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Selfies at the science museum: exploring girls' identity performances in a science learning space

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ABSTRACT

Science education has a seemingly intractable gender problem and remains largely the reserve of White, middle-class men and boys, especially in the physical sciences. In this paper, taking an intersectional approach to Butler's idea of identity as performance, we explore the affordances and limitations of a specific science learning space (a science museum) for girls. We discuss four types of performance, one based on 'good' behaviour, one combining masculinity and 'race'/ethnicity, one of silence and one based on being 'cool'. We focus on the experiences of 25 girls aged 12-13, from a mixture of ethnic backgrounds, from two inner-city, state-run, co-educational London schools, in the UK. We argue that the museum space put girls in a difficult position for both learning science *and* enacting the identities they were invested in. We conclude by reflecting on the implications for science learning spaces that disrupt rather than reproduce social inequalities.

Introduction

Utibe:	Alisha, do you want to come and sit on my boat?
Alisha:	No thank you Utibe. Come take a picture, Utibe, take a picture, take a picture Utibe (she uses a silly voice)
Utibe:	I don't have a phone (pause, then in a US accent) Oh my god look at me (to Alisha posing)
Alisha:	No Utibe, I have my poses ready, look at this!

Understanding how science education is practised such that some students struggle while others flourish is not straightforward. The field note extract above shows Alisha (a Black British, working-class girl) and Utibe (a Black African, working-class boy) talking during their class visit to a science museum. We were interested in these 12 and 13 year olds inter-actions because unlike Utibe, Alisha largely ignored all the exhibits in this gallery about transport, focusing instead on taking photographs of herself (selfies). But what value did the selfies hold for her? And what were the affordances of this science learning

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space for performing 'herself' and/or learning science? In this paper we explore girls' visits to a science museum through the lens of identity as performance (Butler 1990). In exploring girls' identity performances we take up Walkerdine's (1990) question – what positions are available to girls – and apply it to the seemingly intractable problem of gender and science education.[1]

Research on socio-cultural issues, including gender and identity, has emerged as a key focus for those exploring how people learn science (or not) (Scantlebury et al. in press). Understanding the roles of gender and identity in science education is important because around the world scientific practices, knowledge, education and careers, especially in the physical sciences, remain the reserve of men and boys, in ways that are also marked by class and 'race'/ethnicity (Brotman and Moore 2008; Campion and Shrum 2004; Lynch and Nowosenetz 2009; Schiebinger 2007). Indeed, research suggests that in some countries, for women and girls, especially those from racialised minorities and/or working class backgrounds, being yourself while learning science is difficult. In the US, for example, researchers have described the 'double bind" that undermines the science learning experiences of women and girls from racialised minorities on the basis of both their gender and 'race'/ethnicity (Ong et al. 2011, 175). Similarly in the UK, where this study was based, researchers have shown how the intersecting subjectivities of women and girls' lives, including but not limited to gender, 'race'/ethnicity and class, trouble experiences of science education in a triple or multiple bind (Archer et al. 2012; Walkerdine 1990; Wong 2011). Who you are matters for learning science.

Studies across a range of science learning spaces suggest that everyone, including girls, is more engaged with and better able to learn science when their identities, knowledges and behaviours are valued and reflected in a given space (Barton et al. 2013; Carlone, Scott, and Lowder 2014; Nasir and Hand 2008). But a growing number of studies also document the extra work needed by women and girls to pursue studying science whilst being themselves (Francis et al. 2017; Gonsalves, Rahm, and Carvalho 2013; Johnson et al. 2011; Ong 2005; Thompson 2014). Taken together, these two sets of studies suggest an urgent need to better understand how girls enact the identity performances they are invested in *while* learning science.

At the same time, it is crucial to consider how studies of gender, identity and science education are framed and understood. Research on the idea of 'successful' girls in education suggests that studies of identity can too easily be read as locating girls as individually responsible for the positions available to them, and in doing so, minimise or obscure the limiting effects of structural inequalities (Allen 2016; Baker 2010; Ringrose 2007). This is particularly problematic in science education where the effects of entrenched gendered, racialised and classed biases have been repeatedly found to penalise women and girls within and beyond school (Atwater et al. 2013; Francis et al. 2017; Gilbert 2001; Lemke 1990; Steinke et al. 2006).

A small but growing number of studies suggest that gender is a significant issue for learning in science museums, science centres and other informal science learning spaces. For instance, studies have found that certain kinds of exhibits attract boys more than girls, and that parents provide their sons with more scientific explanations than their daughters, gendered family dynamics museums may do little to disrupt (Crowley et al. 2001; Ramey-Gassert 1996). Furthermore, science museums have been criticised as spaces that reflect and reify White, male privilege while Othering people outside this

narrow category through exhibit design, text and content (Dawson 2014; Dawson 2019; Lavine and Karp 1991; Levin 2010). These challenges have prompted researchers to explore what gender-inclusive science learning might look like in museums and science centres, examining exhibit design and staff attitudes (Achiam and Holmegaard 2017; Dancstep and Sindorf 2018).

