UCL
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**02 May 2018**

# *Building Bridges*

# Final Research Report


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# Executive summary

**Introduction, research context and approach**

The 'Building Bridges' project is a partnership between the Science Museum and the BG Group. The overall aim of the project is to provide links ('bridges') between the science learnt at school, the science encountered at the Science Museum, and as part of every-day family activities. The project is a structured sequence of activities, occurring in school, at the Science Museum, and at home.

The Science Museum invited the University College London (UCL) Institute of Archaeology to collaborate on the research of the project, owing to the Institute's expertise in how families engage with museums and with science. The research focuses explicitly on the family element of the 'Building Bridges' project to illuminate this important yet under-researched part of the project. The research questions focus on how families' cultural references and everyday conversations might relate to science, and what the impact of their involvement in the 'Building Bridges' project is.

A qualitative, in-depth approach is adopted that took place over one year. It involves interviews with teachers, focus groups with parents and pupils, and observations and interviews during activities and events. The research also involves case studies with four families from under-represented backgrounds whereby families were visited in their homes, communities and accompanied on trips to the Science Museum.

**Key findings**

***Teachers' views on pupils and parents***

- Teachers state that their schools' efforts to promote science might not be reaching all pupils, with pupils from poor backgrounds, those not achieving highly academically and girls missing out.
- Year 7 is a time of great change for pupils' lives as they adjust to secondary school and move towards independence. This change is associated with the increased influence of peers and close friends, for leisure activities and for guidance and support.
- Teachers rarely see or have contact with their pupils' parents, and do not know much about pupils' families. Teachers highlight that families have a huge influence on pupils, but language, cultural or other reasons prevent some parents from engaging with their children's education at school.

***Pupils' and parents' views and experiences of home life, hobbies and school***

- Common activities that the whole family continue to enjoy together relate primarily to relatively short activities in the home, such as watching television, cooking and gardening, as well as special occasions that often relate to extended family and religious events.
- Pupils' main interests and hobbies relate to technology and sports. Technology, primarily in terms of smartphone and social media use, is an all-pervasive part of pupils' lives, including for educational purposes. Parents often do not understand these uses and they feel excluded. In addition, there is some concern that pupils are spending too much time interacting with technology. Rather than imposing limits themselves, parents rely on schools to regulate their children's use of technology, in

part because they are unsure about the extent to which their children use technology for educational activities.

- For the most part pupils enjoy school, and both they and their parents have high aspiration to do well and get 'good' jobs. However, parents often do not think they possess the necessary understanding of curriculum content or educational structures to support their children. This parental perception is based on a range of factors, including their confidence, difficulties understanding the English language used at school, and their own limited experiences of attending UK schools as pupils. Pupils do not yet have clear career ambitions, and teachers state that it is too early for them as teachers to explicitly guide Year 7 pupils towards various career options.
- Science is not a particularly popular subject, particularly amongst girls. Pupils become less enthusiastic about science during the higher years. Most families characterised science as important and as high status, and simultaneously as difficult, nerdy and somethings they were not inclined to engage with or that formed part of their every-day family lives.

***Families' views and experiences of the Science Museum and 'Building Bridges' project***

- Parents and pupils described the Science Museum in relation to education at school and as a place for school visits, rather than also as a place for their family to engage with science.
- Pupils were exceedingly positive about the 'Building Bridges' project because it was fun, highly interactive, novel, and because they received special attention from the Science Museum as part of their involvement. The project gave pupils a chance to engage with science content in a different way, and allowed pupils to play a different role compared to at school. All pupils recalled some of the activities that they had taking part in during the project, often in remarkable depth. However, pupils did not spontaneously make links between the science that formed part of the project and the science encountered at school. Pupils also stated that a 'normal' visit to the Museum would possibly not be as entertaining because they would not receive the special attention that formed part of the project.
- Parents were aware of the 'Building Bridges' project, and described it as an attractive and unique project for their children to be involved in to support learning at school. However, most parents did not think of the project as also being specifically for families like themselves.
- Many families who attended the family event had never previously been to the Science Museum. They viewed the event as a sign of being valued by the Museum, which is a view that they did not always previously have.
- Families described the event in very positive ways, such as '*inspirational*' and '*amazing*'. They viewed the range of activities, and the presentation of objects and interaction with staff as highlighting the breadth of science. Some of the activities, such as the production of liquid nitrogen ice-cream also provoked reflection on elements of science. Activities were particularly effective if they explicitly encouraged collaboration between parents and children, such as making cardboard virtual reality headsets.
- Families were sometimes unsure which activities related to science, which objects were part of the event, and to what extent activities and objects related to the 'Building Bridges' project. These uncertainties created a sense of bewilderment

amongst some families that contributes towards a sense of the Museum being somewhat alien and obscure to them.

- Families at the event did not always think of the wider setting of the Museum as being accessible and engaging, and often did not think that they could have experiences similar to those at the event on a 'normal' visit. Such views highlight the challenges facing the Science Museum in explicitly welcoming diverse family audiences by providing specific events, while simultaneously being seen to be accessible to these audiences without the need to provide specific events.

***Insights from the case study families***

- The four family case studies provide in-depth insights into why some families do not or only infrequently visit museums, and provide suggestions for the Science Museum and beyond to think about and address issues of under-representation. All case study families come from backgrounds that are under-represented at the Science Museum and other museums, and three of the four families do not, or only very rarely visit museums.
- Family time for the case study families can be split into weekdays and weekends, with most after-school time spent at home, such as when children 'hang out' or engage with technology. Most time that parents and children spend together during weekdays occurs at dinner time.
- At weekends, parents from the case study families often sought out 'special time' with their children, for example as part of a shared interest in football or music.
- Case study families had clear identities related to cultural and national heritage, and religion and location. Such identities and associated local communities provide opportunities to socialise, develop interests and gain valuable information and advice that is used as part of their every-day lives. Case study families often trusted, respected and relied on these local communities more than on official information and guidance.
- Three of the four case study families did not think of the Science Museum as having direct relevance to their specific interests, culture or history. Families spoke about visits to the Science Museum and other museums as a welcome and enjoyable part of school provision, but not as a place for them to visit as a family.
- The case study families have limited time together and want to use this time to engage in something that they see as either explicitly fun, such as visiting a restaurant, or something that they perceive as directly supportive of their children's school work, such as helping with school projects.
- One case study family highlights how families can build up capital to visit museums and successfully engage with content provided there based on simply visiting museums rather than having pre-existing capital.
- When asked, the case study families mentioned a range of potential benefits with respect to providing a Science Museum app for families, such as information in several languages, and tailoring information for specific ages and interests. However, potential drawbacks of an app were also voiced: it might be difficult to use; might distract from looking at and interacting with objects; some families might see downloading the app as a requirement to visiting; families might be unsure if the app costs money or uses their phone credit; and using the app might make some families feel more compelled to donate or otherwise spend money in the Museum.

# 1. Introduction

The 'Building Bridges' project is a partnership between the Science Museum and the BG Group. It began in the academic year of 2012/2013, and initially involved schools from five London boroughs[1] in close proximity to the Museum, and schools from Reading joined in 2013/2014. In the academic year of 2015/2016 a total of 17 schools took part, with one Year 7 class from each school being selected by the school to take part in the project. As discussed in Section 6, there were different approaches with respect to how schools selected which Year 7 class would take part in the project. Ten of the 17 schools can be described as 'faith schools' in that they have an explicit Christian ethos[2]. 11 of the 17 schools have been graded as 'outstanding' by Ofsted, with five schools receiving the grade 'good', and one school being 'inadequate'[3].

The overall aim of the project is to provide links ('bridges') between the science learnt at school, the science encountered at the Science Museum, and as part of everyday family activities. The project is a structured sequence of activities, occurring in school, at the Science Museum, and at home, taking place over the duration of one academic year from September - July. The uniqueness of the project rests in its multi-nodal approach in that there are numerous points of contact with teachers, pupils and families. These points of contact include teacher CPD courses, outreach visits to the school, pupil visits to the Science Museum, a family event at the Museum, classroom resources for use before, during and after the visits, as well as family resources.

Running through the project is the underlying focus on the importance of science as an inherent and important part of everyday life. Engaging with science offers people opportunities to gain new understanding, strengthen existing knowledge, spend time with friends and family (Rennie and Stocklmayer, 2003), and develop scientific literacy and enjoy themselves (Falk and Needham, 2011). Politically, this science engagement is viewed as important jointly due to strengthening the scientific workforce and in terms of providing opportunities for individuals to more actively contribute to scientific, and associated social and political decisions (Krapp and Prenzel, 2011). There is also a growing awareness that engaging the public with science allows for mutual learning in that both scientists and publics have valuable experience, knowledge and opinions that contribute to the development of science and its relevance to society (McCallie *et al.*, 2009).

