which a boy 'does' masculinity within a particular moment or context may vary across time, space and according to the audience, the resources available to them, their social position (e.g. ethnicity, social class), and so on. Hence while there are a myriad of ways of 'doing boy' – i.e. producing the social actor in question as a masculine, gendered subject - some performances may generate more patriarchal power, status or authority than others.

Second, we extend our interest in gender identity to the concept of 'science identity', drawing on Carlone & Johnson's (2007) definition which refers to an individual's sense of herself as interested in and competent at science and the extent to which they are recognised (as being talented, having potential in science) by others. That is, science identity captures the extent to which a person sees herself, and is recognised by others as being, 'scientific' or 'a science person'. As research has shown, students learn science better when they can successfully perform a valued science identity (and vice versa) (e.g. Brickhouse, Lowery, & Schultz, 2000; Calabrese Barton & Tan 2010; Carlone, 2004). Hence, in this paper, we are particularly interested in the relationship (and extent of congruence or dissonance) between boys' performances of masculinity and their performances of science identity. That is, to what extent do the boys' different performances of masculinity on the visit align, or not, with the production of science identity (and hence science learning) – and what are the implications of these performances of masculinity for the science identities and learning of other students?

Finally, we draw on Bourdieu's concept of *field* to frame our understanding of the museum context. The work of the French sociologist, Pierre Bourdieu (e.g. 1977, 1984, 2001), has been highly influential within the social sciences, particularly his theory of practice, which seeks to understand the reproduction of social inequalities in society. Bourdieu proposes that relations of privilege and domination are produced through the interaction of *habitus* (a person's internal, cognitive matrix of dispositions, developed through socialisation) with *capital* (the resources available to them – which can be economic, cultural, social and symbolic) and *field* (social contexts). He is centrally concerned with the interplay between agency and structure and how people may behave in certain ways and make particular choices, but not within conditions of their own choosing. In this paper, we draw on his concept of field as a means for conceptualising

the science museum context. Field has been described as 'a space of conflict and competition' (Wacquant 1992, p.17) and a 'structured system of social positions – occupied by either individuals or institutions' (Jenkins, 1992: 85). Field is more than just a physical place or context, it is a socially constructed space that entails socially performed actions and relations. As Colley (2014: 669) writes:

A field is not only a set of given external conditions which have themselves been socially devised or imposed, like the rules and the pitch or court in soccer or tennis. It is also the agentic and partly subjective *playing* of the game through our *habitus*. The field ... is constructed *only* through the human doings of human beings.

Moreover, as Bourdieu and Wacquant (1992) discuss, field plays a crucial role in the reproduction of social relations in that it (i) structures and determines the value of capital and (ii) both structures and is co-constituted by habitus. In other words, both capital and habitus vary according to field. In other words, we use Bourdieu's concept of field to help us to understand the science museum context as a socially constructed space, formed through sets of interpersonal relations that are structured by particular relations of power and 'rules', which our young people are both operating within and also contributing to the construction of, through their actions.

Methods

Two schools from inner central London were recruited for this small-scale, qualitative study, which was carried out as part of the first stage of the longer, five year *Enterprising Science* study. Participating schools were approached on the basis of being state-run, co-educational and within $\pm 20\%$ of the GCSE¹ results of other schools within their local area. Given the aims of the Enterprising Science project, to explore how informal science education experiences were experienced by students from socially disadvantaged backgrounds, the two schools were also recruited because they had relatively high proportions of students who spoke English as a second language and were registered as eligible for free school meals, compared to other schools in the same region. Schools were purposively selected in order to work with students, teachers and families who might not usually be able to access a wide range of ISLE practices or have particularly high levels of 'science capital' (Archer et al. 2014; Archer et al., 2015).

The study employs practice-based research to understand how a science museum - school collaboration might affect students. Two mixed-ability classes of students from Mareton

¹ GCSE's (General Certificate of Secondary Education) are series of exams students take in the UK when they are 16.

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School were involved and one middle-set² class of students from Coleville School. In total 60 students took part in the school trip to the museum (36 boys and 24 girls). 55 were from Mareton School: 25 from Ms. Jones' class (14 boys and 11 girls) and 19 from Mrs Thompson's class (11 boys and 8 girls). 16 students from Coleville School attended, 11 boys and 5 girls, all from Mr Williams' class. Notably, for this analysis, boys outnumbered girls in each visiting group, while students came predominantly from working-class backgrounds and a range of ethnic backgrounds. Turkish, Polish and Portuguese languages were the most frequently spoken languages among the students (project information was translated into these languages, as well as provided in English).

The core data drawn on in this paper come from school field-trips to a science museum. Each museum visit was observed by a team of six researchers and was recorded using field notes, photographs and audio recordings. Researchers followed an ethnographic approach, using field notes to try to capture how students behaved, what they said and how students engaged with the activities they encountered during each visit (Brewer, 2000; Walsh, 1998). Field notes were semi-structured and followed observation guidelines agreed by the team, including recording what students were doing, whether they appear to be engaged with the task or not, group dynamics, which students were being more or less dominant, facilitation from teachers and museum staff and the content of student discussions as well as other events of note (Hammersley & Atkinson, 1997).

Students in all three classes were randomly divided by their teachers into groups of fourⁱ at the start of the visit and a researcher joined each group. Ethical permission had been sought from student and their parents for taking part in the research and while permission was granted for all students to be observed, not all granted permission to be audio-recorded. Hence a 'target' student from each group was audio-recorded to provide an additional way to check field notes. The teacher and teaching assistant from each class were also audio-recorded. These audio recordings were partially transcribed, anonymised and used to augment the field notes. In total, over the c. 14 hours of the three class visits, 18 sets of observation notes and audio recordings were collected.

The core field-trip data used in this analysis is supported by a second data set of data generated with students and their teachers before and after the visits to explore their expectations and interpretations of the visits. Four discussion groups (two at Mareton and two at Coleville) were carried out with students before the visits and seven discussion groups were

² We note the distinction here between a mixed-ability class where students have not been separated into different classes based on their academic ability and attainment and a middle set class where students have been divided into groups according to academic ability and attainment.

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conducted after the museum visit (four at Mareton and three at Coleville). Discussion groups were designed to explore student expectations or reactions to different elements of the interventions, their understanding of the purposes of the activities and to what extent they felt engaged and interested. Students were also asked about their attitudes to science more broadly, including about their science classes and teachers, and engagement with science outside of school.

Interviews with teachers were conducted before ($n = 3$) and after ($n = 3$) the class visit to the museum. Teacher interviews focused on the teachers' expectations and reflections on the resources and activities provided as part of the intervention, their reflections on how the students engaged with those and how they found each of the elements to deliver. Teachers were also asked about their own attitudes towards science, their ideas and experience of teaching science and their engagement with science outside their job. Focus groups and interviews were transcribed, anonymised and used in this analysis to develop a view of the field-trips from the perspective of the participants.

Analysis

In line with our theoretical framework, our approach to analysis treats identity performances as combining talk, gestures, embodiment and behaviours. As Edley (2001) argues, splitting actions or practices apart from talk is a "false distinction" (p. 192). Our analytic approach, therefore, involves a multidimensional interrogation of boys' behaviours, words, gestures and movements to see what sorts of 'ways of being' are being constructed in any given moment, but particularly what sorts of 'ways of being a boy/man' and 'ways of being a science student' are being constructed through the boys' talk and behaviours. Moreover, we treat these performances as non-discrete, that is, a boy may engage in more than one 'type' of performance.

Visit field notes, images and partial-audio transcripts were analysed alongside the focus groups and interview data. The analysis process (detailed below) was carried out by the lead and second authors, followed by a secondary analysis by all the other authors. The lead and second authors developed the frameworks and the second author searched the data to populate this framework, which was then further analysed and refined by the lead author. The final framework was checked by all authors. Following an ethnographic approach to qualitative data analysis, themes were interrogated as to their prevalence within the data, convergent and divergent examples were explored and data were analysed in relation to the three data sets in order to develop analytic reliability (Cohen, Manion, & Morrison, 2011; Miles & Huberman, 1994).

Data were analysed using a discourse analytic approach (Burman & Parker, 1993), informed by a Butlerian conceptualisation of gender identity as performance, as discussed earlier.

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As Allred & Burman (2005) discuss, discourse analytic approaches differ from more general approaches to discourse analysis (Wilkinson & Kitzinger, 1995) in that they do not attempt a close, 'micro' textual analysis but rather look for patterned talk (discourses) within the data. A key feature of a discourse analytic approach is looking for how power is organised within (the boys') talk and drawing out the social implications of particular constructions. In other words, our analysis asks: What is the talk 'doing'? What is being normalised or defended? Where is the locus on power within a particular construction – whose interests are being asserted? Who or what is being othered? What is normalised or closed down?

To begin with, data were searched (using a theoretically guided analysis) to identify potential performances of masculinity. This analysis was undertaken by the lead and second authors, using the NVivo software package, with both authors providing checks for one another on the reliability of coded extracts in relation to the specified codes. We approached the analysis with the view that a student may potentially enact any number or type of gender identity performance across the space of their visit, hence we did not seek to classify each boy in terms of just one type of performance, rather we coded for all performances of masculinity within a given student's data.