This article contributes to the growing literature on the roles of gender and identity in education by focusing on girls' experiences in a specific science learning space, a science museum. We discuss the affordances and limitations of girls' identity performances for the positions available to them as science learners as well as for girls' agency. We argue, if we are to take the challenge of inclusive education seriously, we must rethink how girls' identities and science learning are understood and aligned.

Theoretical background

We draw on post-structural, intersectional feminist approaches to understand girls' behaviours in the museum as identity performances (Butler 1990; Hill Collins and Bilge 2016). Education researchers have argued that we must consider what is involved in the 'girling' and 'boying' of bodies to explore how gender performances are constructed in practice in specific educational contexts (Francis and Paechter 2015; Holland et al. 2001; Walkerdine, Lucey, and Melody 2002). We use our empirical data to explore this idea, and draw out how the affordances and limitations of girls' performances might be understood for both science learning and girls' agency in science learning spaces.

For Butler, gender performances draw on, recreate and/or resist social norms of what it means to be female/male; 'such acts, gestures, enactments, generally construed, are *performative* in the sense that the essence of identity that they otherwise purport to express are *fabrications* manufactured and sustained through corporeal signs and other discursive means' (1990, 185 italics in the original). This post-structural approach to gender is echoed in work that views other social axes, such as class or 'race'/ethnicity, as social constructs that influence identity (Hill Collins and Bilge 2016; Holland et al. 2001). In broad terms, this perspective sees identities as embodied practices, bound up in social norms about what it means to be a certain kind of person.

We use intersectional feminist theories because they help us to think about gender as inextricably linked to other aspects of girls' identities and performances. While the history of intersectional feminism is debated, it critiques Western feminist theory as predominantly concerned with Eurocentric and Northern global contexts and the experiences of White, middle-class, able-bodied, heterosexual women (Crenshaw 1991; Hill Collins and Bilge 2016; Mohanty 2003; Roy 2016). Intersectional approaches instead pull the experiences of women and girls outside this limited focus into view. Thinking about intersectionality is useful for any analysis of gender since, for example, no one is without 'race'/ethnicity, nor can aspects of ourselves be neatly stacked or separated analytically. Thus, although we foreground gender in this paper, we note that girls' identity performances drew on the intersecting subjectivities of their lives in ways that make analysing one facet at the expense of another problematic. In particular, we draw on Puwar (2004) and Gunaratnam's (2015) notion of intersectionality as kaleidoscopic, to help us understand the shifting relationships between different aspects of girls' identity performances, differently combined and/or foregrounded in different moments.

Intersectional feminism also reminds us that not all performances are available to all bodies in all spaces (Mohanty 2003; Paechter 2007; Puwar 2004). Local, as well as global, socio-historic and political contexts influence girls' identity performances, not least structural inequalities such as racism, sexism and/or classed oppression. Identity performances remain rooted in bodies, communities, space and time (Johnson 2017; Massey 1994; Paechter 2007; Puwar 2004). Thus some bodies, given their age, shape, colour, clothes or demeanour, in combination with specific spaces and structural inequalities, encounter problems that other bodies do not.

Furthermore, how people read identity performances (peers, teachers or indeed, researchers) can be as important as how they are enacted, especially in understanding how performances are legitimated or rejected (Currie, Kelly, and Pomerantz 2007; Gee 2000). In other words, it matters if performances are intelligible in a given space (Butler 1990). Taking into account how performances are read allows us to think about how they might be read or misread across time and space (Francis and Paechter 2015). For instance, identity performances can be misread in ways that are racist and/or sexist (Lorde 1984). Puwar (2004) has shown, for example, how some bodies (those of women and people from racialised minorities) are less desirable and less accepted in particular spaces than others, in ways that are marked by sexism, racism and histories of colonialism. In persistently entering such spaces, whether parliament, a museum or a local park, Puwar (2004) has argued people create alternative readings of their selves, the people around them *and* the specific space they are in. Thus, in educational spaces as Mohanty (1989, 183) has argued, 'teachers and students produce, reinforce, recreate, resist, and transform ideas about race, gender, and difference'. We draw on these ideas to see identity performances as situated practices in science learning spaces, practices marked by structural inequalities but open to improvisation and change over time (Holland et al. 2001).