The project sets out to inspire and engage young people from diverse backgrounds, encouraging them to explore STEM[4] subjects and career paths, and to make sense of the science that shapes their lives. It combines formal learning in the classroom, with non-formal learning at the Museum and at home. The project in this manner focuses on how children learn science as part of their education in schools, as well as how families learn science during their everyday lives.

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[1] The London boroughs involved were: Brent, Southwark, Wandsworth, Kensington and Chelsea and Westminster

[2] 26% of state maintained secondary schools in London are 'faith schools'.

[3] Around 21% of state maintained secondary schools in London are graded by Ofsted as 'outstanding' in 2015.

[4] Science, technology, engineering and mathematics.

Running through the project is a focus on the concepts and skills associated with science rather than a focus on a specific scientific topic. More specifically, the project is built around the development of a set of pupil skills important for science engagement, emphasised in programme resources and in face-to-face sessions with Museum staff. These are: asking questions; sharing knowledge and ideas; creative problem solving; finding and using evidence and being a team player.

In so doing the project seeks to support the science engagement of pupils and their families through activities and resources that:

- Provide opportunities for pupils to reflect and discuss science at home, and thus to promote the relevance of science in their lives and communities.
- Raise awareness of the skills that are used and developed through doing science, and that these are useful for everyday life, education and careers.

The project thus builds on science as a constantly evolving and locally defined set of concepts, knowledge and skills that allows us to see and understand various types of information (Knorr, 1999; Latour and Woolgar, 1986). This definition highlights the relevance and omnipresence of science in the lives of families, such as when engaged in cooking, shopping or gardening.

Previous research on the 'Building Bridges' project conducted between 2012-2015 focused on the impact of the project on how pupils view, respond to and engage with science in school. This research provided evidence that multi-nodal interventions can have a longer lasting impact on pupil attitudes to science than simpler, single-node ones, such as a one-off visit to a science festival. An important finding of this research is also that the pupil's families play an important role in establishing this impact.

Prior academic research suggests that most children have positive attitudes towards science until they reach the age of around 10 years. Subsequently, their interest in science declines and by age 14 their attitudes and interests have largely been formed (Archer *et al.*, 2010). The early secondary school years are therefore critical in considering how to engage people with science.

It is widely acknowledged in the academic literature that much of what children and adults know about science originates from learning within the family (Bell *et al.*, 2009; Dierking, 2012). Families, through their everyday interactions, shared experiences, views and dispositions, have and continue to develop understanding, including knowledge and skills related to science (Banks *et al.*, 2007). Research commissioned by the Wellcome trust in 2014 (Atkinson and Mason, 2014) outlines that families are cited by young people aged 12 and above as key influences in their lives. This includes a positive and consistent influence of parents who provide guidance and support. But, it can also include parents' limited, lacking or negative influence, which is often shaped by difficult family circumstances. These parents might not seek out educational activities, including museum visits, for many diverse reasons, including lack of time and money, negative preconceptions, feeling intimidated or perceiving such activities as culturally irrelevant to them.

The research presented here focuses on the family element of the 'Building Bridges' project in an effort to illuminate this important yet under-researched part of the project, and to contribute to practitioner understanding and academic attention in this area. The Science Museum invited the University College London (UCL) Institute of Archaeology to collaborate on this research, based on the Institute's prior experience and on-going research interest in how families engage with museums and with science. The research takes a qualitative, in-depth approach to explicitly consider families who are under-represented visitor groups of the Science Museum. Such under-represented groups include families from ethnic minority backgrounds, and families with low socio-economic statuses. Considering reasons and structural barriers deterring such groups from visiting science museums matters because science is a valuable resource in our societies (Dawson, 2016). Museums are potentially useful places for families to engage with science, enjoy and learn about science, and to develop science career aspiration, and appreciate science as an important part of diverse cultures and societies (Falk *et al.*, 2007).

An important element of the research is also to foster a practitioner-researcher collaboration whereby the researchers from UCL and practitioners from the Science Museum work together throughout the research to share ideas, feed back findings and collaboratively develop methods for data collection and analysis. Both the Science Museum and UCL have an interest in supporting science learning, and in helping people understand the relevance of science within everyday life. More specifically, in widening participation form families who are under-represented in museums. The aim of the practitioner-researcher collaboration is simultaneously to support on-going theorising in the field of science engagement in museums, as well as to be of practical use at the Science Museum and beyond.

## 2. Research context

Recent survey research suggests that over the course of one year about two-thirds (67%) of UK publics[5] visited at least one science-related leisure or cultural setting, including museums, and most individuals visited these attractions with their family (Department for Business, Innovation and Skills, 2014). Museum, including the Science Museum, generally aim to inspire and educate their visitors, including families (Falk *et al.*, 2007). Families are an important visitor group for museums as a stream of income, for example through entrance fees and by providing a justification for public funding and private sponsorship. Museums also often have a public duty to offer access to their collections for visitors, including families (e.g., National Heritage Act, 1983). In addition, most museums aim not only to offer access, but also actively aspire towards being recognised as welcoming and relevant settings for families to enjoy themselves and to learn (Museums Association, 2011).

The overwhelming majority of research with respect to families as museum visitors has focused on those families who are already visitors. This research highlights that families, as other visitors are directly involved in creating their experiences in museums (Hein, 1998), with engagement and learning being a cumulative process that takes place across time and in many

[5] 'Publics' is noted as a plural term to illustrate the diversity of various groups of individuals that make up 'the public' (National Science Foundation, 1982).

situations (Lemke, 2000). There is lots of evidence to suggest the potential of museums to support engagement with science across settings and learners' ages (Bell *et al.*, 2009; Bevan *et al.*, 2013). When visiting museums people talk to each other, they interact with objects and information provided, and they reflect on elements of their visits that are of interest and relevance to them. Ellenbogen *et al.* (2007) suggest that examining how families engage with science in museums researchers should shift from purely studying outcomes determined largely by the museum, to also directly studying the meaning that museums have for families. This focus on the families' perspectives includes taking into account not only how resources provided in museums shape the experience therein, but also how attributes that families bring to the museum setting, primarily in terms of their interests, knowledge and wider views shape their experiences (Moussouri, 2003).

Considering these potential opportunities for engaging with science, over the past 15 years the museum sector has progressively tried to increase such opportunities for a diverse range of visitors (Dillon, 2011). However, families visiting museums continue to come for a narrow demographic profile, consisting primarily of white, middle-class, urban families (Department for Business, Innovation and Skills, 2014). Families from minority ethnic backgrounds and low socio-economic status are consistently under-represented in most museums in the UK, as well as in the US and Canada (Callanan *et al.*, 2013; Dawson, 2016). There are no specific data outlining patterns of under-representation in museums, and the reasons behind patterns of under-representation are not fully understood (Dawson, 2014).

The focus on social exclusion from museums has primarily been framed in terms of 'barriers' that prevent certain groups of people from visiting. These barriers might are said to include cost, geographic distance, as well as limited interest in museums and science (Dawson, 2014; Bell *et al*., 2009). Dawson (2014, 2016) argues that while such a barrier model appears to provide a common sense answer to the question on under-representation, it neglects how barriers, such as cost and limited interest might overlap. In addition, a barrier model cannot explain why the demographic profile of visitors to museums in the UK has remained remarkably stable since the financial barrier was removed with the introduction of free admission to many museums since the 1990s. For example, visitor numbers to the Science Museum rose when the entrance free to the Science Museum was removed through government subsidy. However, analysis of visitors suggests that the removal of entrance fees has not been associated with a diversification of visitors. Rather, those visitors who were already coming to the Museum, simply visited more often (Ipsos MORI, 2003). Reflecting on reasons why people may not visit museums through a lens of 'barriers' does not provide insights into why and how social exclusion occurs, and how to encourage visits to museums.

It is also important to acknowledge that the focus on 'barriers' has been critiqued for implying the requirement for non-visitors to change to fit the museums. Such a requirement can be seen to pathologise non-visitors, to highlight that they lack certain attributes, and oblige them to assimilate the privileged, dominant knowledge and practices presented (Bell *et al.*, 2009). The requirement locates educational disadvantage and failure to succeed with the pupils, their families and cultures. Such a requirement to assimilate dominant knowledge and practices is also harmful because it corresponds to findings that young people from many ethnic and linguistically diverse groups from poor backgrounds are often positioned as 'problems' within the education system, branding them as 'outsiders' (Rahm and Ash, 2008).

Rather than addressing issues of under-representation of certain visitor groups in museums, a focus on 'barriers' and on non-visitors are possessing problematic traits might actually reinforce cycles of inequality and under-representation (Dawson, 2014).