To guide our identification of constructions and enactments of 'masculinity' (and 'femininity') we used Francis' (2000) gender binary tabulation, which details the traits dominantly associated with masculinity and femininity within contemporary British culture (and maps out the relational nature of these traits). For instance, Francis' mapping of dominant gendered discourse enabled us to recognise that talk, practices and resources that are organised around strength and competition (e.g. as we observed during the boys' engagement with particular interactive exhibits) are dominantly configured as performances of masculinity (and carry social power).

In line with Francis' conceptualisation, our categorisation of each gender performance was then overlaid with a reading of power, in order to account for the extent to which each young person was performing an identity that is congruent with, or challenging of, dominant gender norms associated with the (perceived) sex of their body. That is, whether they are performing monoglossic or heteroglossic gender identity, to use Francis' terminology. For instance, to give a common example, behaviours that are popularly associated with 'assertiveness' when performed by a man are often read as 'aggressive' when performed by a woman. Equally, 'caring behaviours are stereotypically interpreted as being 'normal' when performed by a woman but might be read as 'effeminate' when performed by a man. Note that this is *not* our own value judgement – in line with our Butlerian approach we do not see an 'natural essence' within

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performances, rather we are trying to explicate how we coded particularly performances as being dominantly aligned with masculinity or femininity.

The above process led us to identify two main groupings of performances of masculinity – laddishness and muscular intellect - each of which seemed to hang together internally and aligned with the literature. A small amount of coded data remained, which seemed to be organised around the production of masculinity, but which did not fit either of these two categories. This set of ‘mundane’ or unremarkable performances which were analysed through a back and forth movement between the literature and data until we arrived at a classification of ‘translocational’ performances (performances that moved across social boundaries, for instance, drawing on multiple discourses of ethnicity, gender and social class, see below for more detail). The three performances of masculinity 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 & Huberman, 1994) and to record the number of boys enacting each performance.

The next stage of the analysis involved interrogating these performances in relation to performances of science identity and instances of potential science engagement. As before, the whole data set was coded by the lead and second authors, using NVivo, in line with the conceptual framework outlined earlier to identify performances of science identity (e.g. instances of ‘talking science’, Lemke 1990; instances of self-identification or recognition by others as ‘being scientific’; examples of personal connection with science). In this way, we sought to establish any instances of congruence, or dissonance, between the performances of masculinity and performances of science identity and engagement.

Next, we searched the data to code (using NVivo) instances of the extent to which performances of masculinity were supported, or challenged, by others (the field, staff and other students). For instance, using Francis’ table as a guide, we coded data in terms of how masculinity is reproduced and supported (or challenged) by the science museum field, and the extent to which staff and students concurred with, or challenged, boys’ performances of masculinity during the visit. Finally, we searched the data to identify the implications of the boys’ performances of masculinity for others’ science engagement. This involved reading the data ‘around’ each coded performance (e.g. to code for how for how girls’ might be silenced or marginalised by particular performances of masculinity) and was particularly attuned to interplays and practices of power, and in particular, sought to tease out gendered, classed, and racialized discourses within respondents’ data. For example, we collated instances where boys defended or challenged the idea of science as ‘masculine’. We then explored how and where particular tropes

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of masculinity were being reproduced or resisted (e.g. the production of masculinity through engagement with particular exhibits) and how these intersect with classed and racialised discourses (e.g. as expressed through 'rap', laddishness or muscular intellect).

Science learning context

Each class visited the same science museum once in the middle of the spring term, during the school day. The museum was a large institution, with galleries of historic objects and interactive galleries (with both 'hands-on' and computer-based exhibits). According to best practice for school trips to museums the teachers and museum staff had worked together to develop curriculum-linked materials for use in class before and after the visits to help students contextualise and learn from their visit to the museum. For the two classes from Mareton School, these materials focused on the theme of 'Doctors and Diseases', exploring the scientific work of four figures from the history of medicine; Edward Jenner, Alexander Fleming, Joseph Lister and John Snow. The class from Coleville School focused on a different part of the science curriculum, on the theme of Forces.

The visits were organised so that students carried out a series of structured, semi-facilitated activities in the morning, working in groups of between three and five, and less structured activities in interactive galleries in the afternoon. The school curriculum themes were explicitly linked to specific objects in the museum collections, which students researched in class before their visits, made videos about the objects in teams during their visits and worked on their videos and related blog posts again after their visits. For instance, Damis, Deon, Arif and Betul from Ms. Jones' class at Mareton School were part of the same group during the visit. Their class was learning about the Doctors and Diseases theme and Damis was responsible for researching and making a short film about Edward Jenner, while Deon was responsible for John Snow, Arif for Joseph Lister and Betul for Alexander Fleming. The Coleville class, whose curriculum topic was 'forces' focused on large iconic objects within the museum rather than historical figures and explored how these objects (a rocket, a plane, a large snow-plough and a hovercraft) related to the subject of forces. Thus in the Coleville groups, students were responsible for researching and filming one object each, for instance in one group Rachel was responsible for the seaplane, Ryan for the hovercraft, Sam for the snow plough and Jason for the rocket.

During the visit students were also asked to find additional objects they were interested in to add to their films, to film introductions and conclusions to their films. The films were made using flip-camera's and students were provided with additional props (such as a stethoscope, a petri dish, a balloon) as well as materials students brought with them from their class work. Students ate lunch together as a class and spent time in the afternoons in an interactive gallery:

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Mareton School visited a gallery of interactive computer based exhibits and Coleville School went to a gallery of hands-on, mechanical interactives. The visits were facilitated by the class teachers, accompanied by a science technician from the school and a team of five museum facilitation staff (all white middle-class women). In addition each group of students was joined by a researcher (the six paper authors): five of whom are white middle-class women academic researchers and the other is a white middle-class male museum educator. All students were brought to the museum by bus and each class visited separately, that is, classes did not overlap with one another's visits.

Results

RQ1: What performances of masculinity did the boys enact during the visits?

We identified two main performances of masculinity that were enacted by boys during the visits: 'laddishness' and 'muscular intellect'. We also noted a third, less common performance, of 'translocational masculinity'. Each of these is discussed in turn.

(a) **'Laddishness'**. Almost all the boys (with three exceptions) were recorded as enacting 'laddishness' at some point during their visits ($n = 33$). Performances of laddishness typically involved resistance to school workⁱⁱ, mucking about 'macho' behaviours, engaging in sexist/sexual banter competitive, flirting, and finding ways to (appear to) resist doing any science work (e.g. sneaking off, hiding from teachers and facilitators, avoiding group work and tasks) and "having a laff" (Willis, 1977, p.29). Boys from a range of different ethnic backgrounds were observed performing laddishness, although, in line with the literature, the most consistent and most publically visible performances tended to be enacted by black and white working-class boys (e.g. Sewell 1997; Mac an Ghail 1998). We interpreted many of the performances of 'laddishness' as culturally entangled, (Hesse 2000), fusing tropes of Black masculinity – for instance, what Majors and Billson (1992) term 'cool pose' - through their embodied performances of 'swagger' and rap music (e.g. throughout the visit, Erkan, a Turkish boy, repeatedly sings "they see me rollin", from the chorus of a US rap song by Black artist *Chamillionaire*, critiquing police racism).

Recognising that our participant numbers are relatively small and the data are not clear cut, we are hesitant to draw firm conclusions - however, our field notes suggest that, at a *general level*, South and East Asian boys were slightly more likely to engage in sporadic performances of laddishness, whereas those who performed laddishness more consistently and persistently were more likely to be from white or black ethnic backgrounds. For instance, Kemal and Karim (respectively Turkish and South Asian working-class boys, Mrs Thompson's class, Mareton)

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occasionally messed about in between activities, such as playing at 'cops and robbers' when moving between objects in a gallery. But at most other times, they completed tasks and 'behaved'. Other boys, such as Anwar (South Asian working-class boy in Mrs Thompson's Mareton class) and Bataar (Mongolian working-class boy, Ms. Jones' Mareton class) also avoided taking part in particular science activities by drifting away during group work and hiding themselves from view, but engaged at other times.

In comparison, Jason (Black British working-class boy, Mr Williams' Coleville class) provides a good illustration of those boys whose performances of 'laddishness' were more consistent and were enacted over the duration of the visit. Jason engaged with most structured, facilitated science learning activities with little enthusiasm, except where they overlapped with 'messaging about', having a laugh, or his interests in stereotypically masculine topics such as cars and planes. Field notes record many instances of Jason messaging about, often organised around objects (like 'guns') and activities (such as fighting and 'having a laff') that are stereotypically associated with hegemonic masculinity. For instance field notes record how "Jason 'fires' the flipcam like a gun at objects" and "Jason fights with Ryan to hold the flipcam", "Jason entertains his group by messaging about".