Methods

The data used here are drawn from a larger study – called Enterprising Science – about the science learning experiences of young people from socially disadvantaged backgrounds in the UK. We explore data from the museum visits of three science classes from two inner-city, state-run, co-educational London schools (Mareton School and Coleville School). In comparison to other local schools, both had large numbers of students registered for free school meals and a high proportion of students who spoke English as an additional language. When the project started both schools were neither the best nor worst in their local areas in terms of exam results.[2] We situate the students in terms of self-reported data on gender, class and ethnicity generated via a questionnaire that they completed annually as part of the larger project.[3]

We took an ethnographic approach to exploring the museum visits and agree with Eisenhart's (2001) view of ethnography as a tool for understanding socio-historic, political and cultural issues that reach beyond the immediate research setting. In other words, that detailed, site-specific research, even if only a snapshot in time, can tell us something useful about the wider world. Visits were researched[4] following a participant observation approach and collected data included field-notes, photographs and audio-recordings (Hammersley and Atkinson 1997). In total 61 students visited the museum and data from 25 girls aged 12-13, as well as their teachers (5), teaching assistants (2) and

museum facilitators (6) are discussed here. Each class visited the museum separately and their visits lasted approximately four hours. We focus on the girls' experiences in the museum, although we draw on data from boys at times for context (Archer et al. 2016). Pseudonyms are used to anonymise the schools, school staff, students and museum facilitators.

To understand girls' identity performances our initial analyses followed standard, qualitative analytic approaches. We began with an iterative analysis, developing patterns from the data, then applying theoretical perspectives (Miles and Huberman 1994). We analysed performances as more than just talk, coding how students conducted themselves, walking, singing, dancing, hiding, being loud or quiet, sociable or not, and so on (Edley 2001). We were interested in understanding how the different ways that girls' enacted their performances had differing affordances for learning science and for girls' agency.

It became clear however, that there was a tension between developing patterns or typologies and retaining a degree of analytic ambiguity, when we tried to understand how girls performed their selves from an intersectional perspective. Indeed, as Currie, Kelly, and Pomerantz (2007) note, analyses can fix certain readings of girls' performances, where multiple interpretations are actually possible. As a result, in our analyses we drew on Puwar (2004) and Gunaratnam's (2015) concept of intersectional identities as kaleidoscopic. Thus, the performances we discuss below are not to be read as discrete, but rather that girls' enacted multiple performances, as well as drawing on different aspects of their selves at different times. Although the simplicity of a typological approach is seductive, in what follows we try to retain a sense of the differing readings of girls' performances and their implications.

Results

In exploring the visits through our question – what positions are available for girls in a science museum – we found girls' identity performances in the museum could be understood in four main ways. Firstly, in 'good girl student' performances, being conscientious and well behaved was foregrounded. A second group of performances drew on a combination of masculinity and 'race/ethnicity. A third kind of performance was organised around silence and a fourth kind focused on performing 'cool', drawing on gender, 'race'/ethnicity and class. We discuss below the affordances and limitations of these performances for both learning science and girls' agency.

While a detailed analysis of the museum itself is not the focus of this paper, we note at the outset of this section the museum was an in-between sort of a place for the girls. It was neither classroom nor playground, but echoes of both haunted the visits. For instance, visits followed a tour plan agreed in advance between museum staff and class teachers, based on school curricula. Girls visited with their school science teachers and science class peers, carrying with them pre-existing relationships, curricula and practices.

Though students were excited to be away from school, the museum posed its own challenges. The museum covered historic and contemporary science, technology and nature. Galleries included exhibitions where historic objects were displayed in glass boxes, 'hands-on' exhibits intended to support visitors' physical exploration of scientific phenomena and computer game exhibits designed to showcase contemporary science. Across this wealth of topics, exhibit formats, artefacts of material culture, images and stories we found gallery

after gallery marked by troublingly narrow representations of gender, 'race'/ethnicity and class. Science was represented, as the saying goes, as stale, pale and male. As research on similar spaces suggests, White men were the heroes of science, celebrated as geniuses, inventors or brave pilots, while women, people from racialised minorities and/or people from working class backgrounds were invisible or Othered (Dawson 2018; Dawson 2019; Lavine and Karp 1991; Levin 2010).

Students rarely encountered representations of women and people from racialised minorities in the museum, and when they did, they were presented as the objects rather than the subjects of science. Thus when students saw women in museum content, they were represented as reproductive vehicles, notably through a diorama of childbirth, the display of a chastity belt or as displays of disembodied wombs. Similarly, people from racialised minorities were represented in exhibits about boats (where Asian figures seemed to crew a model of a historic boat, to be compared to the White crew of a more technologically 'advanced' European boat), or as victims of disease in a gallery about medicine. Furthermore, as discussed later in this paper, we found exhibit design to be gendered in function as well as in content and representation, echoing previous research (Achiam and Holmegaard 2017; Dancstep and Sindorf 2018; Ramey-Gassert 1996). Thus we suggest that the way science and science learning opportunities were constructed by the museum positioned science as a Eurocentric, male and privileged pursuit.