Framing under-representation in ways other than 'barriers' is difficult. Research in museums shows that science is often presented, possibly often unintended, as an authoritative 'truth' that leaves little room for interpretations from others who do not conform to the dominant white, male frames of reference (Dawson, 2014). Museums in the manner might not sufficiently take 'difference' into account (Sandell, 2007). Research in schools indicates the difficulties of such conformity for people from diverse backgrounds in that their views, experiences and identities can be overlooked, deemed unimportant and irrelevant (Roth and Calabrese Barton, 2004).

Research from the US and Canada indicates that social positions, including gender and ethnicity play more important roles during museum experiences than a focus on 'barriers' suggests (Dawson, 2014). For example, gender bias in parent-child interactions have been noted with parents explaining more often to boys than to girls (Crawley *et al.*, 2001). Archer *et al.* (2016a) also point out how performances of gender influence experiences in museums amongst pupils on a school visit. Such performances intersect with ethnicity and social class, and can be leveraged to encourage science learning if appropriately supported. However, science learning in museums and other settings may also be hindered if experiences and information presented do not align with gender expectations, disempower certain gender performances, or exclude specific groups. For example, framing museum objects as being more interesting and appropriate for boys may exclude girls. With respect to the influence of ethnicity and language, research with families in the US from Latin-American backgrounds (Ash, 2004) indicates that they often found museums unwelcoming, that language used was difficult and that the activities offered were often irrelevant.

Overall, there is less research from the UK, but there is a body of research that considers poverty in the UK, outlining the many aspects of life that poor families are excluded from. For example, families who live in poverty are much less likely than other people to visit museums (Taking Part Survey, 2010). Poverty in the UK is higher amongst ethnic minority groups than amongst other groups (Kenway and Palmer, 2007). Sandell (2007) and Dawson (2014) highlight that museums have sometimes contributed to disempowering and oppressing minority communities, such as by providing only limited relevant exhibits, images and histories of ethnic minorities. These authors suggest that these kinds of features in museums contribute to such communities being under-represented as museum visitors. The reasons that ethnic minority groups, in particular those from poor backgrounds, are less likely to visit museums is therefore not solely based on financial constraints, but rather on a complex combination of inter-related factors that also include social and cultural aspects that are shaped amongst others by their families, neighbourhoods and schools (Dawson, 2014). In particular, as highlighted by Dawson (2016) it is worth noting that children and young people and their families may well have an interest in science, but that this interest does not necessarily pave the way towards visiting science museums. Clearly there is a need to more closely examine the connections between interests, aspirations and visiting museums. Taking into account these issues and challenges of under-representation, there has been increasing awareness concerning the importance of conducting specific research and developing

projects considering not only those families who are already museum visitors, but also explicitly focus on families who are absent or only very irregular visitors.

One on-going research project that does focus on such aspects is the Enterprising Science project, which is a five-year study based on a collaboration between the Science Museum and King's College London, funded by BP. The project started in 2013, and aims to support more pupils to find science engaging and useful for improving their life chances. The project facilitates partnerships between museums and schools, and seeks to build 'science capital' amongst the young people, families and schools, with a particular focus on young people from disadvantaged backgrounds. 'Science capital' is a form of cultural capital that relates to science, such as specialist knowledge, qualifications, interest and social connections (Archer *et al.*, 2012). Such resources can, for example, help individuals or groups navigate complex scientific writing, understand routes into a science career or follow hobbies related to science. Cultural capital refers to material and symbolic goods that can help to achieve social mobility for individuals if these goods are recognised by others. It can therefore be described as social relations within an exchange system of material and symbolic goods that are admirable and worthy of being attained in specific social settings in that they convey power and status (Harker *et al.*, 1990). Cultural capital can be acquired through various means, an often-cited example being individuals gaining capital through educational qualifications that are valued in a certain field (Bourdieu and Passeron, 1990).

Interim findings from the 'Enterprising Science' project report on visits to the Science Museum with five families who had never previously visited (Archer *et al.*, 2016b). These findings indicate that all five families enjoyed their visits, but also experienced elements as being disorienting and overwhelming. For example, families had difficulty navigating the layout of the museum, and were often unable to comprehend the language used. Furthermore, families did not understand the unspoken 'rules of the game', and felt 'like a fish out of water' in that they were 'different' to other visitors. The nature and purpose of activities was unclear to them, they did not understand which objects and exhibits they were allowed to touch, and whether it was necessary to remain quiet in the museum. Overall, the general atmosphere of the museums was one in which families had fun, but from which they were unable to derive educational benefits or feel socially included.

These findings from the 'Enterprising Science' project indicate the many challenges in supporting families who are under-represented in museums. However, as yet there is little research into the types of activities that such families do participate in, and what interests, experiences, understanding and aspirations they have beyond a specific focus on science. The current research focus on these aspects that may not be explicitly related to science, but which may nonetheless provide important insights into how to address issues surrounding under-representation of specific groups in museums.

## 3. Theoretical framework

The theoretical framework that informs the research is centred around 'funds of knowledge', which can be described as the cultural practices and understandings that are embedded in the daily practices and routines of families (Gonzales *et al.*, 2005). A focus on 'funds of

knowledge' highlights that all families and wider communities have valuable educational resources, such as based on everyday experiences, knowledge passed on from parents to children and cultural beliefs and values. Gonzales *et al.* (2005) highlight how families accumulate multiple bodies of skills and understanding that are necessary for their everyday lives, including their work and well-being. These 'funds of knowledge' result from lived experiences, and particularly social interactions, including what people do and what they say about what they do. In this way individuals build up, consume and share knowledge and skills amongst their families and wider communities. 'Funds of knowledge' can in this manner be described as 'tools' that are distributed across individuals, settings and situations rather than being based solely in the minds of individuals. Individuals and their social surroundings are inseparable. Overall, the 'funds of knowledge' framework is important in drawing attention to the knowledge, skills and experiences that under-represented groups have, and to move away from a focus on deficits and barriers (see Section 2).

Ash (2004) offers insights into how 'funds of knowledge', especially those related to science, are established. She suggests that the everyday understanding of science is based in the cultural, historical, gestural and spoken practice of adults and children as they interact with one another, artefacts and phenomena. These interactions occur within different social and physical contexts, such as the home, school, and workplace. These contexts overlap with experiences and insights gained in one context potentially being useful within another context. In addition, individuals regularly cross boundaries between contexts, including those of the home and school, and those of different languages. With respect to science, individuals regularly cross the boundaries of the overlapping contexts of everyday science experiences and those within formal settings, such as schools. Parents and children interact with everyday scientific phenomena, for example in that their talk includes short and sometimes basic explanations of the natural world that are infused with normalised, culturally enshrined explanations about the world (e.g., Crowley *et al.*, 2001). This talk and associated ideas often become more aligned with canonical scientific thinking over time, such as by being influenced by interactions with scientific ideas in schools, books and museums (Ash, 2004). However, for some families such interactions are more difficult, for example if the ideas presented are in the English language and this is not the primary family language. Ash also points out that non-English speaking families might not readily use the standard European American middle class learning strategies that generally dominate museums and other settings. In this light such families may not be able to use, extend and show their 'funds of knowledge' to the same extent as other families.

The concept of 'funds of knowledge' is related to the concept of cultural capital. Cultural capital refers to material and symbolic goods that can help to achieve social mobility for individuals if these goods are recognised by others (Bourdieu, 1986). It can therefore be described as social relations within an exchange system of material and symbolic goods that are admirable and worthy of being attained in specific social settings in that they convey power and status (Harker *et al.*, 1990). A consideration of cultural capital helps to understand how non-economic resources can be very important for status and social mobility. Archer *et al.* (2012) refer to 'science capital' as a form of cultural capital that relates to science, such as specialist knowledge, qualifications, interest and social connections. Such resources can, for example, help individuals or groups navigate complex scientific writing, understand routes into a science career or follow hobbies related to science.

Rios-Aguilar *et al.* (2011) outlined how the concepts of 'funds of knowledge' and cultural capital complement each other, and that a focus on both concepts offers a more nuanced understanding of under-represented groups in educational settings than a sole focus on either concept. It is suggested that understanding 'funds of knowledge' within the context of capital draws attention to the extent to which such funds can be converted in capital. Both concepts together highlight the diverse resources that under-represented groups possess, while also focusing on power dynamics within educational settings. A focus on both concepts together thus provides insights into why some assets have not translated into better educational opportunities and outcomes for under-represented groups. In this light 'funds of knowledge' and capital cannot be fused in that equating 'funds of knowledge' with capital avoids addressing '*education-related inequities and economic injustices*' (Lubienski, 2003, p. 30).