As we discuss elsewhere in greater detail (Dawson et al, under review), girls were also observed to 'muck about' during the visits, however their disengagement was overwhelmingly organised around stereotypically 'feminine' objects and interests, such as beauty and appearance and performances of heterosexual 'attractive' femininity (for instance, avoiding doing tasks by spending time taking 'selfies', discussing romantic relations, fixing hair, and so on).

'(b) Muscular intellect': science as brainy, authoritative, masculine

We noted 14 boys, from various ethnic backgrounds, producing masculinity during the intervention through the performance of 'muscular intellect'. Generally these were different boys compared with those who performed laddishness, although, as we discuss further below, a couple of the boys (like Sam) who performed muscular intellect also engaged in sporadic displays of laddishness. We did not note any particular patterns by ethnicity in terms of which boys performed muscular intellect.

Performances of 'muscular intellect' described in other studies have focused on how displays of superior knowledge and intelligence can be used, as Redman and Mac an Ghail put it, to "push people around intellectually" (p. 169, 1997). As enacted by the boys in this study 'muscular intellect' involved highly confident, assertive - sometimes aggressive - displays of scientific knowledge and 'talking science', that is, doing science through the medium of language

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(Lemke 1990), which boys used to position themselves as dominant within particular interactions and settings. For instance, such displays included assertive claims to scientific interest, confident demonstrations, and competitive verbal 'one-up-manship', over scientific knowledge, and assuming a dominant role, telling other students what to do during the visit (both in terms of scientific content and the structure of activities).

An example of the performance of muscular intellect comes from Mendo, a Black-African, working-class boy from Ms. Jones' Mareton class. In the History of Medicine gallery, Mendo authoritatively explained in detail to other students about Egyptian mummies:

Mendo points at case of mummies "that is an infant, that is a bird", a group of students are around him and he is explaining what the different objects are.

In another example, a museum facilitator explained to a group of students how food goes off, relating this to the discovery of penicillin by Alexander Fleming. Mendo added to her explanation, stating to the group, "that is why they [food packets] have best before dates". In such performances Mendo attempted to distinguish, and assert his superiority, over his peers by confidently presenting his own more extensive scientific knowledge. He demonstrated not only that he understood the science content to hand during the museum visit but also adopted the status of a teacher or facilitator, explaining the content to other students.

Amongst the 14 boys who performed 'muscular intellect' during the field-trips to varying degrees, it was Sam, a Black-African, working-class boy from Mr Williams' Coleville class, who enacted the most sustained and consistent performances of 'muscular intellect'. Sam displayed an impressive interest in and knowledge of science. In the pre-visit focus group with students from the Coleville class, Sam presented himself as a knowledgeable science student, a statement accepted and supported by the other students in the focus group. Sam performed with apparent ease during the museum visit, appearing interested, engaged, 'on-task', knowledgeable about science, demonstrating and fluency in 'talking science' (Lemke 1990) and was easily able to make links between the science objects, science stories and science learning opportunities presented by the museum and their other experiences.

Although as discussed in more detail elsewhere (Dawson et al., under review), seven girls ostensibly engaged in performances of 'muscular intellect' (e.g. through loud, confident displays of science knowledge), we observed that these performances were more likely to be read as transgressive by others, compared to boys' performances. For instance, girls performances of muscular intellect were more likely to be read as 'bossy' and/or were sanctioned or questioned by staff (e.g. one girl was told not to 'tell' others the answers, in a way that was never the case for Jason). We interpret this as aligning with Francis' (2000) observation that gender inequalities are

such that similar performances are interpreted very differently depending on dominant perceptions of the sexed body of the person performing the actions (e.g. a behaviour may be labelled 'assertive' when performed by a boy, but 'bossy' when performed by a girl).

'(c) Translocational' masculinity

Across the three visits we noted a small number of occasions where boys ($n = 12$) from a range of ethnic backgrounds performed what we have termed 'translocational' masculinity. We use 'translocational' to denote how these were hybridised identity performances that draw across multiple social axes, incorporating, for instance, discourses of ethnicity and social class within constructions of masculinity.

Compared to performances of laddishness (which were performed by a large number of boys and with a high level of frequency), and muscular intellect (performed by a smaller number of boys but with considerable frequency), performances of 'translocational' masculinity were relatively sporadic. These performances tended to be enacted in 'small moments' by boys who also performed laddishness and/or muscular intellect during the visits.

The terminology 'translocational' borrows directly from the concept of translocational positionality that has been proposed by feminists such as Anthias (e.g. 2001). Translocational positionality has been developed as a lens for understanding intersectional forms of identity and belonging (Anthias 2001). It seeks to move beyond rigid forms of identity politics (organised around rigid notions of 'who we are') towards a more open politics of 'rooting and shifting' in which forms of subjectivity and identification are more open and negotiated, organised for instance around shared values and prioritising points of connection. Although developed as a form of feminist politics, we experiment with the term here as a means of trying to capture those aspects of the boys' masculine identity performances that try to move beyond narrow hegemonic performances of masculinity and which highlight points of connection across ethnicity and class within performances of 'doing boy'.

Boys' performances of 'translocational masculinity' were different in tone and consequence from performances of laddishness or muscular intellect. Translocational performances foregrounded intersections of gender and ethnicity, and involved boys drawing on their own varied cultural resources and experiences to establish links and points of commonality between their own lives, interests and values and the museum context. For instance, these performances often constructed masculinity as 'active' (one of the dimensions of popular masculinity identified by Francis' gender binary table) through reference to participation in transnational forms of popular culture, such as playing video games and consuming popular music and film, but were orientated at producing the self as a 'normal' or 'regular' boy, rather

than 'macho' or 'intellectual' (as in the case of performances of laddishness and muscular intellect). Performances of translocational masculinity were notably less 'spectacular' than those of laddishness or muscular intellect. Indeed, translocational performances tended to be less emotionally charged and were less obviously performances of power in that they did not seek or require an audience in the same way as laddishness and muscular intellect and sought to connect with (rather than marginalise or dominate) others across axes of social difference. In these moments, boys' performances were organised around making connections, e.g. between 'masculine' science (objects) and the boys' everyday lives as urban young men. For instance, Sam connected one of the planes in the plane gallery to a game he plays at home on his Wii ("there's a seaplane on the Wii that you can cruise around on") and to planes that he had seen in popular films (like 'Back to the Future' and 'Mr Peabody and Sherman').

A few girls were also noted as performing femininity in a comparable way, that is foregrounding connections across ethnicity and gender and using their own cultural experiences and resources to connect with the science content in the museum. In this respect, we see the performances of masculinity and femininity that we are highlighting here as being very close to the sorts of practices that have been identified among youth in 'funds of knowledge' research (e.g. Moll et al 1992; Zipin 2009) – albeit here we focus particularly on the gendered nature and implications of these identity performances.

RQ2 How were the performances congruent or dissonant from science identity and engagement?

(a) Laddishness: Resisting - but also partially enabling - science engagement

Willis's (1977) classic study of working-class masculinity and education includes an account of the group of 'lads'³ visiting a museum with their school. Over the course of the day, the lads' sat at the back of the coach (which they vandalised) and messed about in the museum, defacing and vandalising dioramas and exhibits. Our analysis suggests that almost 40 years later similar (although admittedly less extreme) patterns were apparent in the behaviours and performances of the boys in this study who, although younger than those in Willis's (1977) study, were from similar inner-city, working-class backgrounds.

As noted in the preceding section, performances of laddishness were organised around resisting doing any school work – which arguably worked against our boys' engagement with science and performances of science identity during the visits. For instance, Erkan (Turkish

³ Who were, at the time of his study, leaving school and starting jobs, thus older by between three or four years than the students in this study.

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working-class boys, Ms. Jones' class, Mareton) spent a lot of time during his visit dodging the more structured learning activities by moving away and hiding from teachers, museum facilitators and the rest of their group. On one occasion field notes recorded him and his friend wandering off during a task and hiding behind a large exhibit, out of view, where they joked and talked about who is strongest, fastest or most popular with girls. As Erkan's example illustrates, his laddish resistance to the 'school work' aspects of the visit was often enacted through heterosexuality (e.g. flirting) and hegemonic masculinity (e.g. fighting). For instance, Erkan was recorded flirting and fighting at particular points when he was meant to be working:

"Erkan takes pictures of [Lexi and Alisha] with his friend"

"Erkan and his friend mock fight, then they mock wrestle"

"Erkan and his friend immediately run off & can be heard play fighting around the corner"

Indeed, when required by staff to engage with the set tasks, boys like Jason (who had been persistently performing laddishness during the visit) struggled to engage in the structured science learning activities. For instance, Jason became flustered and confused when it was his turn to present his work: "he wails to his friend, Sam, "I don't even know what to do"".

During the visits, boys not only enacted 'laddish' performances as a way to resist personally engaging with science learning activities but as a way of also disrupting other students' (but particularly other boys') potential engagement. For instance, Daniel (white-working class boy, Mr Williams' Coleville class), performed 'laddishness' all morning during the visit, avoiding group work, distracting others and messing about. During one group work session, Daniel mucked about and teased Ajani, (a Black working-class boy), putting Ajani off from doing his work.