Tensions between 'good' behaviour and learning science

Navigating performances of both femininity and being academically successful is far from easy in and beyond science learning spaces, especially for girls from racialised minorities (Archer 2008; Fordham 1993; Nunn 2018). Indeed, as in other studies, we found being a 'good' student whilst female in the science museum rested on helpful and 'nice' behaviour rather than subject-knowledge or affinity (Read, Francis, and Skelton 2011; Walkerdine 1990). In particular, we suggest 'good girl student' performances were not well aligned with science learning in the museum in two ways. First, although such girls seemed to be engaging with (most) science-learning activities in the museum, they did so while seeming to side-step science content through a focus on 'good student' behaviours such as task-completion. Second, as a result of exhibit design, there were instances where engaging with a science-learning activity sat at odds with the behaviours prioritised through 'good girl student' performances, such that some girls avoided using these exhibits. Notably, we did not find examples of boys stuck in a similar predicament (Archer et al. 2016). Thus, as we discuss below through examples from Grace's visit, some of the science-learning activities the girls encountered in the museum were configured in ways that made learning science whilst performing 'good *girl* student' difficult.

Grace (a Black-Caribbean, working class girl) was described by her teacher as 'nice' and one of a 'handful of kids that'll probably do some really good work'. What we saw during the visit was that this 'good work' hinged on classroom rules of being polite, supportive (of teachers as well as students) and focused on the completion of assigned science-learning tasks (her own and others) as fieldnotes from a History of Aviation gallery show:

Grace looks at the boys' work. There is no capital letter. This is disgraceful" she says […] As they get to the bottom of the stairs, the boys hide and Grace tells them off: "We can all see you, you know, what are you doing?"

Her 'good girl student' performance appeared to be recognised, since peers followed her instructions and her behaviour was rewarded by praise from museum facilitators.

To our initial surprise however, in analysing her visit we found that despite appearing attentive during science-learning tasks, Grace rarely displayed an interest in science, used scientific words or talked about science and, in her support for peers, rarely supplied scientific knowledge. Grace also avoided exhibits that required certain kinds of behaviours, as other studies of girls in science museums have found (Dancstep and Sindorf 2018). For instance, Grace and her friend Hannah (a White-British, working class girl), both refused to touch an 'electric shock' exhibit, even when explicitly instructed to do so. Similarly, Grace cautioned Hannah to 'try and stay dignified' when using an exhibit that needed to be awkwardly climbed on top of in an interactive gallery. These exhibits seemed well suited to performances of 'laddish' masculinity and were eagerly used by their male peers, who shouted and jostled one another (Archer et al. 2016; Mac an Ghaill 1994). We suggest however, such exhibits required ways of 'doing science' that sat at odds with 'good girl student' performances, premised as they were on narrow discourses of appropriate feminine behaviour (Butler 1990). As a result, because using these exhibits required Grace and Hannah to get involved in 'laddish' behaviours, such as shouting or climbing, they put the girls in a difficult position. They could not carry out their assigned learning tasks (to use these exhibits) while maintaining 'good girl student' behaviour.

As Walkerdine (1990) notes however, it is important to be careful in what we ascribe to girls' behaviours. Girls' enacting 'good girl student' performances worked hard and were respected by peers and teachers. Indeed, for girls like Grace, whose performance of 'good girl student' emphasised a proto-teacher role, here was a way to be in charge of peers and to talk with teachers and museum facilitators as equals, by trading on their expertise as reliable students who knew what do to. As others have argued however, successful performances rest as much on how they are read by others as how they are enacted (Butler 1990; Gee 2000; Holland et al. 2001). Research on science learning has repeatedly found that being recognised as a successful science student hinges on confident displays of scientific knowledge, interest and active participation in gendered ways (Carlone, Scott, and Lowder 2014; Nasir and Hand 2008). Thus we find it troubling that with their emphasis on good behaviour, supporting others and avoiding certain kinds of learning opportunity, 'good girl student' performances did not put girls in a good position to develop or be recognised for scientific expertise or interests. We suggest therefore that 'good girl student' performances were not well aligned with access to certain science learning opportunities in the museum and did not support girls' visibility as science learners.

Trying to learn science through performances of masculinity and 'race'/ethnicity

That girls draw on discourses of masculinity as well as femininity in their identity performances is not a new idea in or beyond studies of education (Francis 2010; Renold 2008). We build on this work to suggest that girls' performances of masculinity were complicated by

'race'/ethnicity in the science museum. However, we also suggest the affordances of these kaleidoscopic performances for both learning science and girls agency were limited because of how they were read by others (Butler 1990; Francis 2010).

Performances of masculinity seemed at first to have significant affordances for girls' learning science in the museum. For instance, Kayefi (a Black African, middle class girl) performed muscular intellect through loud, confident displays of her interest in and knowledge of science to make bids for attention, as these fieldnotes show:

> In the History of Technology gallery the group are told by the museum facilitator to find the next object. Kayefi shouts out answers. She seems keen to win. Kayefi seems both proud of her work and competitive, she tells her group: "Oh you boys, you think you work harder. Stand there and watch me do my stuff!"