A person's 'funds of knowledge' and their cultural capital are connected to their identities. Identities can be conceptualised as constantly developing entities occurring within physical and social contexts, which are shaped by and shape self-representations based on perceived group membership (Tate and Linn, 2005). Gee (2001, p. 99) characterises identities as individuals recognising themselves and being recognised by others '*as a certain "kind of person" in a given context*'. Identities incorporate interests in that interests shape how individuals develop, maintain and recognise their identities. Moussouri (2003) suggests that families bring identity-related experiences, expectations, and understanding to museums that influence how they interact with museum content and each other, and how these experiences are interpreted. Similarly, Ellenbogen (2003) outlines how families use museums for based on their needs and interests, principally to affirm and develop identities. Considering identities in relation to 'funds of knowledge' and cultural capital adds an understanding of how people's perceptions of themselves and other people's perceptions of them mediates and influences existing experiences, insights and skills and the development of new ones.

## 4. Research questions

The research questions are based on insights gained from prior research, gaps in existing understanding within the academic literature, as well as the aims of the 'Building Bridges' project. Prior research as part of the 'Building Bridges' project has focused on the experiences of pupils without explicit consideration of their families. The current research seeks to compliment and extend this research by focusing on the families of pupils involved in the 'Building Bridges' project. In this manner the current research aims to contribute to a broader understanding of under-represented and 'absent' family visitors to museums, as well as examine the specific aims of the 'Building Bridges' project and provide suggestions for the on-going project, and future projects at the Science Museum and elsewhere. The research questions are:

- How might families' cultural references and values, including their interests and aspirations, affect their engagement with Western science?

- How do families' everyday conversations, activities and skills relate to science content, process and/or practice?

- What is the impact of families' involvement in the 'Building Bridges' project on their views, conversations and activities related to science?

Overall therefore, the research aims to build on the awareness that all families are important for supporting the aims of the 'Building Bridges' project, and to explicitly examine how to engage families from under-represented groups.

# 5. Research approach and methods

## 5.1 Participants and data collection

The research is based on five groups of participants: Case study families; parents; pupils; families at the family event; and teachers. Data collection started in March 2016 and ended in April 2017. Data collection comprised family case studies, a focus group with parents, a focus group with pupils, interviews with teachers, interviews and feedback gained at the family evening, and observations during outreach visits to schools and school visits to the Science Museum. Data collection with case study families ended in April 2017.

### 5.1.1 Family case studies

The main group of participants in this research are four case study families. These families come from backgrounds that constitute under-represented groups at the Science Museum, and started taking part of the 'Building Bridges' project at the start of the 2015/2016 academic year. The families were selected from the 17 schools who were part of the 'Building Bridges' project at the start of the 2015/2016 academic year. All teachers who are the project leads at their school were approached during face-to-face meetings and via email to ask whether their school could take part in the research. Eleven teachers agreed. These teachers were asked to contact families in receipt of Pupil Premium[6] to ask them via email, telephone or during one-to-one meetings whether they would like to take part in the research.

A sample size of four families was used, with each family constituting one case in a case study approach. Previous research indicates that using multiple cases enhances conclusions, increases the understanding gained and allows for more robust data (Yin, 2003). A note on the recruitment of families for the family case studies: Several parents responded to my invitation to take part in the research with an explanation that they would like to take part but their child in Year 7 would not. In Section 7 I discuss the finding that families sometimes struggled to engage in activities together beyond the home.

Ethnographic methods were used for the family case studies. Ethnography is the holistic account of a situation or activity in its natural environment. It makes explicit what is tacit and implicit to the individuals or groups of individuals engaged in these situations and activities

[6] Pupil Premium is additional government funding provided to raise the attainment of disadvantaged pupils and close the gap between them and their peers. As in previous research, Pupil Premium was used in this research as an indicator of low socio-economic status of pupils' families (e.g., Atkinson and Mason, 2014).

(Geerz, 1973). The research builds on the increased use of ethnographic methods for research in science engagement (Brandt and Carlone, 2012), and specifically studies that use ethnographic approaches to consider families in museums (e.g., Briseño-Garzón, 2010). There are different ways of using ethnography as a research method, with this study being based on the ethnographic methods of participant observation and interviews (Merriam, 1998).

The main method of data collection for the case studies was participant observation of families during meetings with them. Meetings with families involved visiting their homes, accompanying them to local events, to church, to school pick-ups, and to the Science Museum. In total I accompanied three families to the Science Museum, two families one time each in August 2016, and one family once in August 2016 and again in December 2016. Participant observation allowed me to gather information on families' activities and discourse, and provided an informal way to gain their views, perceptions and attitudes with respect to the research questions (Silverman, 2006).

One of the main tenants of participant observation is to establish and maintain prolonged contact with a group to encourage 'natural' interaction with its members by taking part in their activities (Lareau, 1996). Participant observation thus allows researchers to obtain first-hand encounters and insiders' perspectives on phenomena of interest as they are happening, rather than relying entirely on second-hand accounts from interviews (Merriam, 1998). An important aspect linked to the prolonged engagement with the social group is for the researcher to establish a role that ensures acceptance into the group, builds trust, and does not disrupt on-going social interactions and activity (Cohen *et al.*, 2007). During participant observation I fulfilled various roles at different times and with different families. The most prominent roles were those of a perceived staff member of the Science Museum, a researcher, and a parent.

When I first met families, they saw me primarily as akin to a staff member of the Science Museum. Families viewed me as knowledgeable about various aspects of the Museum and the 'Building Bridge' project, such as exhibitions and objects at the Museum. During subsequent meetings with families my role as a perceived staff member became less prominent. Families realised that my understanding of and relationship with the Science Museum was not what one might expect of a staff member. While I did not purposefully withhold information about the Museum and the project, I did not want to be falsely perceived as a member of staff. This role would possibly have made families reluctant to provide honest views about the Museum and the project, and would have made participant observation more challenging. My role as a perceived staff member and thus as someone with close ties to the organisation was initially inevitable, but it was a role that I did not seek to encourage, and that weakened over the course of the study as my roles as a researcher and a parent became more important.

My role as a researcher was prominent throughout the study, and was most evident during interviews, or when families witnessed me taking field notes or setting up audio recording. Families knew that I was a researcher at University College London (UCL), a university that most families had heard of. Families were curious about my interest in them and the 'Building Bridges' project, and I used this curiosity to engage families in conversations about their interests. My role as a researcher also enabled me to ask direct questions, for instance: *'Other*

*researchers might think that science forms a big part of the everyday lives of all families; what do you think?'.* In the roles of a perceived staff member and researcher I was able to observe families mainly from a bystanders' perspective, and minimally participate in family activities. From the start of the research, and particularly during second and subsequent meetings with families, they were interested to hear about my own family and how I as a parent dealt with a range of issues ranging from formal education to family celebrations. In this role as a parent I was able to establish familiarity with parents and engage them in discussion about their views of parenting and of science. It was this role as a parent that allowed me to shift from mere observation of family activity to more active participation in their activity. I was able to 'blend in' with family conversation, and thus gained an insider perspective of families' everyday lives.

An essential element of participant observation is writing field notes. Field notes are written descriptions of events, settings and people, and the meaning that these events have for the people involved (Geerz, 1973). These descriptions may also include the researcher's thoughts, feelings and emerging ideas. Field notes are therefore essential in recording events during participant observation for subsequent analysis. In documenting the researcher's thoughts, feelings and ideas they can be viewed as an initial stage of analysis (Emerson *et al.*, 2001). When writing field notes I described what I heard and saw, such as the physical context, conversations and activities, and also included my feelings, reactions, and initial interpretations (Bogdan and Biklen, 2003). I wrote some field notes during meetings with families, and added to these soon afterwards.

Interviews formed an important element of family case studies in directly eliciting views from family members. These interviews occurred during meeting with all families and included asking families about aspects of the observed activities, the Science Museum and elements of the 'Building Bridges' project. The initial interviews were mainly unstructured in that they were exploratory using broad questions rather than seeking to answer specific ones. As the study progressed, questions became more focused on aspects that emerged as important.

Over Spring - Winter 2016 I met one family seven times, two families five times, and one family four times. The total contact time with all families was around 40 hours. I also had contact with three families over the phone, on social media, primarily Facebook, and messaged families via Snapchat and WhatsApp. This use of technology allowed me to have contact with three families on an on-going basis that fitted in with their daily lives. I was not able to have contact using technology or meet with the Kelly family after the Summer of 2016 as they were busy, and clearly disengaged from the research. Table 1 overleaf provides an overview of the four case study families and associated data collection.

Table 1: Overview of case study families

| Family name | Family composition | Family background[7] | School | How many times met |
|---|---|---|---|---|
| Taylor | Mother Lisa, father Mick, 12-year old Michael, 9-year old Pearl, 3-year old twins Joshua and Elijah | Caribbean | Christ Church | Five times |
| Miller | Mother Sandy, 12-year old Vanessa and 2-year old Polly | White British | Saint Joseph's | Seven times |
| Kelly | Mother Siobhan, father Greg, 17- year old Sian, 16-year old Aileen and 12-year old Chloe | White Irish | Christ Church | Four times |
| Gomez | Mother Maria, 12-year old Fernando | South American | Saint Mary | Five times |

### 5.1.2 Focus group with parents

Ten parents took part in a parents focus group at Christ Church school. The aim of this focus group was to elicit the views of more parents than would have been possible throught the other data collection methods alone. The focus group was also set up to enable lively discussion amongst parents so that a diverse range of opinions could be gathered.