Ajani started, but then stopped when got a bit tongue tied. Ally helped him talk though why it was interesting.

(Daniel, in silly voice 'good, good').

Ajani started again, but Daniel interrupted again

(F, irritated with him: 'do you think you're funny?')

Laddish performances also involved more explicit resistance of science identity, often as part of 'having a laugh' and trying to gain peer attention and make others laugh. For example, Jason mocked the science content of the visit in an attempt to make other students laugh:

"Jason says "science has brought the earth come alive" in a slightly sarcastic way, using a very funny voice and gestures".

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Their investment in these performances of laddishness was such that when asked to reflect on their visits (during post visit discussion groups), these boys primarily recalled instances of laddish behaviour. For instance, boys from Ms. Jones' Mareton class recalled their enjoyment of the coach and the opportunity to flirt with girls. While these aspects were not the *only* aspects of the visit that boys said they enjoyed, they were among the most mentioned and memorable aspects, suggesting that the boys did not recognise (or at least did not want to publically articulate) any science-related aspects of the visit that they might have found interesting or enjoyable. We interpret these examples as illustrating how performances of laddishness can sit in tension with performances of science identity, due to laddishness being organised around the resistance of both school work and 'intellectualism' (both of which we identify as commonly recognised and valued aspects of popular performances of science identity).

However, we did observe some occasions in which the boys' performances of laddishness appeared more congruent with – and even potentially facilitating of - science engagement. These instances occurred largely in an interactive gallery with 'hands on' exhibits that the boys engaged with through 'laddish' performances of peer competition (with other boys) and 'macho' displays of 'strength' and jokey 'messaging about'. Unsurprisingly, given the alignment with hegemonic masculinity, we noted such behaviours far more among boys than girls (see Dawson et al., under review). The opportunity to perform competitive masculinity appeared particularly engaging for the boys. For instance, Sam and Adam (Black, working-class boys from Coleville School) enjoyed competing at an interactive designed to engage users with concepts of weight and speed, linked to the curriculum subject 'forces' that the visit was organised around:

Sam is running weights down a slope on the Downhill Racer interactive with Adam. "Let's have a race". He is trying to win. "I won! Start again". He calls out when he has won "I won! Yeah, dominated!"

Similar instances were observed among the Coleville class who, after lunch, visited a 'hands-on' interactive gallery in the museum, where the students instinctively split into boys and girls only groups. The boys raced to a large, multi-part interactive at the centre of the space and began to engage with it through performances of 'laddish' masculinity, which involved showing how strong and fast they were at the activity, as described in the field notes:

The boys go straight to the big ball interactive exhibit. They joke about together. Jason and Sam laugh and pull at the ropes. They call out to one another as to whether to pull it or drop it. A gallery explainer goes over to facilitate. The explainer talks to Isaac, but the other boys all ignore him and just pull on the ropes as hard as they can. It looks like they are doing a test of strength. They pull

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the rope to drop a weight and make a tennis ball jump in the air. Sam likes it when the ball flies out high. "Let's all do it together and then let go!", "Mine went the highest".

Similar performances were enacted by boys on a number of exhibits throughout this gallery, with boys competing to 'win' different exhibits in a variety of ways, such as trying to be the fastest or strongest. The boys were very loud and physical during these displays, often dominating and monopolising the exhibits, such that other visitors often moved away or left the immediate area while the boys were playing.

One reading of these examples is that, by appealing to typically 'laddish' interests and behaviours such as strength and competitiveness, the 'hands-on' interactives were engaging the boys with science learning 'by stealth'. It is possible that the boys' engagement with these interactives was valuable in that it enabled a sense of ease and familiarity with science that might facilitate the (future) development of science learning and/or science identity. That is, their engagement with these interactives may have enabled them to perform science - even if the boys themselves were not aware of this - which can be a valuable precursor for learning (Cazden 1981).

However, our observations and post-visit discussion group data suggest that on the whole, the boys' overwhelming focus on performing competition and 'macho' masculinity meant that they largely 'missed' (and even actively resisted, as exemplified by their ignoring of staff who attempted to facilitate) the more formalised science content. For instance, after completing their more structured science learning activities, one half of the Coleville class were promised a 'reward' by their science museum facilitator, Jenny, who promised to show them an exhibit where they could get an 'electric shock'.

Electric shock exhibit – there is lots of excitement. Jenny asks them to hold hands. Jason moves round the group so that he doesn't have to hold Hannah's hand. Lots of laughter as all the students get a shock. Sam and Jason shriek in delight at the shocks. They recoil and laugh when they get shocked. Jason dares the others "yeah, do it, do it, do it!" Sam asks "do you want me to do it?!" and organises some of the others. Jenny tries to ask them who can tell her what is happening? But the students are too caught up in the fun and don't answer. They all race off upstairs to lunch. Sam tells his friends who didn't go to the "electric shock thing" that "that was live!"

Both boys and girls engaged with the electricity exhibit. The boys, however, used the opportunity provided by the exhibit to enact performances of 'laddish' masculinity. While the

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girls seemed to enjoy themselves, they were far less vocal about how 'brave' and 'strong' they were being. The electric shock of the exhibit provided a focus for boys to perform acts of bravery which they constructed as masculine. Jason, for example, declared "I'm gonna be a man here" and reached out his hand to touch the middle of the exhibit where the live current lurked.

Performances of identity in these moments were, for boys like Isaac and Jason, focused on being brave, strong or fast, but did not include discussing the phenomena to hand, attempting to provide explanations, asking questions or developing links between this and other experiences elsewhere. Notably when Jenny attempted to facilitate the students at the electric shock exhibit in making links between their shocks and science knowledge about why the shocks were happening, no students tried to answer. Her attempts to facilitate science learning were by and large ignored by the boys. Moreover, when asked in post-visit discussion groups about how the electricity exhibit worked, the boys were largely unable to offer an explanation ("I'm still wondering"), focusing instead on how "we got to mess around and like, play with things". We suggest that although boys may have derived some performance learning benefits from their engagement with the interactives, few appeared to have developed or solidified these experiences further into more formalised, articulated forms of learning. Indeed, only one boy, Sam - a Black African boy from Coleville school, who is discussed in greater detail in the next section - was able to attempt to explain the scientific content of any of the different 'hands-on' interactive exhibits.

Likewise, Darren appeared to enjoy the computer-interactive gallery a great deal, laughing, talking with friends, using different computers and playing the 'games'. Yet he also appeared to not understand the 'point' or the rules of the game and seemed not to understand what he was doing.

Darren says "what do you do?" Ally facilitates. Darren slaps his button waiting for the game to start. He doesn't seem to be listening to Ally's instructions. Darren says "Where's my one?" and Yelps "what the hell?" And jumps up and down. He shouts "Yes!" When he gets the electronic person to sit on the toilet. He shouts out "I've collected 4!" But he doesn't follow the instructions. Darren exclaims "Bloody hell it's going fast now! Miss, please tell me I won. Miss, I scored some but it says I scored none!" Darren doesn't seem to understand the game and doesn't understand why he didn't score any points.

When he realised he had 'lost' he became very frustrated and stopped playing.

Indeed, boys' engagement with the interactives seemed to last only as long as the exhibit afforded them the opportunity to perform laddishness. For instance, Damis and Kosoko used

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the computer games that they played on in one gallery as opportunities to 'have a laugh', flirt with girls, make toilet humour jokes, and be competitive with one another. Ultimately, when the game no longer enabled Damis to continue performing laddish masculinity (i.e. when he did not 'win') he exclaimed "I don't wanna play no more" and disengaged.

As such, we suggest that the building of science identity may remain a long way off and would require considerable further scaffolding and support. Indeed, in the post-visit discussion groups, few boys were able to articulate any links between science and the interactive exhibits and none of these boys articulated any sense of a deepening interest of relationship with science during or after the visit. Data from the post-visit discussion groups indicated that boys who predominantly performed laddishness (from all three classes) were much less likely, compared with boys who engaged through muscular intellect, to be able to articulate any science learning from the 'hands-on' interactives, despite making extensive use of them. Nor did the experiences appear to help the students make connections between science and their own lives (compared with performances of translocational masculinity).

In other words, while the boys did engage with science through performances of laddishness - that is, boys were engaged in performances of science, appeared focused, interested and were eagerly 'doing' science through their play, often for notable lengths of time - we suggest that the learning and identity potential of these moments was also constrained by these very same performances of laddishness.

Research suggests that the practice of 'making science fun' in science museums, science centres and similar informal science learning environments and programmes has been framed by professionals in those institutions as a key benefit of informal science learning and engagement (Dawson et al., under review). Our analysis suggests, however, that the practice of 'making science fun' was differentially interpreted by students in our study in ways that were marked by gender and class (and ethnicity – to the extent that white and black boys were the most likely to consistently perform laddishness). In particular, the competitive 'fun' that had been designed into interactive science-learning opportunities did seem to engage boys to the extent that they enthusiastically played with particular exhibits, but that the potential for enhancing the boys' science engagement was constrained because the boys' interaction with the exhibits was dominated by performances of 'laddish' masculinity, which were organised around resisting explicit 'learning' opportunities.