Unlike performances of 'good girl student', performances of 'muscular intellect' created a platform for girls to boldly demonstrate scientific expertise, interest and cleverness, in ways often associated with White, middle-class boys and recognised as a valued form of participation in science education (Archer et al. 2018; Carlone, Scott, and Lowder 2014; Francis 2010; Mac an Ghaill 1994). Similarly, 'tomboy' performances that emphasised being one of the boys seemed to provide girls in otherwise all-male groups with a way to participate in group activities (such as mocking others) and a way to use the more 'laddish' exhibits (particularly those operated via feats of strength, speed or agility) (Renold 2008).

The intersecting subjectivities of girls' lives complicate however, what we have described so far as an analysis of performances drawing on masculinity. We suggest that girls whose performances involved being loud, academically confident, and/or physically and verbally assertive, also drew on their ethnic backgrounds as young Black or Turkish women at certain times and in different ways to access science learning opportunities (Fordham 1993; Koonce 2012; Mirza 2006; Nunn 2018). Kayefi's performance, for example, could be understood as drawing on the talking-with-attitude practices of some female Black students, to garner attention for her scientific expertise: 'watch me do my stuff!' (Koonce 2012). Thus, we suggest that girls were drawing on their ethnic backgrounds as racialised minorities, alongside or perhaps instead of masculinity.

It is clearly problematic that particular iterations of these performances (such as some of those inflected with 'tomboy' behaviours) rested at times on subjugating others. However, building on Francis and Paechter's (2015) view of girls' masculine performances, we see these as transgressive rather than purely hegemonic performances. We suggest that these assertive performances afforded girls agency and ways to challenge the limited positions available to them, both as young girls from racialised minorities and as science learners, in a science museum where science content and certain science-learning practices were narrowly configured as masculine and White (Archer et al. 2016; Dawson 2018; Holland et al. 2001; Puwar 2004; Schiebinger 2007).

Boisterous performances (whether understood as drawing on masculinity, 'race'/ethnicity or both) had the potential therefore, to support girls' agency and visibility as science learners. However, these performances were undermined because some adults found them unintelligible in this space (Butler 1990; Gee 2000; Walkerdine 1990). We found these performances were (mis)understood in embodied terms; accepted or punished according to a narrow interpretive framework based on the gendered and 'raced'/ethnic body of the student in question (Francis 2010; Massey 1994; Showunmi 2017).

Kayefi was repeatedly told by her teacher and teaching assistant not to 'show off' when attempting to display her scientific knowledge, while 'tomboy' Esrin (a Turkish, working class girl) was told off more than the boys in her group for fighting:

> A kicking 'game' breaks out between Koray & Esrin (he previously kicked her during group work). Ersin shouts at him a lot. Ally (museum facilitator) tells Esrin not to kick Koray and to be silent, but says nothing to Koray.

We suggest that because these assertive, kaleidoscopic performances drew on racialised forms of 'race'/ethnicity and masculinity – foregrounding different aspects of girls identities at different times and sometimes at the same time – these performances were doubly unintelligible (Butler 1990; Puwar 2004). Staff disciplined loud, assertive and/or unruly performances by girls from racialised minorities because, we suggest, they were read through racialised and gendered lenses as transgressive (mis)behaviours (Evans 1988; Fordham 1993; Showunmi 2017). Thus, while such performances potentially afforded girls valuable opportunities to exercise their agency and/or take on celebrated science learner positions, they were limited by others racist and sexist (mis)interpretations (Gee 2000; Lorde 1984). In other words, even when girls' performances appeared to be in line with successful science student positions (through confident displays of scientific expertise or assertively using certain interactive exhibits), it seemed impossible for them to be recognised as such (Carlone, Scott, and Lowder 2014; Nasir and Hand 2008).

Closing down science learning through silence

Silence in education spaces, like loudness, has been understood in different ways for different girls (Fordham 1993; Francis, Skelton, and Read 2010; Walkerdine, Lucey, and Melody 2002). We build on Scantlebury et al. (in press) to argue that despite a focus on talk in research on science education, exploring silence is key for understanding how students experience science learning spaces differently. Across the visits, girls seemed sometimes silenced by their male peers and at other times seemed to choose their silence. We coded 'silent/invisible' performances where girls withdrew from or were shut out of social interactions and group work during the visits. We argue this closed down opportunities for science learning and, depending on whether silence was chosen or imposed, the girls' agency. While these performances drew on discourses of femininity as quiet or passive, we suggest that interpreting them is complicated by girls' 'race'/ethnicity and classed subjectivities.

Identity performances are enacted in social as well as physical spaces and, as researchers remind us, gendered performances of masculinity and femininity often develop in relation to one another (Butler 1990; Francis, Skelton, and Read 2010). Where girls' were silenced by boys, we found this relational positioning (boys as active/loud, girls as passive/quiet) developed through science-learning group work, where the group included only one girl. In these groups, girls' bids for involvement, space or voice were ignored and/or derided by boys. Boys in such groups commandeered the attention of teachers and facilitators. Even girls with scientific expertise like Amber, (a Black-African, working class girl), who belonged to her school's science club, struggled to engage with tasks in her male-dominated group where she was put in an impossible position through the boys domineering behaviours, as this extract shows:

> No one is interested to join Amber in the group task, so she does it by herself. Amber is keen on science and goes to the science club, which she told me proudly. It seemed that she did not get along with the boys in her group. For example, when they were asked to give her feedback about her presentation, all started shouting "louder" (about 10 times in total!) and teased her that she never speaks at all.