All parents who took part in the parents focus group had a child who was part of the 'Building Bridges' project and attends a Year 7 class at Christ Church school. Parents were recruited by the project lead teacher at the school based on their child being in receipt of 'pupil premium'. The focus group took place at the school immediately prior to a parents' evening as this was deemed to encourage participation. Parents received an incentive of £20 for taking part. One parent in this focus group took part in a family case study. The focus group lasted around 70 minutes.

### 5.1.3 Focus group with pupils

Thirteen pupils took part in a pupils focus group. The aim of the pupils focus group was to explicitly gain insgihts into the views of pupils. All pupils attended the Year 7 class at Christ Church school. The parents of three pupils had taken part in the parents focus group, but none of the pupils were part of a family case study.

Pupils were recruited by the project lead teacher based on pupils being in receipt of 'pupil premium'. The focus group took place at the school during school hours, and lasted around 50 minutes. Pupils were provided with a small gift from the Science museum as a 'thank you' for taking part.

[7] Self-described by families.

### 5.1.4 Interviews with teachers

Four teachers were interviewed. All teachers were the 'Building Bridges' project lead at their school, and were approached to take part in the interviews in person during Science Museum outreach visits to schools, or during visits by the schools to the Science Museum. It is important to note that one of these four teachers does not actually teach the class who is involved in 'Building Bridges' project. Three of the teachers who were interviewed are from schools that are attended by the case study families.

The aim of the teachers interviews was to gather teachers' views and experiences of the 'Building Bridges' project, and provide background information on the schools, the local community, pupils and families. As such the interviews not only provide insights into the views and experiences of teachers, but also offer a complimentary perspective to the insider perspective gained through the family case studies. Interviews lasted between 20-30 minutes.

### 5.1.5 Data collection at the Science Museum family event

Data collection at the Science Museum family event on 13th July 2016 consisted of observation at the event, short interviews and a 'feedback wall'. Seventy-seven families took part in the interviews. The aim of these interviews was to gather families' views, experiences and expectations with regard to these events, and how such aspects may impact their views of the Science Museum and science more widely. Interviews lasted around two-five minutes.

At the family event a 'feedback wall' was set up with the questions '*What did you enjoy most about this evening?'* and '*How would describe the Science Museum to a friend?*'. 'Post-it' notes were provided for families to write down their views of the events. A total of 59 families provided feeback at the event.

### 5.1.6 Observations during outreach visits to schools and school visits to the Science Museum

Two observations were undertaken on outreach visits by the Science Museum to schools, and five observations were undertaken on school visits to the Science Museum. During these observations I took notes on what I saw and heard, as well as my impressions and thoughts on these aspects of the projects. I also casually spoke to pupils, teachers and the Science Museum team to gain insights in their views, experiences and expectations. Such observations and conversations allowed me to gain insights into how pupils, teachers and the Museum team experience an important element of the 'Building Bridges' project.

Details of all data collection methods are summarised in Table 2 overleaf.

Table 2: Summary of data collection

| **Data collection method** | **School** | **Number of participants** | **Dates** |
|---|---|---|---|
| Family case studies | Christ Church School (two families), Saint Mary School, Saint Joseph's School | Four families | March 2016 – April 2017 |
| Focus group with parents | Christ Church School | Ten parents | May 2016 |
| Focus group with pupils | Christ Church School | 13 pupils | July 2016 |
| Interviews with teachers | Christ Church School, Saint Mary School, Saint Joseph's School, Willow Hill School | Four teachers | May-June 2016 |
| Interviews at the Science Museum family event | At least ten different schools | 77 families | July 2016 |
| Comments on feedback wall at the Science Museum family event | Unknown | 59 families in July | July 2016 |
| Observations during outreach visits to schools | Hillbury School, Leeway School | Two school groups | March 2016 |
| Observations during school visits to the Science Museum | Christ Church School, Saint Mary School, Saint Joseph's School, Willow Hill School Junction Road School | Five school groups | April-May 2016 |

## 5.2 Data analysis

A spreadsheet was used to keep records of observations, interviews, focus groups and meetings with families. This spreadsheet allowed for data to be connected across sources. The data generated by the research was field notes, notes from interviews and focus groups, as well as comments provided by families on the feedback wall at the family event. As stated, writing field notes is an essential element of participant observation, and they were typed immediately or as soon as possible after observations and meetings with families. In typing up sections of interviews and focus groups I focused on those aspects that were relevant to the research questions, as well as aspects that emerged as important over the course of the study. While typing field notes and sections from interviews and focus groups I included reflections on how my observations related to previous observations, interviews, focus groups or the literature, thus signifying this as the initial stage of analysis (Emerson *et al.*, 2001).

The study is based on open coding. Open coding involved assigning codes to determine aspects linked to the research focus. It is an inductive process that is shaped from 'the bottom up' by directly using data to gradually develop findings. For example, when speaking about

their views of science parents referred to the school as the primary source of their children's understanding of science. It was clear from the focus group with parents that they did not think of their everyday family lives as being important for their children's scientific understanding because they did not think of science as interesting and accessible to them as families. I therefore included '*views of science*' as a code to analyse parents' descriptions of their family engagement with science.

Conducting and analysing interviews, focus groups and observations occurred iteratively in that I did not conduct and analyse interviews, focus groups and observations as separate stages of the research, but rather gathered data and analysed it in an on-going manner. This iterative process allowed for interviews, focus groups and observation on emerging findings to be conducted.

All data except the first field note were coded bearing in mind the already identified codes. This constant comparative method (Glaser and Strauss, 1967) allowed for the continuous comparison of newly assigned codes to those that had previously been allocated across data sources and families. Open coding and the constant comparative method thus provided novel insights that had initially not been considered. The constant comparative method was also used to organise codes into higher-order categories, based on codes within one category having common features (Merriam, 1998). Initially categories were tentative, and were then refined during data accumulation through the constant comparative method.

A sample extract of coding a teacher interview is provided in Table 3 overleaf. For ease of viewing several stages of coding have been amalgamated into one column ('coding'), with brackets representing how codes were grouped into higher order categories.

Table 3: Sample extract of coding of a teacher interview

| **Interview notes** | **Coding to consider how teachers characterised their pupils** | **Category** |
|---|---|---|
| Naomi:<br>*What would you say really shapes how a pupil gets on here at school?*<br><br>Teacher:<br>*So many things really…*<br>*It's individual for each family…*<br><br>*They're in it together really, as a family.*<br><br>*Overall I'd say that the parents are really important.*<br><br>Naomi:<br>*What about the pupils themselves… How do they relate to their parents?*<br><br>Teacher:<br>*I think there's a lot of change at this age...*<br>*The kids are changing.*<br>*They want to do things by themselves,*<br><br>*they are sometimes keen to distance themselves from parents.* | Many influences<br>Individual differences<br>Whole family<br><br>Parents<br><br>Age-related changes<br>Doing things alone<br>Distance from parents | Influence of family<br><br>Influence of parents<br><br>Pupils developing independence |

## 5.3 Reflections on the research approach

### 5.3.1 Ethical considerations

The study followed ethics guidelines from the University College London Research Ethics Committee, from which the study received ethical clearance. In addition, literature about ethical considerations during research informed the study, and is discussed below.

An important ethical consideration is informed consent. For this study I approached families through personal introductions by teachers, such as during parents' evening or events at the school, as well as via email. All families who were interested in taking part in the research were emailed adult and child information sheets. On meeting families I also verbally explained the research aims, and their involvement. I made it clear to families that they were not required to take part in the research, and that this was not a mandatory part of their involvement in the 'Building Bridges' project. I then asked children and parents whether they would like to participate so that they could jointly give verbal consent. Written consent from a parent was sought to consent for their family to take part in the research. Throughout the research I aimed to build a relationship of trust and respect, which aims to '*contribute to a more anthropologically and sociologically informed bases for proper conduct*' (Atkinson, 2009,

p. 25), thus supporting informed consent based on the ethnographic approach adopted by the study.

As the study involves research with children, I followed the National Children's Bureau research guidelines. I explicitly explained in clear language and in full detail to each potential child participant what the study involved, that their contribution in the study is entirely voluntary, that their personal details remain anonymous and confidential and that they can withdraw from the study.