(b) **Muscular intellect: facilitating science identity and engagement**

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In contrast to performances of laddishness, performances of muscular intellect appeared to align comfortably with performances of science identity and engagement during the visits. For instance, during the museum visit, Sam frequently drew on this science knowledge within his performances of 'muscular intellect'. Through his performances, Sam managed to dominate the attention and support available from attendant adults and he rarely let other students answer questions by the simple virtue of answering them first. Sam frequently offered scientific explanations of phenomena and displays a keen interest in, and knowledge of, science. He was comfortable using scientific concepts and terminology and often took on a role as group leader, or facilitator:

Sam gestures to the seaplane and talks the most out of anyone in the group (e.g. talks about the wings and how the wing shape makes it faster). He also answers questions (e.g. "because it is streamlined")...

Jason asks about an exhibit, "is it real?" Jenny replies yes. Sam starts to explain how he thinks it works...

Students, teacher and Jenny all look at the 'toaster project' exhibit. Jenny asks them to point out what they can see and facilitates them to understand the exhibit. Ryan and Sam are both very engaged and point out and identify lots of items. Sam offers more scientific explanations for some items (e.g. "that's made out of metal so that's a good conductor of heat. That could be a good one to use").

Sam's use of scientific terminology and concepts can be read as examples of him 'marshalling the semantic resources of a powerful and specialized way of talking about the world' (Lemke 1990: xi). Sam's performance of 'muscular intellect' extended to explaining scientific content to his peers, as well as answering adult's questions. Sam frequently asked attendant adults questions that demonstrated his knowledge of and interest in science and the content of the science museum. For example, field notes show that before entering the flight gallery, "Sam asks Jenny if they have the Wright brothers' plane", a question demonstrating a level of specialised knowledge and familiarity with the museum that few other students showed.

We interpreted the combination of Sam's pre-existing science knowledge and his performances of muscular intellect via 'talking science' as helping him to leverage (and explicitly display) science learning from the visit. For instance, Sam was the only boy who was able to link his experiences with the interactive exhibits (discussed above) with science learning. In a post-visit focus group, Sam explained that the large circuit 'hands-on' interactive was interesting to

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him "because the circuit like was very unique". He was also the only boy to use scientific concepts to talk about the Electric Shock exhibit:

I think it's because like where we all have like electrical waves in our body ... like when something electrical hits us it like sends a shock from our finger to our brain, and then a shock round our body, and then it passes on if like there's someone holding your hand or something.

However, as we discuss further below in relation to RQ3, Sam's performances of scientific expertise were not without consequence, and could be interpreted as closing down potential opportunities for some other students to engage with science and develop science identities.

Moreover, we interpreted Sam as 'possibilising' his engagement with science and his science identity through a socially skilled 'balancing' of his performances of muscular intellect with sporadic, carefully managed performances of laddishness, that were sufficiently authentic to carry peer currency but which were not too extreme so as to attract disapproval or sanctions from staff. In this way, Sam was able to successfully maintain a position of popularity among the other boys, despite his unapologetic academic engagement and interest in science. We suggest that he managed to balance this science identity through his performances of both muscular intellect and laddishness. That is, he off-set his 'good student' academic performances and engagement with science learning with occasional 'laddish' performances of sociability, 'having a laugh', mocking other boys, and selective messing about. In line with findings research by Francis et al. (2009), which investigated how high achieving students maintain popularity, Sam was also able to draw on key resources such as being good looking, sporty and having a 'fall guy' best friend (Jason), whose position as 'class clown' and 'cool lad' helped balance Sam's 'good science student' performances. In this respect, Sam stood out from the other boys by virtue of being better able to draw on a range of resources and ways of 'being' in the museum that enabled him to be 'possibilise' (authentically perform) both science identity and popular masculinity.

Translocational masculinity: making productive links with science

Although relatively few in number, boys' performances of translocational masculinity were interpreted as congruent with performances of science identity and science engagement. Indeed, being able to personalise science concepts and practices provided, for some boys, a powerful way to relate to the science learning opportunities and objects they encountered. Darren, for example, who spent the majority of the visit enacting a 'laddish' performance, eschewing the school-like structured science learning activities, briefly transformed his way of

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'doing boy' during the visit upon encountering exhibits which he thought were about breathing, which he felt resonated with his own chronic lung condition and an upcoming hospital appointment.

During these performances, boys drew on their personal and cultural resources and experiences to engage with science learning. For instance, three boys, Jason (Black African-Caribbean) and Obi (Black African) from Mr Williams' Coleville class, and Kosoko (Black African, Ms. Jones' Mareton class) all sang or rapped as part of their filmed science research presentations during their visits. As field notes record, Kosoko's group had finished filming next to an exhibit in the medical gallery and instead of describing the objects to the flip-camera as they had before, when it was Kosoko's turn he decided to rap his presentation:

"The students make a drumbeat and Kosoko does a rap about vaccine & small pox, as they sing the other students come back to watch".

In this moment Kosoko's performance combined his love of, and identification with, popular U.S. Black masculine expressive forms (e.g. rap) with a performance of science identity, conveying his research on vaccination and small pox. His performance was positively received by his peers and the attendant adults, including his teacher, Ms. Jones.

Similarly, Kane, a Black African-Caribbean working-class boy from Mrs Thompson's Mareton class talked with one of the museum facilitators about boats after seeing one in a gallery, describing his experience of boat on a family holiday to Trinidad and Tobago.

The importance and utility of 'making connections' between science and cultural backgrounds of urban youth is discussed in detail in the work of Roth (2008), Aikenhead (2002) and Barton and her colleagues (Barton & Tan, 2009, 2010; Barton, et al., 2008). Hence we suggest that the intersectional nature of translocational performances of masculinity offer potentially powerful ways for all boys to learn about science, but might be particularly empowering for young men from underserved, urban backgrounds.

However, as noted above, these were relatively sporadic, 'small' performances – and, we would argue, will require more scaffolding and support in order to further consolidate learning and facilitate the further building of science identity.

RQ3: How were the boys' performances supported, resisted or challenged by others?

We discuss this RQ in four ways: (1) how the **field** supported and reinforced and co-constituted performances of hegemonic masculinity (laddishness and muscular intellect) but constrained performances of translocational masculinity; (2) How **other students** (boys and girls) supported

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or resisted boys' performances of masculinity; (3) how **staff** supported or constrained the different identity performances

Field: We interpreted all three performances of masculinity as being supported and enabled by the field in that the science museum content and exhibits privileged masculinity. The association of science with masculinity within the museum space is perhaps not surprising given established critiques of the dominant 'white, male' culture of science (e.g. Harding 1989). Indeed, one striking feature of all three museum visits was the number of objects encountered by students that were linked to stereotypical popular male interests. Planes, cars, engines, trains, shuttles, ships, motorbikes, computers and a range of other, often very large, machines were all not only prominent exhibits within the museum, but – particularly in the case of Coleville school - were a key focus for the visit activities. For instance, in the two Mareton school class visits, the activity subject matter focused on four white, male figures from the history of science □ Lister, Jenner, Fleming and Snow □ who were framed as 'heros' of science (McNeil, 2007). Coleville school students' focal objects were: a large snow-plough, a sea plane, a hovercraft and a rocket. Although these four objects were not explicitly described as 'male' in exhibit text or images, we found that they were interpreted as objects of male interest by students. One group (of boys and girls) for example, encouraged a particularly reluctant boy to participate by trying to interest him in the planes saying: "every boy likes planes – remember when you were little?"

In all three classes boys (from varied ethnic backgrounds) repeatedly, and excitedly, expressed their interest in the cars, planes and other large, mechanical objects they saw in the museum. While, as described elsewhere in more detail (Dawson et al., under review), girls did engage with these objects – not least because they had almost no alternatives – on the whole, their engagement and enthusiasm for these objects appeared more reservedⁱⁱⁱ. In contrast, boys frequently exclaimed at how amazing the large mechanical objects were and spent time talking with one another, as well as attendant adults, about the objects. As the following field notes record for the different groups records, Damis, Adam, Erkan and friends were all excited by a display of cars:

Damis is pointing to the cars exhibited around the gallery 'My Ford Focus. These are all my cars!'

Adam notices the stacked cars and points excitedly.

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The boys find a cut in half mini-cooper car. The boys touch the car a lot. They try to pick it up. Erkan recites the label to the group and calls it 'his' mini-cooper.

Kane says 'I've been on a lot of boats in my life, but I'd like to go on this one because it's fast ...'

As the above extracts illustrate, many of the boys displayed a strong identification, even a sense of ownership, with the vehicles, describing particular objects as 'my' car/ boat. Boys typically directed each other's attention to these stereotypically male objects which, we suggest, were used as symbolic resources (Edley & Wetherell 1995) within their performances of popular masculinity. For instance, Jamal (Coleville school), directed Serhan's attention towards a green racing car telling him "this is what you wanna do". Across the visits, we noted 22/36 boys using stereotypically 'male' museum objects in this way within their performances of masculinity.