Unlike the girls involved in 'tomboy' or 'cool girl' performances, girls whose silence and invisibility appeared to be chosen, did not seem to purposefully avoid science-learning activities. However, there were very few coded instances of girls enacting 'silent/invisible' performances *while* actively taking part in science tasks, even quietly (such as talking about science and joining group activities), or displaying an interest in exhibits (such as stopping to read exhibit texts or look at objects). As a result, girls involved in performances of 'silent/invisible' had few opportunities to demonstrate or be recognised for their knowledge of or interest in science, key features of being recognised as successful science students (Carlone, Scott, and Lowder 2014; Nasir and Hand 2008). We suggest therefore, that 'silent/invisible' performances undermined the girls' claims to space and voice within this science learning space, while reproducing narrow discourses about girls as passive and quiet (Francis, Skelton, and Read 2010).

While 'silent/invisible' performances were clearly problematic since they reflect an extremely limited position for girls' science learning, when chosen, they could be understood as strategic for girls' agency. For example, fieldnotes about Talia, (a Black British, working class girl), reflect her limited involvement with peers and the museum tasks, such as; 'Talia is playing with her shadow, she has barely spoken while I've been observing' and 'Talia wanders off on her own'. In trying to understand Talia's 'silent/invisible' performance, we found framing such performances as only or always about passive femininity inadequate. Instead, we turned to research which suggests some academically successful girls from racialised minorities navigate the potentially treacherous waters of education by hiding their achievement through performances of quietness and seeming reserved (Fordham 1993). Indeed, as other studies remind us, operating under the radar can also be a strategic choice for White, working-class girls (Lucey, Melody, and Walkerdine 2003). Thus, we suggest that whilst clearly limiting in terms of the positions available for girls' science learning, withdrawing from social interactions in science-learning spaces could also be seen as a tactical, protective performance or even a rejection of the situation for certain girls in response to marginalisation through peer interactions and/or the museum space (Fordham 1993; Scantlebury et al. in press).

'Cool girls': A contradictory position for science learning

As mentioned earlier, the representation of 'Others' – in this case women, people from racialised minorities and/or working class backgrounds – was rare and problematic (sexist/racist/classed) in the museum. As a result, the space offered little support for girls to enact performances that were congruent with both learning science *and* the kinds of femininity, 'race'/ethnicity or class identities girls were invested in. We found girls' used 'cool girl' performances to reframe their visits to support the identities they were already invested in, making claims to space and voice in the museum that were hard to ignore. While 'cool girl' performances seemed to support girls' agency, this often (though, as discussed below, not always) came at the cost of learning science.

As with other performances discussed here, the girls classed and 'raced'/ethnic backgrounds influenced their 'cool girl' performances in a kaleidoscopic manner. We found that girls drew on gendered performances of being a popular student described by Francis, Skelton, and Read (2010), which foreground being (hetero)sexually attractive, through appeals to fashion, prettiness and sociability (flirting with boys and chatting with friends). Girls combined this with classed 'ladette' performances of being loud, funny and avoiding school work, and racialised performances as assertive girls from racialised backgrounds (Fordham 1993; Jackson 2006). Girls chatted in a mixture of street slang, their family languages and English, sometimes code-switching to avoid being understood by adults. The girls loudly sang and danced to songs together, drawing, as others have found, on the popularity of Black cultural forms regardless of their specific 'race'/ethnicity, to perform being 'cool', creating kaleidoscopic performances that drew on all their identity resources (Paechter 2007).

We found girls enacting performances of 'cool girl' mainly used their own resources and artefacts (bodies, phones, friends, songs, dances), rather than museum artefacts (science exhibits, objects or interactives) (Holland et al. 2001; Paechter 2007). We combine Jackson's (2006) argument that 'ladette' performances protect working class girls from academic failure with Nunn's (2018, 244) point that 'Black girls are often trapped in environments that do not fully support their personal and academic development'. Thus we suggest that performances of 'cool girl' supported the girls' agency and protected them against academic failure in a science learning space that did not meet their needs and did not reflect the realities of their lives.

Alisha and Lex (both Black British, working class girls), for instance, ignored the content of a history of technology gallery filled with large engines, cars and tractors. Instead, they danced to music from their phones and took numerous photographs of themselves with their phones (selfies) as these fieldnotes show:

Alisha:	Oh Lex, we have to dance right, otherwise it's unbearable (pause) look, she's so vain miss (to museum facilitator Ally)
Ally (facilitator):	Why's she so vain?
Alisha:	She's just taking pictures of herself
Ally:	Oh so she's doing another selfie […]
Alisha:	I have like one pose (takes more photos, laughs)
Lex:	I need to quickly sort out my hair (long pause)
	Lex starts doing selfies and both Lex and Alisha continued to take many selfies and show their friends until we left the gallery.