In order to minimise the risk of breaching anonymity and confidentiality I took care to ensure that all contributions and participant details that could identify them were encrypted, securely stored and anonymised during analysis and reporting. For example, handwritten field notes did not state the names of participants, and were typed up in an anonymised form following each interaction with a family. Electronic files were securely stored using FileVault software.

### 5.3.2 'Generalisability' of the findings

'Generalisability' is the degree to which an account of specific instances can be generalised beyond these instances (Maxwell, 2002). Maxwell (2002, p. 53) distinguishes between '*internal generalisability*' and '*external generalisability*', which relates to generalising within the community, group or institution that the research is based on, and generalising to other communities, groups or institutions, respectively. This distinction provides a useful approach to consider the extent to which findings can be generalised. As outlined below, findings could be generalised to under-represented family visitors at the Science Museum, and to under-represented family visitors at other museums.

Families taking part in the study share demographic characteristics with under-represented family visitors at the Science Museum, suggesting that findings generalise to these families. However, it is noteworthy that the families taking part in the research all have children at 'faith' schools. This is in part based on 'faith' schools being over-represented on the 'Building Bridges' project compared to the rate of 'faith' schools in London overall. Generalisations to other museums can also be made in that the findings are likely to apply to families who do not regularly visit other museums, and who may therefore display similar views, conversations and activities to those of families in this study. This means that despite the importance of the families' individual identities, the findings are relevant to other museums. They provide insights into the kinds of conversations and activities related to science and beyond that families engage in during their everyday lives, as well as how they view science and museums. The findings provide an account of under-represented family visitors that is of relevance beyond the specific setting of the Science Museum and the families who took part in this study. The findings are of importance to the broader museum community, including researchers, practitioners and policy makers in that they demonstrate the complexity of everyday family life, and illuminate the associated opportunities to promote museum visits and engagement with science.

# 6. Findings from interviews with teachers

## 6.1 How teachers characterised their schools

The schools of the four teachers who were interviewed are typical of the schools taking part in the 'Building Bridges' project overall in that they are large comprehensive schools that have around 120 pupils from diverse backgrounds per year group, and describe themselves as having a Christian ethos.

All teachers stated that there are at least five primary schools that feed into their respective secondary school. The teachers also all noted that there are often pupils who have recently moved to the area from other primary schools, and that it is rare to have a class with more than two or three children from the same primary school. In addition, there are a lot of in-year admissions to the schools, based mostly on pupils moving house, but sometimes also because pupils move from other local schools.

All schools 'set' pupils at the beginning of year 7, based on SATs results in Year 6. This 'setting' is often done without explicitly informing pupils or parents. Teachers also stated that 'setting' pupils at the beginning of the year is often not very reliable, and sometimes pupils are 'set' again to accommodate changes in their academic performance. Towards the end of Year 7, and in particular during Year 8, pupils and parents generally become more aware and are explicitly informed about 'setting'. All teachers agreed that this puts a lot of pressure on pupils, and that pupils often get anxious about GCSEs.

The four schools of the teachers who were interviewed have an overarching ethos that encourages broad engagement with science. For example, three of the four teachers mentioned that their schools have annual science festivals, that they have an after-school science club, and that they send students information about science fairs at universities and beyond. All teachers noted that the senior management teams at their respective schools realised the importance of science not only for pupils' academic progress, but also for wider life chances.

However, while these teachers welcomed this ethos they also acknowledged that the message of science being interesting, fun and 'for all' generally only reached a select group of pupils who achieve highly in science academically. Two teachers explicitly stated that they felt their schools could do more to promote an ethos of science across the school, such as putting up more visually attractive science displays and providing more opportunities for all students to visit science centres and museums. In addition, as outlined by one teacher efforts to promote an ethos of science often did not reach girls:

'*There's the after-school science club and there are leaflets about science events. There's also the annual science festival at the school… There is a lot going on, but mostly it's the boys. In the science club there isn't a single girl. It's a shame. I just don't think the message here is reaching the girls.*'
(Teacher, 19.05.2016)

## 6.2 How teachers characterised their pupils

All four teachers who were interviewed highlighted that Year 7 was a time of great change for children's lives. They noted that over the course of Year 7 children moved towards much greater independence, and that they, as teachers, encouraged and supported such independence. According to all teachers there is a large difference between pupils at the beginning compared to at the end of Year 7 in terms of their independence. Pupils at the beginning of the year still share many attributes with primary school children, such as relying on teachers to remind them about homework and the need to bring in their sports kit. In contrast, towards the end of the year pupils take on much greater responsibility for such aspects, with teachers taking a step back:

'*At the beginning (of Year 7) the kids are still very much in primary school mode. They expect teachers to look after things like when to bring in their sports kit, and remind them of homework and dinner money… At the end of the year teachers take a step back and they are much more independent, they sort their own things out*.'
(Teacher, 10.06.2016)

In moving towards greater independence the influence of peers grows significantly. Pupils often form strong friendship groups in which they spend a large amount of their time at schools and during time outside of school. Teachers also noted that pupils refer to such friendship groups for guidance and support when needed:

'*The friendship groups are often really strong, of course they hang out together a lot. But, they are also such an important point of reference for the kids. They use friendships for support and advice… They get a lot out of them*.'
(Teacher, 10.06.2016)

In talking about the strong friendship groups, teachers noted that parents often seek to influence their children to be part of groups that they as parents deem desirable and 'good'. Teachers noted that this was the case for many parents who might not appear to be particularly interested in supporting their children's academic progress. According the teachers, parents often feel more able and determined to influence their children's choice of peer group than children's academic progress:

'*I think that a lot of parents really try to influence their children in what friends they have… They want their child to be with the "good" crowd. Some of the parents are really determined about it. They'll sometimes not show that much interest in their child's schoolwork, but then the pupil will tell me how they tell them not to hang out with that kid, or go and spend time with that other kid*.'
(Teacher, 27.06.2016)

All teachers agreed that such parental efforts to influence their children's association with a particular peer group were often futile. Pupils wanted to be part of groups that they perceived as desirable because they were 'cool', often in precise ways that parents rejected and deemed not 'good'. Teachers also agreed that parents had only fairly limited options to influence their children's peer groups because much of the interaction occurred beyond the reach of parents, and in ways not accessible or understood by them. The use of smartphone apps was the prime

example given by teachers to highlight this issue. Pupils used apps, such as Snapchat and Whatsapp to communicate with their friends, and parents either did not understand such ways of communicating or were simply not included in it. The use of smartphone apps gives pupils a way of interacting with each other that differs to how their parents communicate using phones, and that, according to teachers, parents do not understand. Pupils newly developing independence included being able to communicate in ways with their friends that was not accessible to parents:

'*The way the pupils communicate is very different to how their parents interact. Parents might use their phones to talk or to send a message, or WhatsApp. But it's very different with the pupils. They use it at such a faster pace, they use it for direct communication. Parents just don't have access to that use of technology, they often don't understand it*.'
(Teacher, 10.06.2016)

Teachers noted that while the use of technology was an essential part of pupils' everyday lives, pupils were often also aware of spending too much time interacting with technology. Two teachers stated that several of their pupils had imposed limits on using technology to ensure they have sufficient time and energy for other things, such as playing sports or doing schoolwork:

'*The technology is such a big part of the kids' lives, it is just everywhere… I do know that several of the Year 7s set themselves limits. They realise that they are missing out on doing other things. They're missing out on doing sport, and they can get behind in school work… They actually set themselves limits. I don't know how well it works, but there is the awareness and intention*.'
(Teacher, 19.05.2016)

Teachers agreed that the use of technology, including smartphones, was essential for their teaching, such as in pupils looking up information on the internet, using educational videos or sending homework assignments. However, teachers believed that it was sometimes difficult for pupils, for parents, and sometimes even for themselves to distinguish between useful academic content versus non-educational content. Teachers are aware of specific trusted websites and apps, but stated that technology moves at such a fast pace that it is challenging to keep up to date. One teacher explained how a group of pupils had made him aware of a very useful educational vlogger that he had subsequently recommended to other pupils. Overall, teachers deemed technology as an important educational tool.

When talking about pupils' use of technology teachers mentioned their pupils' differing access to technology, based on their families' financial resources. Some pupils have access to more, better and newer technology because their parents are able and willing to purchase it. According to teachers, pupils are acutely aware of which technology is currently the most desirable, and often spend significant efforts to access this technology, such as by pressurising parents or saving money. Teachers noted that parents are often unsure about which types of technology their children need for school, with some parents contacting teachers whether a particular smartphone is a requirement.