As discussed previously, Bourdieu proposes that there is a co-constitutive relationship between habitus and field, hence we might suggest that if the museum field privileges masculinity in various ways, this may encourage boys' performances of hegemonic masculinity, which in turn contribute to their constitution of the museum field as 'masculine' or a 'male space'.

The congruence, between popular masculinity and key museum objects, provided a potential 'hook' for maintaining (or gaining) the interest of boys during the visits. Some museum facilitators also drew out connections between some of the large, iconic, masculine museum objects and wider examples of popular masculinity. One facilitator, for example, described a hovercraft in the museum as similar to that in James Bond film, Bond being an archetypal hero of hegemonic masculinity.

In some instances, the stereotypically masculine objects were not only sources of interest for the boys, but also enabled them to perform a 'knowledgeable' (science) identity. For instance, some boys were able to draw on their pre-existing knowledge of cars, boats or engines to help them confidently present themselves as knowledgeable (that is, to perform expertise) during the visits. Isaac, for example, drew on his prior knowledge of cars to describe a particular object (a Rover), which he chose to film in detail as part of his class assignment in the museum. When prompted, he was also able to link the car to what he has been studying in class:

Boys do a big circle through the gallery.

Isaac: 'I'm just gonna do the next thing that I see.' ... 'I want to do the bicycle ...

No, I'll do the train. Oh, I want to do the bike. No, forget it.'

Isaac: 'I'm just gonna do any vehicle.'

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Kane: 'I'll do the boat.' Lucy comes to warn they now really have just 8 minutes left.

Isaac: 'I've chosen mine.'

Isaac chose the black Rover. Lucy reminds them again to think about forces. Isaac talks about the car – he talks about how it looks ... 'This is related to friction, ... I mean forces and transport because the force on the wheel when it's driving called friction and it's smooth ...

We suggest that encounters with these stereotypically masculine objects helped the boys – from across ethnic backgrounds - feel comfortable during the visit, due to the alignment between their own interests, the museum field and the task in hand. In one sense, these moments might be read as helping to support the boys to develop a 'science identity' (Carlone & Johnson 2006), in which they can draw on their own cultural resources (Barton & Tan, 2009). As Thompson (2014) suggests, building on students' identities in science education can be an effective pedagogic tool. Moreover, these boys were able to present themselves as 'knowledgeable about science' – and had an opportunity to have this knowledge recognised by others. This recognition was enacted informally within the groups and more formally, through the structure of the video task, which legitimated these interests and knowledge.

However, we suggest that the privileging of stereotypically masculine objects in the museum also afforded boys a platform from which to assert performances of hegemonic masculinity, which were potentially problematic in various ways. For instance, the privileging of masculinity within the field and its alignment with the boys' habitus, enabled some boys to assert themselves more confidently during the visit in relation to girls. For example, in the planes gallery, a girl asked if she could start her film about a specific plane. Daniel, a previously quiet boy in the group, stepped forward to 'take over', asserting "because I'm an expert on planes".

While the alignment between masculinity in the field and among the boys could be viewed as 'positive' in that they enabled some boys to engage more with science and perform 'science identities' that drew on their masculine interests and resources, as we shall now discuss, it can also be problematic in that hegemonic forms of masculinity inherently entails domination and exclusion of girls and less 'macho' boys. Moreover, the effectiveness of using masculinity as a 'hook' for engaging boys with science learning may vary according to which particular performances of hegemonic masculinity the boys engage in – with some being more, or less, aligned with more formalised learning.

Students – girls and non-hegemonic boys. Successful identity performances depend on these performances being recognised as authentic by others. On the whole, students (girls and boys)

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supported boys' performances of translocational masculinity, in that we did not observe instances of these being challenged, reprimanded or sanctioned. Performances of laddishness and muscular intellect, however, appeared to be more contested. We suggest that this is due to these performances being recognised as practices of power – and hence entailing higher stakes (with more students bidding for potential recognition). Indeed, although Sam appeared very successful in able to combine performances of laddishness and muscular intellect in ways that enabled him to be both a successful lad and a successful student, this was not the case for all boys.

Boys whose laddish performances were judged by their peers as being inauthentic were roundly mocked, teased, physically pushed-around or shouted at by more dominant boys during the visits. Ryan, a white working-class boy from Mr Williams' Coleville class was, for example, shouted at and ridiculed for not being strong or fast enough when the boys used the large circuit of mechanical interactives. As Jason shouted at him, "come on, you're weak, hurry". While Ryan performed masculinity as a 'lad', messing about during structured, facilitated science learning tasks, having a laugh with the other boys it was notable that his adulthood and strength were frequently called into question by the other lads. For instance Ryan's excitement at the start of their time in the 'hands-on' gallery was mocked:

Sam jokes with some of the other boys that Ryan's getting excited because "he's never been to Chessington or anywhere, so this is a big step!" Cos you know when he goes to Chessington, he's not allowed on any rides cos he's too short!"
Another boy says "Ryan still sucks his thumb, you know" Someone calls out "calm down, Ryan!"

As Edley and Wetherell (1995) note, hegemonic forms of masculinity create difficulties for boys whose identities do not align with being 'hard' or 'laddish'. For Ryan, being physically smaller than many of the other 'lads' meant he was subjected to ridicule as both 'weak' and immature (sucking his thumb). Furthermore, as a study by Francis et al (2009) suggests, student popularity can rest upon physical characteristics (or resources), such as being strong or tall, which may not be open to boys such as Ryan. As such, exhibits which demand and prioritise attributes such as strength and competitiveness may inadvertently play into the reproduction of particular hierarchies of power within boys' performances of masculinity.

Daniel (White, working-class boy, from Coleville) largely performed laddish masculinity during the visit. However, in one of the galleries filled with airplanes, hovercraft, models of airplanes and flight games, Daniel's interest in these vehicles led him to try to re-engage with the science learning work that his group were doing. Daniel attempted to do so through

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performances of muscular intellect, for instance, assertively telling his peers and the museum facilitator what he knew about planes, asserting and interrupting with new information that he had gleaned from the exhibits and showing his interest in the subject and his motivation to learn.

Unfortunately for Daniel, his performances were judged inauthentic by his fellow group members, who responded to his attempts to engage with science learning by belittling him and undermining and questioning his claims to knowledge. For instance, they challenged his proffered knowledge about planes, saying “Was you making it up?” and berating him as “Literally – stupid, innit”. On multiple occasions, group members walked away from Daniel and refused to acknowledge his performances of muscular intellect. For instance in the extract below, Chloe, a white working-class girl in Daniel’s group, undermined Daniel’s attempt to show his knowledge about a snow-plough.

Ally asked them about what they could see and Chloe described the ridges (on the treads) that would’ve helped it get through the snow. Daniel said how fast it could go, to which Chloe responded: ‘He’s just reading out’.

In not recognising Daniel’s performance of ‘muscular intellect’ as genuine by responding that he was “just reading out”, Chloe rendered Daniel’s performance illegitimate. Ajani, from the same group further responded to Daniel’s attempt at muscular intellect by describing Daniel’s contributions to the discussion as “just general knowledge”. In other words, we suggest that while performances of muscular intellect may, in many ways, align well with science engagement and science identity and may work well for boys like Sam, they remain problematic in that they are restricted to particular male bodies (those who are judged to have the appropriate academic and embodied resources to be judged ‘authentic’).

Staff. It was notable across the visits that all three performances of masculinity appeared to be supported by staff, in the sense that they were not admonished. Perhaps most surprisingly of the three, laddish behaviours were largely not sanctioned and were treated by staff and students as unremarkable on the visits. Boys were rarely reprimanded by teachers or facilitators for displays of ‘laddish’ behaviour. Indeed, only one boy is recorded as having been told off once (during Ms. Jones’ class visit, Mareton). A few boys were admonished by other students, notably by assertive girls. As we discuss elsewhere, this stood in marked contrast to girls, given that where girls did perform equivalent ‘laddette’ (Jackson 2006) behaviours on the visits, these performances were usually either censored by the girls themselves, their peers or the attending adults (see Dawson et al., under review).

Although, as we discuss elsewhere (Dawson et al, under review), some girls also asserted themselves through performances of muscular intellect, the way that these performances were

received by adults during the visits was also markedly different to boys. For instance, whereas a couple of girls were reprimanded by staff for being too 'bossy' (dominant), throughout all three visits there were no recorded instances of boys being reprimanded by adults or other students for comparable performances of muscular intellect. That is, we suggest that the performance of muscular intellect is dominantly aligned with masculinity in such a way that it is seen as 'normal' aspect of masculinity but as a deviant performance of femininity.

RQ4 What are the implications of the boys' performances of masculinity for who can/cannot do science identity?