We suggest that 'cool girls' used selfies to resist the narrow, difficult or invisible positions available to them during the visits. First, although selfies could be considered a form of engagement with exhibits, we noticed no instances of the girls taking selfies with museum artefacts. Instead, we found that girls used their bodies, phones and relationships to generate valued images of their selves, instead of engaging with museum content or the science learning tasks assigned by their teachers and facilitators (Jackson 2006). Second, as Drew argued in Agrawal (2016), the selfies represented a novel opportunity to change who *is* seen and *can be* seen in museums. In this sense, the fieldnotes could be read as Alisha and Lex attempting a transgressive performance, to reinscribe representations of themselves as young, Black, working-class women into and beyond this science learning space, using their own resources. At the same time

however, it is clearly problematic that because of the way science and science education were configured, the girls seemed to avoid them in pursuit of the identity performances that they were more invested in.

Notably, some 'cool girls' did engage with science on the rare occasion when an exhibit or interactive aligned with valued aspects of their identities (Archer et al. 2012; Barton et al. 2013; Gonsalves, Rahm, and Carvalho 2013; Thompson 2014). Because so few exhibits represented stories the girls' could identify with, we were particularly interested when Alisha and Lex used an exhibit in a history of medicine gallery to demonstrate and be recognised for their scientific knowledge (Carlone, Scott, and Lowder 2014; Nasir and Hand 2008). Alisha initially screamed at a photograph of an African toddler covered in smallpox blisters, using her shock and outrage to refuse to do her assigned science learning task (a presentation on smallpox): 'Look down there, yeah. Miss, I can't do smallpox now – look at that picture'. With encouragement from her group and the facilitator however, Alisha went on to do her presentation:

> Alisha: As you can see, the picture down there, show them Lex, shows how smallpox was caught and how it came up on the little boy's body. Oh miss, it's disgusting! And then the African people – 'cos they look African miss – they made a cure, and some other, like, this is an object of cure, and yeah, that's it.
>
> Lucy: [museum facilitator] prompts the students to talk about how vaccines are given and also asked what was important about Africa, in terms of the display.
>
> Alisha: Africa is the place that has the most [smallpox]
>
> Lucy: It was the most affected by it?
>   Lex then points out that Africa is still affected by malaria

We suggest that the image of a Black child prompted Alisha and Lex to make their scientific knowledge visible and to be recognised for it, creating a position for themselves as 'cool girls' *and* science learners in the museum. Similarly, exhibits about reproduction created a space for girls to connect with science through 'cool girl' performances because such exhibits foregrounded the heterosexual femininity they were so invested in. For instance, girls from Mareton School discussed a childbirth diorama in terms of parenting and future careers, albeit stereotypically female roles; with one girl commenting, 'Oh – she's giving birth, I want to be a midwife when I grow up'.

It is clearly problematic however, that some girls' only points of connection with science in the museum was through facets of their identities that they valued, but were pathologised or narrowly represented in exhibits in racist and sexist ways (Lavine and Karp 1991; Levin 2010; Schiebinger 2007). It was difficult to even find the few exhibits that represented valued identities that girls' could connect with; the extract above was the only representation of Blackness that Lex and Alisha encountered during their visit and we found no examples of girls' from Coleville School finding exhibits about racialised minorities or women. Furthermore, while performances of 'cool girl' supported the girls' efforts to resist science learning while protecting their agency and the identities they were invested in, as Walkerdine (1990) reminds us, not all forms of resistance are revolutionary. The girls' had little power to change how people like them were represented in the museum and even their selfies reproduced narrow, sexist stereotypes about how women and girls are valued based on (hetero)sexual attractiveness (Paechter 2007). We suggest that since 'cool girls' (and several girls enacting the other performances) avoided science learning opportunities in order to enact and/or protect the identities they were

already invested in, we must consider how best to reconfigure science museums and similar spaces to support girls to be themselves *and* learn science.

Conclusion

To return to Walkerdine's (1990) question, our findings suggest that the science museum visits we studied left girls in a difficult position for learning science and performing the identities they were invested in. Our findings support other studies that show that girls are better able to learn science in spaces where their identities are valued, in a museum, at school or wherever those spaces may be (Barton et al. 2013; Thompson 2014). The combination of the museum space and the identity performances we have discussed here seemed to configure valued ways of 'doing science' and 'doing girl' as difficult at best and, at worst, as mutually exclusive.