A further important theme during interviews with teachers was science. When talking about science all teachers noted that overall science is not a particularly popular subject, but that in Year 7 pupils still have lots of fun during science lessons. Teachers noted that in Year 8 and 9, as pupils move towards GCSEs, science becomes increasingly unpopular. Pupils get concerned about GCSEs, and there is a strong perception amongst pupils and parents that science GCSEs are difficult. However, teachers also noted that within each year group there is often a group of pupils who are particularly interested and engaged with science. Such excitement for science can spread towards other pupils, and create an atmosphere in the classroom that makes science fun, and easier to teach. For example, the teacher who was noted earlier as having been recommended a vlogger by a pupil, stated that several pupils had watched this vlogger's videos, which had increased the appeal of science lessons. All teachers noted that such groups consisted mainly of boys, and that science was less appealing to girls than to boys. Teachers suggested that they were unsure about reasons for such differences, but noted cultural, societal, religious as well as biological, innate reasons:

'*I'm not sure why boys tend to be more inclined to find science appealing than girls… I think girls are taught the importance of other things from an early age… Many cultural references, religion and societies don't see girls as very scientifically or technically minded… On the whole I would say that girls tend to be more interested in people and art, while the boys are more interested in building things, technology and science*.'
(Teacher, 19.05.2016)

When asked about their pupils' career ambitions, teachers agreed that in Year 7 most of the pupils do not yet have a clear idea of what their career choices are. Pupils are still finding their feet in secondary school, and pupils are often still unsure about which school subjects to focus on. Teachers states that it is important for pupils to try out different school subjects, to engage in a broad range of interests beyond the core subjects, and to allow themselves time to think about various career options. Teachers encourage thoughts about further study and career options during Year 8, but not in Year 7.

However, interests and attitudes towards science present in Year 7 shape pupils' future educational and career choices. Teachers stated that that greater interest in science amongst boys in Year 7 was associated with them being more likely to hold educational and career aspirations related to science. These views correspond to prior research. For example, a fairly large body of research in the UK and abroad suggests that boys in primary and secondary school tend to have more positive attitudes towards science than girls (e.g., Brotman and Moore, 2008; Sjoberg and Schreiner, 2005), and that reasons for such differences are highly complex (Archer *et al.*, 2013). Many girls do not think of gender as being a barrier to studying or working in science, and say that they can follow any educational course or profession in the future. However, the actual choices of subjects and careers can be described as gender traditional, with the uptake of science courses and science professions being low amongst girls (Darke *et al.*, 2002). Archer *et al.* (2013) explored reasons why girls in Year 6 at UK primary schools do not think of science as being 'for them' as an educational and career choice. Based on qualitative research with 25 girls, Archer *et al.* suggest that girls frequently aspired towards caring professions, such as childcare or teaching, as well as professions related to glamour and beauty, such as acting. These aspirations reflect dominant discourses of hetero-

femininity that value girls and women as nurturing (Renold, 2001), and of science as masculine and distinct from the arts (Archer *et al.*, 2013).

## 6.3 How teachers characterised pupils' families and the local community

On a day-to-day basis teachers rarely see their pupils' parents or other family members other than in the first week of school in Year 7 when parents often accompany their children to school. All teachers stated that they had little direct contact, neither face-to-face nor via email, with their pupil's families, other than one or two parents' evenings at the school or sometimes to special events, such as a summer fair. Two teachers stated that only around two thirds of the parents came to parents' evenings, and that they had never met some of the parents. If occurring, encounters with parents focused almost exclusively on the academic progress of children, rather than broader aspects associated with children's lives. Teachers highlighted that parents did not view them, as teachers, as being a source of much pastoral care or support beyond the subject they teach at school. The only exception to this general sentiment might arise if a pupil has special needs, including language needs, or there are specific disciple issues that disrupted teaching. In these cases teachers work with a designated member of staff, such as a family liaison officer, and families to support pupils:

'*I don't have much contact with the parents. Some I've never met. Those that I have met more than once or twice, it's because there is a problem, like the kid is in trouble at school. Other than that we just get on with the job, and with the pupils here*.'
(Teacher, 10.06.2016)

Despite having little contact with their pupils' families, and while acknowledging that pupils in Year 7 make great bounds towards independence, all teachers stated that families have a huge influence on pupils. While the influence of the school and peers grows throughout the secondary school years, the importance of the family stays paramount. Teachers highlight that parents are often guided by individuals, groups and local communities, such as in that they might seek support from local community and religious groups. Teachers also speculated that some families might still have ties to primary school, based partly on younger siblings still attending these schools:

'*Families are really important, they are always important throughout secondary school… I think a lot of parents rely quite a lot on local groups, community groups and such. I also know that some still have contact with primary school, there are often close links there, sometimes because of younger siblings. They can all help families*.'
(Teacher, 05.05.2016)

Teachers noted that the English language can be a problem for several parents, which means that they do not always understand notes sent home from school, or information provided on the school website. Two teachers stated that their school sometimes phones parents if they know that there are language barriers, however, there is not always time for this. In addition, sometimes it may not be language alone but also cultural, religious and social differences that might prevent parents from engaging with information provided by the school. For example, some parents simply do not think they are able to support their children and think of their children's education as being the responsibility of the school:

'*I think for some parents it's not just the language, it's also cultural things… They might not think they can help. They think the school does a good job, and that's sorted, they hand over a lot of the responsibility to the school*.'
(Teacher, 05.05.2016)

## 6.4 Teachers' views of the Science Museum and the Building Bridges project

All teachers were very positive about the Science Museum and the 'Building Bridges' project. Teachers agreed that while buy-in from their senior management team was important, it was even more important that teachers involved in directly interacting with pupils and the Science Museum were engaged and enthusiastic. This enthusiasm is important because teachers often spent time beyond their working hours to organise elements of the project. While teachers would ideally want additional time to spend on the project, they did not think this was realistic:

'*It's important for the teachers to be engaged and really want to be part of the project… Yeah, ideally I'd like more time to work on things for the project, to be given additional planning time. But that's just not going to happen. The involvement from the head is important to sign things off, but I'm not going to be expecting additional time… You just have to want to do it (work on the 'Building Bridges' project), as you'll have to do it partly in your own time*.'
(Teacher, 05.05.2016)

Reasons why teachers were enthusiastic about the project, and wanted to be involved, are based primarily on the reputation of the Science Museum in providing interesting and fun activities and resources that complement the curriculum. Teachers agreed that their schools would not be able to provide pupils with such activities and resources. Two teachers spoke about seeking opportunities to broaden pupils' exposure to science within the historical, cultural and societal context of the Museum.

'*I really want to be able to expose the pupils to science in a broad sense. I think the project gives the historical, cultural and societal context of the Science Museum. It's really not something that the school can provide.*'
(Teacher, 27.06.2016)

Teachers recognised and trusted the Science Museum as a 'brand' to provide exciting activities that would engage pupils and stimulate an increased interest in science. All teachers appreciated the multi-nodal approach as being a very rare type of project, and that such a unique project was special and beneficial when compared to a single visit to the Museum, or a single outreach visit to the school. Teachers also spoke about the project taking place over the entire school year as being a useful longer-term approach that was memorable to pupils and that shaped their school year:

'*I'd say that the project has really shaped the pupils' school year. They've had several parts of the project spread across the year, and that really provided a memorable experience. It's very different to just having one visit to the Museum or the (Science Museum) team coming to the school. I'd say that the most important part is it being longer-term.*' (Teacher, 05.05.2016)

All teachers agreed that those pupils who were unlikely to already have regular exposure to visiting museums or other extracurricular cultural activity related to science would benefit most from the project. However, there was no consistent approach of selecting a class to take part. Two of the teachers stated that their schools selected classes from the middle set, whereas one teacher stated that her school selected a class from the bottom set. Another teacher stated that his school had selected a class in which there was a particularly high number of pupils eligible for Pupil Premium. However, this teacher stated that this had not been the case in previous project years.

Reasons for selecting classes from the bottom set and classes with a high number of pupils eligible for Pupil Premium were based on this encouraging these pupils to become more engaged with science. There was a perception that pupils from top sets, and pupils who are not eligible for Pupil Premium are more likely to already be engaged with science, and to have more opportunities to engage with science:

'*I think it's best to select a bottom set to take part (in the 'Building Bridges' project). They can be encouraged to get more engaged with science. The pupils from the top sets, and the better off pupils, they are already engaged and have more opportunities.*'
(Teacher, 05.05.2016)

As previously discussed, all teachers highlighted the importance of the individual teacher who takes part in the 'Building Bridges' project being very interested in taking part, and being willing to spend additional time on the project. Bearing in mind this importance, all teachers agreed that for practical considerations selecting a Year 7 class with such a teacher was a greatest importance.

'*I think that the project would be the most beneficial to those pupils who don't have access to museums, who don't have that kind of background… I think that the class with kids like that should be selected to take part in the project. But then, for practical reasons, most importantly I think the class teachers has to be engaged, they have to be willing to put in the extra time. Otherwise the project would be wasted, the kids then wouldn't actually get that benefit anyway.*'
(Teacher, 27.06.2016)

None of the teachers spontaneously spoke about the explicit involvement of families in the project. When prompted, all teachers agreed that this was important, but that they were unsure to what extent parents were involved in the project beyond signing consent forms and possibly coming to the family event. Suggestions for how the family element of the 'Building Bridges' project could be strengthened are provided in Section 11.