We found that performances of laddishness and muscular intellect both entailed problematic implications for the science engagement and inclusion of girls and non-hegemonic boys. For instance, we noted that when boys' engaged with exhibits through laddishness, they also tended to reproduce exclusionary and sexist view of science – as 'for boys'. For example, in the post-visit discussion groups, boys who had engaged through performances of laddishness tended to construct the exhibits as being 'for boys', drawing on dominant, stereotypical constructions of gender in which masculinity is aligned with physicality, strength and competition, and femininity is aligned with 'softness', cooperation and weakness and passivity (e.g. see Francis 2000).

We also noted that boys' performances of laddishness and muscular intellect appeared to silence or marginalise other students. For instance, Tamir (a mixed, White/Black working-class boy) and Jake (White British, working-class boy), both from Mrs Thompson's Mareton class, and Deon (Black Caribbean working-class boy, Ms. Jones' Mareton class), were not recorded as enacting 'laddish' performances at all during the visit. Although they quietly engaged in group work, the overwhelmingly 'laddish' and muscular intellect performances enacted by the rest of the boys on their visits meant that these quieter boys appeared almost invisible, to staff and other students, during the visits, limiting their opportunities to be recognised as performing science identities. Likewise, as discussed earlier, we observed that many girls did not participate while boys were using (and dominating) the interactive exhibits. As exemplified by the field notes extract that opens the paper, girls tended not to compete, remaining at the side line, quietly watching the boys or waiting for a turn.

Some students, as noted earlier, also experienced their work and efforts being talked over, dismissed or taken over by boys who were performing laddishness or muscular intellect. For example, Isaac, a White British working-class boy from Mr Williams' Coleville class, enacted a performance of 'muscular intellect' that stretched across the entire visit and involved aspects of

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teacherly support for his peers. However, his performances were not all altruistic and, on occasion, also involved putting others down. Isaac assumed a leadership role, putting himself 'in charge' by virtue of his scientific knowledge. Isaac's use of knowledge to 'dominate' others can be understood as a form of 'muscular intellect', which he drew on both in being knowledgeable about the science content involved or how a particular task, such as 'directing' Amber's film in the extract below:

Amber reads her notes. 'As you can see, this is a snow plough ...'

Isaac to Amber [quite rudely]: 'You have to do it louder! I didn't hear you.'

Amber starts again,

Isaac keep shouting 'Louder, louder!'

Amber does her speech again, trying to speak in a louder voice.

Isaac calls Kane: 'Kane, come down. It's a group activity!'

Isaac led Amber's attempt to complete her science learning task (filming her research about the snow plough), interrupting her, instructing her and shouting at her. In the same episode Isaac also sought to control Kane, a mixed White/Black Caribbean working-class boy from the same group, who had attempted to remove himself from the group work situation and was prevented from doing so by Isaac loudly and publically recalling him to the group. Isaac worked to police the actions of his peers, telling them what to do and when. At times he did so through physical control, pushing and shouting at his peers. For instance, when filming in the flight gallery Isaac controlled who would and would not be in another student's film; "Isaac pushed Abdul away from where side of the seaplane 'Abdul, you're not in the video'." Isaac's performance of 'dominant' student appeared to draw on aspects of 'muscular intellect' as well as being a 'lad', particularly in terms of embodied power and strength, verging on fighting. Although we are anxious not to 'over-claim' from our data, and noting the difficulty in attempting to disentangle the workings of power within the data, it is also possible that Isaac's embodiment (as a white boy) further supported his ability to authoritatively perform muscular intellect with a wide range of other students (girls and minority ethnic boys), given the dominant alignment of science with whiteness and masculinity.

Similarly, Sam's confident, authoritative science discourse could be read as, in some instances, reinforcing the 'mystique of science' (Lemke 1990, xi), constructing science as dogmatic, not open to question, and scientific expertise as residing within particular highly academic ('genius') students, such as himself (Lemke 1990). Notably, Sam performed muscular intellect in ways that marginalised and disempowered other students in relation to science, but particularly his group member, Rachel. Sam, Rachel and Sam's friend Jason had been placed in a

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group of four, together with another boy, for the visit. Throughout the visit, field notes recorded how Sam was instrumental in leading the boys to exclude or marginalise Rachel. For instance, she was repeatedly prevented from taking part in her group's activities, with Sam dictating tasks and roles for each student, and rarely making space for Rachel, except when prevailed upon by the attendant adult (Jenny). In her recollections of the visit, Rachel commented on how she had disliked being told what to do by the boys in her groups, for instance complaining that "they tell you to hurry up too much". In his post-visit discussion group interview however, Sam, justified and described his behaviour as 'helpful' for other students, explaining:

Because when Rachel was doing her video she was quite nervous, so my group tried to encourage her, like 'Take your time, just relax and like say what you know' and everything. And then like we also ... like for example the duck, we were holding it ... and like we were helping her.

As Thompson's (2014) study suggests, it is important that science learning opportunities do not preclude the other identities that students are invested in maintaining and developing - particularly for students for whom a science identity might not be an easy fit. However, we would add to this that not all student identity resources are unproblematic and that some performances, like laddishness and muscular intellect, can entail the subordination of others.

In contrast, we interpreted translocational performances as offering the most potential and value to science and museum educators wishing to engage boys with science through a more progressive, socially just politics – although we also recognise the circumscribed and potentially challenging potential of these performances. For instance, we observed that boys' performances of translocational masculinity appeared to be less defensive and potentially less oppressive (in that they were more inclusive) for other students compared with laddishness and muscular intellect. Conceptually, we interpret this as reflecting how such performances are organised around finding points of commonality across gender, ethnicity and social class and are less concerned with asserting social dominance. These broader, more flexible ways of 'doing boy' could offer useful avenues for helping students not only to engage with science but also to help them to engage in reconfiguring what science is for them (Rahm, 2010).

However, a potential constraint on the emancipatory potential of performances of translocational masculinity could be where such performances draw on oppressive cultural forms – for instance, although the boys discussed earlier used rap as a non-exclusionary vehicle for engaging with science content during the visit, this potential might be compromised were they to have drawn on misogynistic rap lyrics (which we would interpret as sliding into culturally entangled performances of laddishness).

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Moreover, while some boys were able to produce translocational performances of masculinity during the visits, we would argue that these were constrained by the masculinist and Eurocentric nature of the museum field that they encountered during their visits. As discussed earlier, the field within which the visits occurred normalised hegemonic forms of masculinity and whiteness. Moreover, students' encounters with representations of ethnicity were predominantly encounters with White, Eurocentric content, while 'Blackness' was represented problematically. Indeed, the only time we recorded students encountering any representation of 'Blackness' during the visits took place within a gallery about health and focused on representations of African countries and people in the context of ill-health and disease. Understandably, these overwhelmingly negative representations of Black people as living in poverty with an extreme burden of disease were shocking for some students. Damis, for example, was upset by a photograph of a young African child ravaged by smallpox:

Damis is shocked by a cover of a booklet with a child with smallpox (the child's face is covered in lumps) ...

'Uuugh, poor kid! Oh my!!'

He seems a bit upset, wanders off for a few seconds but then re-joins the group again.

Julia: 'Yeah, smallpox was horrible.'

The same smallpox exhibit was later screamed at by Alisha, a Black girl in the same class, who declared "Miss, I can't do smallpox now – look at that picture" concluding that "it's frightening". We suggest this episode and the performances of shock and horror it provoked amongst students were particularly problematic since these were the only representations of Black people that were showcased to the students during the museum visits. Not only therefore was museum content primarily framed as and interpreted by students in relation to hegemonic masculinity, but representations of non-dominant people and cultures were either absent or, as the example of the smallpox exhibit demonstrates, problematically negative.

As we discussed at the beginning of the findings section, we understand there to be a co-constitutive relationship between the field and performances of identity. That is, a field (e.g. museum, science classroom) which normalises and privileges dominant, narrow forms of masculinity may hinder or preclude the performance of other, less-hegemonic forms of masculinity (such as translocational masculinity). Equally, a field that values and normalises multiple (e.g. hybrid, intersectional) ways of being may help to promote more equitable performances of identity and masculinity. In this respect, we suggest that reframing science and developing a greater variety of institutionally authenticated ways for students to 'be' when

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engaging with science and/or museums may help support more students to develop a 'science identity' and find science useful, relevant and interesting to their lives.

Discussion

In this paper we have sought to explore the masculinity performances of urban, working-class boys from three participating classes in two schools during a school museum visit that took place as part of a larger project aiming to engage urban young people with science. We identified three main performances of masculinity: 'laddishness' (the most popular and frequent performance), 'muscular intellect' (performed by a smaller number of boys) and 'translocational' performances of masculinity (which were relatively sporadic). We sought to identify the implications of these different performances for the boys' science identification, engagement and science learning, and the implications of the performances for the learning and engagement of others (notably girls and less dominant boys).