Although we foregrounded gender in our analysis, we found an intersectional approach productive in reminding us that identity performances are rarely straightforward. Analytic frictions help to question the extent to which different facets of girls performances can be neatly separated or might be better understood as kaleidoscopic – that is, differing in influence and overlap at different moments and in different spaces (Gunaratnam 2015; Puwar 2004). Such frictions also highlight the differing implications for researchers reading girls' performances as drawing on masculinity, 'race'/ethnicity and/or class backgrounds. As Mohanty (2003) argued, tensions exist between understanding girls as real and understanding girls as discourses. These tensions remind us to resist stabilising girls' performances in our analyses (Currie, Kelly, and Pomerantz 2007). Thus, not only did we find that the girls enacted different ways of 'doing girl' and 'doing science', but their performances included different ways of doing 'race'/ethnicity and class, as well as 'doing masculinity'. We argue that transgressive performances, however fragile or problematic, were possible and created moments in which different identity assemblages could be attempted, potentially challenging and changing the spaces (physical and social) in which they were enacted (Holland et al. 2001; Puwar 2004).

We should perhaps not be surprised that the girls' avoided or resisted certain science learning opportunities in the museum, whether through focusing on being 'well-behaved', being silent, or loudly pursuing other activities that they valued more. Although kaleidoscopic performances of masculinity and 'race'/ethnicity seemed to support some girls' participation in science learning, we suggest requiring girls to 'do boy' in order to 'do science' is no solution to longstanding gender inequalities in science education. Against this backdrop, the rare moments of connection with representations of racialised minorities or women were notable. We do not however, wish to suggest that science museums or other science learning spaces should represent Africa through the burden of disease and White saviour medical narratives, or should represent women in relation to science only as reproductive vessels. Rather, we suggest these moments of connection are analytically fruitful since they show that questioning and reinterpreting the relationships between people and science can create valuable science learning opportunities. Thus our findings add to research that suggests science learning practices can be reconfigured to align with those aspects of girls identities that girls value, rather than rendering such identities invisible or represented only in racist, sexist or other oppressive ways (Thompson 2014). As such, this paper contributes to research trying to understand entrenched gender

inequalities in science education and how they might be disrupted, especially work on how science learning experiences are marked by gender, as well as 'race'/ethnicity and class, across a range of spaces, not least museums (see for example Achiam and Holme-gaard 2017; Brotman and Moore 2008; Dancstep and Sindorf 2018; Gonsalves, Rahm, and Carvalho 2013; Johnson et al. 2011; Wong 2011).

The research described here only represents three snapshots in time, with a small number of girls and a specific museum. We suggest however, following Eisenhart (2001), that ethnographies can reverberate beyond their immediate context. In particular, our findings challenge limiting narratives about ways of 'doing girl' and/or 'doing science' across multiple science learning spaces. Thus, as discussed above, a key implication of this paper for practice is that educators, exhibit designers and those invested in science learning spaces should reconsider the representation and interpretation of people and science to support broader, more inclusive ways to 'do' both girl and science (Schiebinger 2007). Whose voices are heard, whose objects are displayed and how are these stories told? Clearly, this is no easy problem to solve, but herein lies the creative challenge for those involved in designing and delivering science learning opportunities.

Notes

1. We use the term science throughout this paper and define it broadly as science, technology, engineering and maths (STEM). While we agree there are significant differences between the subjects corralled together under this umbrella, a broad definition of science was necessary given the research site, which included a wide range of topics.
2. During the project Coleville School went into what are called 'special measures' in the UK. This happens when Ofsted, the governmental body that audits schools, decides that a school is not providing adequate support for students' education. We mention this only to show that while schools were selected for a degree of social disadvantage, these disadvantages seemed to worsen for certain students during the life of the project (2012–2017).
3. We use the demographic descriptions that students provided us with, for instance, if a student described themselves as British Nigerian, Black British or female we use those words. We also use the term racialised minorities when describing the students as a group in terms of their ethnicity, not least because of the range of different backgrounds across the three classes. We describe students in class terms based on data they provided about their families, such as parental occupations and qualifications.
4. Six researchers took part in each visit, five women and one man.

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Notes on contributors

Emily Dawson's research explores how some science education practices across the formal and informal education sectors (i.e. from schools, to museums, to watching TV at home) set certain kinds of people up to be successful when they engage with science, while other people are set up to fail.

Louise Archer's research focuses on educational identities and inequalities, particularly in relation to gender, ethnicity and social class. She has previously undertaken studies on topics such as British Muslim students' identities and educational experiences and more recently research on inequalities in science participation.

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Jennifer DeWitt's research and evaluation interests include learning and engagement in early years, families and school groups in informal science environments, including the implications of work on science capital in these settings.

Heather King's research interests focus on the pedagogy of museum and out-of-school educators, and the practice of, and policy support for, environmental education in England.

Ada Mau's research focuses on issues and discourses of identities, 'race', gender, social class and social justice in education. They also include heritage language learning, multilingualism, migration, social and cultural policy, informal learning, and youth cultures.

Effrosyni Nomikou's research explores museums practices, from numismatics and curatorial practices to understanding visitor experiences. She has previously undertaken research on science participation in schools and museums, with a focus on equity and access.

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