We found that laddishness, while largely organised around the resistance of formal learning, did facilitate some engagement (and learning as 'doing') with particular exhibits, notably those which enabled performances of competition, machismo and 'bravery'. However, we argued that (perhaps unsurprisingly, given the predication of these performances on resistance to learning and intellectualism) performances of laddishness had a limited and questionable role in promoting further and more formalised science learning, nor did they seem to facilitate a 'science identity' for most boys. In other words, we argue that while 'laddishness' might be mobilised as a vehicle for engaging some boys with particular interactive and/or stereotypical masculine exhibits, this does not necessarily or easily translate into boys developing a science learning trajectory, reconfiguring science itself or being recognised as a 'science person'. Indeed, notwithstanding the small sample and the admitted limited nature of our methodology and analytic frame for identifying learning (particularly our reliance in the discussion groups on asking students to articulate learning and links to science), we noted only one urban working class boy (Sam) who was able to navigate the science museum visit with any ease and who appeared to derive any articulated or sustained science learning benefits from the visit. We also drew attention to the ways in which laddishness is problematic in that it entails the marginalisation and denigration of girls and less hegemonic boys, and hence is also complicit in the exclusion of others from science.

We found that performances of muscular intellect aligned well with science learning and were highly congruent with performances of science identity, given that they are premised on assertive displays of (scientific) identification and knowledge. Hence, on the one hand,

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performances of muscular intellect enabled these working class, ethnically diverse, urban boys to take up positions and identities of scientific expertise, which they may not often get the chance to authentically inhabit during their usual everyday encounters with science. On the other hand, however, these performances reinforced dominant elitist representations of science and were also implicated in the marginalisation of girls and other boys. For instance, performances of 'muscular intellect' enabled these boys to show their superior 'cleverness', due to their ability to be recognised as competent in a high status, elite 'hard' subject such as science. As Archer et al (2014) discuss, such performances "align with (and produce in their own right) dominant discourses in which science is configured as 'brainy', authoritative and 'masculine'. Moreover these performances were not widely accessible to most students, that is, only boys with specific configurations of embodied resources were judged able to perform muscular intellect authentically.

Translocational performances of masculinity were found to offer some more equitable opportunities for boys to engage with science - without necessarily entailing the exclusion of others. As such, we suggest that these performances offer a potentially more productive (and socially just) model for engaging urban boys with science as they are organised around notions of commonality and shared value and interest. However, these performances were relatively sporadic and were largely unsupported by the field.

We argued that hegemonic forms of masculinity were privileged and normalised by the museum field in various ways within the visits, for instance through the physical environment and exhibits, the focus of the intervention activities (which foregrounded famous 'dead white men' of science and 'big boys' toys) and through 'competitive' and physical nature of some of the hands-on interactive exhibits. Drawing on Bourdieu's argument about the interrelationship between habitus and field, we argued that the privileging and normalisation of masculinity within field can, in turn, promote and normalise performances of hegemonic masculinity (which again, also contribute to the re-constitution of the field as 'masculine').

As Nasir & Hand (2008) discuss, the closer the perceived link between an individual's identity and a specific practice, the more likely the person is to be engaged with it. "That is, the person is more likely to participate more extensively and more intensely' (Nasir & Hand 2008, p.147). We argued that the alignment between particular forms of masculinity within the museum and through the designated tasks on this visit offered more opportunities for boys' engagement with science than girls' – but particularly boys who are able to enact more dominant (hegemonic) performances of masculinity. We suggest that our analyses pose a dilemma for science educators who are invested in developing socially just and equitable science engagement

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and learning experiences.: That is, appealing to laddishness and popular masculinity may successfully 'hook' and engage working-class boys with particular science exhibits - yet these experiences may not necessarily enhance the boys' articulated science learning, understanding, interest or identity and may also play into the marginalisation of girls and other boys.

We concur with the premise that a potentially useful approach lies in leveraging youths' own cultural identities and resources (Calabrese Barton & Tan, 2009; Gonsalves, et al., 2013; Tan, et al., 2012), however our analysis suggests that this may be complicated by the question of whether some of these resources might be more problematic than others, as exemplified in this case by the case of boys' performances of hegemonic masculinity through laddishness and muscular intellect.

Our analyses present a challenge for science museums wishing to better engage more diverse youth, given that their collections of objects, historically, overwhelmingly tend to represent 'masculine' interests and contributions. Our work also raises questions for those seeking to use a funds of knowledge perspective to engage urban youth in spaces like science museums – the privileging of masculinity within these spaces affords some boys with a way to combine science engagement and learning with identities they are already invested and which these boys experience as enjoyable. Yet, this form of engagement also marginalises girls and other boys and prevents them from engaging through the different identities and practices that *they* are already invested in. As Thompson (2014) suggests, building on students' identities in science education can be an effective pedagogic tool. The question is however, to what extent can engaging urban young men in science by providing science learning experiences that reinforce performances of hegemonic masculinity really be part of an equitable approach to science education?

We suggest that translocational performances of masculinity appear to offer the most promise for a social justice approach to science engagement. Yet as Thompson's (2014) study suggests, developing pedagogic practices that start and end with learners' interests, knowledges and cultures is no mean feat. In particular, she argues that such science learning experiences can be "frail if student's everyday stories are merely co-opted" (2014, p.45). Furthermore, she argues that "Too often, engagement is considered a means to developing identities in but not beyond science" (p.45, 2014). This point is reiterated by Gonsalves et al. who underline "the importance of finding ways to fit the processes of science, the questioning and exploration of the natural world into youth's experiences, rather than attempting to retro-fit their experiences into science" (2013, p. 1089). Indeed, in reflection we suggest that the development of this project's particular intervention was dominated by concerns to fit the museum experience with the school

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curriculum and that this overrode concerns about finding ways to connect science with students' own experiences – but that this is an aspect that might usefully be developed in future iterations. Moreover, our findings suggest that science educators might usefully pay attention to issues of power and hegemony when considering which aspects of students' lives and identities are foregrounded within attempts to link science to youths' own worlds.

Moreover, we suggest that ISLEs may usefully enhance and develop their critical awareness around the complex & interwoven nature of gender inequalities within their practice and representations of science. This includes the representation of women and those from a range of cultural, ethnic and class backgrounds in both physical objects and collections and in the gendered dimension of 'ways of being' and 'ways of engaging' within the museum. Much of literature and learning theory underpinning activities in ILSEs focus on social interaction, but we suggest that more attention might be given to power dynamics and the implicit, 'hidden' gender messages that might be conveyed within such spaces and interactions. In other words, we call for ISLE practitioners and researchers to engage critically with the way gender influences science learning and engagement, both in terms of how students interpret instructions and content and how ISLEs design their programmes, activities and exhibits.

While we do not wish to be proscriptive (we feel it is more productive for practitioners to reflectively develop their own practice in response to our findings in ways that best fit their own specific settings), we also realise that it can be helpful to signal a few potential more 'concrete' implications for practice. Hence, we suggest that, a future iteration of the museum visits might foreground a more diverse set of 'scientists', topics and objects, being careful to offer broader (e.g. by ethnicity and gender) possibilities for girls and non-hegemonic boys to make meaningful connections between their own identities, interests and concerns and science. Pedagogically, emphasis might be placed on the value of co-operation and group work as ways of authentically 'doing science'. Staff might also give useful attention to sanctioning instances of sexist and homophobic talk and behaviour on the visits. Ideally, we would also support the value of designing exhibits and spaces from the starting point of diversity – for instance, curators and education teams might usefully reflect on whose values, interests and identities are being represented? What messages are being reinforced and conveyed about science – and how might these be broadened and democratised? How might we invite, represent and value diverse visitor identities and experiences in these spaces? What scaffolds can be put in place to help all visitors to make meaningful connections to the objects and exhibits? Education teams might also consider if there are ways to work more closely with particular communities and schools over extended periods of time, in order to build relationships and understanding and to develop ways

of leveraging youth identities and resources that are grounded within the lives, interests and needs of the young people in question.

Conclusion

Informal science learning environments, such as science museums, may offer a potential 'third space' for engaging under-served communities with science. However, our findings suggest that they may also unwittingly play into and reproduce dominant (inequitable) gender relations. Our analysis of the masculinity performances of urban boys from two schools during a museum visit suggests that masculinity was privileged and normalised within the museum field and that most boys engaged with science through performances of hegemonic masculinity. This creates a dilemma: while these performances facilitated science engagement in a number of ways – which may be a desirable goal for science educators wishing to engage urban youth - they were also deeply problematic in equity terms and did not necessarily translate into easily identifiable forms of science learning and/or the development of science identity among the boys. Moreover, performances of laddishness and muscular intellect excluded and marginalized girls and non-dominant boys. We suggest that ISLEs need to be attuned to issues of power and gender in/equality and that efforts to connect science to urban youths' lives might usefully consider a 'translocational' lens.

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ⁱ In a couple of cases, for instance due to a participating student being ill on the day, or another student participating unexpectedly at the last minute, a group contained three or five students.

ⁱⁱ Although some boys may also work 'under cover' to 'hide' their efforts, in order to preserve their public displays of laddishness (Archer 2003; Frosh et al 2002).

ⁱⁱⁱ Of course there were exceptions, e.g. For instance, Hannah, a White, working-class girl from Mr William's Coleville class told her friend Grace not to let her near the computer exhibits because she was 'too' interested in them.