## 7. Findings from the parent focus group

The parent focus group took place before the family event, meaning that parents were not able to comment on this part of the project.

## 7.1 Parents' views of their role in children's education

All parents in the focus group emphasised the very important role of education provided by the school for their children's lives. Parents described the importance of doing well at school in terms of success in life, and, in particular, employment success. However, parents had not explicitly spoken to their children about career choices and their views on employment success are rather vague. For example, parents said that they did not know and did not mind what employment their child takes up, as long as it was a 'good' job that is paid decently.

Parents aim to ensure that their children do their homework on time, study for tests, and that often provide rewards such as money or small gifts if their children do well:

'*I really want him (son) to do well at school, I really do. It's his chance to do well in life and get a good job. I really try to get him to do all his homework and work hard for tests too… I'll give him a pound or something small for doing good work.*'
(Parent, 19.05.2016)

However, overall parents thought of themselves as having only a restricted role in their children's education. Parents wanted to help children succeed, but also expressed the view that they did not know how to support them. Parents said that they did not have enough subject knowledge to help with homework, revision or other school work, and that the structures and processes of the school were unclear. While several parents were frustrated about this limited understanding, parents also said that they were not expected to understand the processes of the school and their children's daily lives there to the same extent as in primary school:

'*I just don't know about the school, I don't know where the children are or what they do, I don't understand who the different teachers are and at what times they have their lessons. I just don't know. Maybe it's now like that, at secondary school.*'
(Parent, 19.05.2016)

These findings correspond to prior research indicating that parents from low socio-economic status (SES) backgrounds do not feel they possess the perceived necessary skills and level of education to actively support their children's education (Atkinson and Mason, 2014).

One aspect in the current findings that relates to these uncertainties about norms, structures and expectations surrounding their children's lives at school is the use of technology. Children are required to use technology to support their learning at school, such as to look up information on the internet. Parents stressed that their children had access to such technology at home in that all had mobile phones, and access to a family tablet or computer. Several parents also said that their children had their own tablet or computer. However, parents also said that their children were spending too much time on the internet and using their smartphones. Parents said that for various reasons they were unable or unwilling to restrict their children's technology use. The most important such reason is that they were unsure about the extent to which their children use technology for educational activities. For example, one parent said that his child sometimes uses his phone as a calculator for homework, and that it would therefore be detrimental to restrict phone use while doing homework. Several parents also explicitly said that they are unsure about what content on

children's phones and on other devices is educational. Overall, parents did not restrict their children's use of phones, tablets or computers, and parents did not make use of parental controls on these devices. However, parents did look to other sources of authority, in particular schools, to regulate their children's use of technology. Four parents also noted that their local church and community centre prohibits the use of mobile phones at certain times. All parents welcomed such externally imposed restrictions, and they hoped that such restrictions and associated discipline would lessen technology use elsewhere without the need for them to intervene:

'*He (son) just spends so much time on the internet: on his phone and then on his computer too. I'd like him not to, but I think sometimes he uses it for homework. I don't want to say no. I can't. For the church services and when they have activities there for teenagers they can't use their phones. That is good. I hope it will help at home too.*'
(Parent, 19.05.2016)

While most parents did not attempt to limit their children's use of technology overall, many parents did state that they had attempted to limit their children gaming. I will discuss this in Section 7.2.

Parents' mentioned after-school clubs run by the school, extra-curricular activities run by local community and religious groups, as well as local libraries as being important for children's education. While parents placed greater importance on the curriculum subjects as taught by the school, they also all highlighted that some other structured activities contributed to their children's academic success. All parents said that they were particularly keen for their children to partake in activities that are closely aligned to curriculum subjects as this indicates to them the educational value of activities. For parents, their children's education was not only based primarily at school, but also for the most part restricted to the curriculum subjects taught there. While parents encouraged their children to attend extra-curricular activities, they themselves generally did not see themselves as supporting potential education benefits:

'*I like my daughter to take part in clubs at the centre (community centre) that are like school subjects. She did a maths wizard club once, that was great. They also have things like pottery and dance. I'm not so keen on them. They're fun, but it's not so much about education and learning.*'
(Parent, 19.05.2016)

Parents in this focus group did not think of conversations and activities that take place outside of school as being particularly relevant or important to education therein. This includes conversations that they have with their children at home, as well as activities that they engage in with their children during their everyday lives, or on special occasions. Section 7.2 explores in more detail parents' views of family life. It is important here however, to acknowledge the narrow view that all parents had of education as being based almost exclusively at school. While parents had great respect and trust in this institution, they did not view it as being easy to understand.

These parental views of their role in their children's education at school can be understood through the lens of concerted cultivation. Lareau (2003) characterises parental views and

actions with respect to childrearing as either aligning with natural growth or concerted cultivation. Natural growth refers to parental views that child development occurs naturally based on children's interests and abilities. Concerted cultivation refers to parental views that child development is heavily influenced by direct guidance and support, which may involve parents using a range of resources, such as emotional, intellectual and financial means to enable their children's social and educational development. Parental views in this focus group are best described as aligning with concerted cultivation in that parents did think of their children's development as deeply influenced by direct guidance and support. However, they viewed the school, and, to some extent, other institutions rather than themselves as providing this guidance and support:

'*Kids don't just go out and learn a whole lot of things by themselves. The school has to help them. The kids need to be helped in what to learn and how to do it… It's up to the school, I can't be guiding my kids' learning.*'
(Parent, 19.05.2016)

## 7.2 Parents' views of family life

The most prominent theme related to parents' views of family life is that their children in Year 7 are gaining greater independence, which sometimes involves not wanting to take part in family activities. This is the case particularly for activities outside of the home, and includes activities that children had previously enjoyed, such as going to a park or spending time in local community centres or playgrounds. On the whole parents were understanding of this change as a normal part of their children moving towards adolescence:

'*It's a normal thing for Year 7 kids not to want to hang out with their parents or do things as a family so much anymore… They're becoming teenagers.*'
(Parent, 19.05.2016)

Parents did say though that they sometimes actively sought out activities for the whole family to engage in together, and that there are some activities that are non-negotiable for their children to take part in. Common activities that, according the parents, the whole family enjoy together relate primarily to relatively short activities in the home, such as watching television, cooking and gardening:

'*I do like to get the whole family together to do things… Often it's quite short activities, like doing a bit of cooking together, older children often do like doing that.*'
(Parent, 19.05.2016)

Parents also said that they occasionally thought of special family activities as treats that they know their children enjoy, such as shopping for clothes and gadgets, going out to eat, and visiting amusement parks. All parents said that their children particularly enjoyed these special family activities if one of their friends accompanied them.

In terms of non-negotiable family activities, there are two main sets of activities. First, parents said that their children are required to help with housework, looking after younger siblings and other chores on a regular basis. These findings correspond to prior research indicating that young people from less affluent households often have specific domestic responsibilities

(Morrow, 1994). Several parents in the focus group said that they used these chores to engage with their children, such as by clearing up the kitchen together, and using this activity to speak with their children. As such, the chores are part of family life:

*'For me, chores are a part of what we do together (as a family). Both my children know that they have to help around the house… I try to get us to do things together: we'll clear up the kitchen together, the younger one puts away dishes, and the older one might sweep the floor or sort the rubbish. I'll check the cupboards for what shopping needs doing and we'll write a list together. I use it as an opportunity to be together.'*
(Parent, 19.05.2016)

Another set of non-negotiable family activities relates to extended family and religious events. All parents mentioned extended family, including aunts, uncles, grandparents, and cousins as a very important part of family life. Parents wanted their children not only to hold close connections to these people, but also to engage in joint family occasions, such as birthdays, Christenings, weddings, and funerals.

As noted in Section 5, the focus group took place with parents whose children attend a Christian faith school. As such, religion features, to a greater or lesser extent, in the everyday school lives of pupils. In addition, around half of the parents said that religion shaped their family lives, such as by observing Christian customs of displaying Christian symbols, saying grace and regularly attending Church services. There is, of course, an overlap between family activities relates to the extended family and religious events in that religious events often included the extended family:

'*He knows that it's not negotiable to go to Sunday worship. We all go together: us (immediate family), my sister and her kids, my uncle and his new wife. We don't have to think about or talk about whether we're doing it. We just are*.'
(Parent, 19.05.2016)

One final important finding with respect to parents' views of family life relates to children's gaming. Around half of the parents said that their children's gaming caused tensions because, in parents' eyes, children were spending too much time gaming, it interferes with family life, and school work. These parents attempt to limit their children's gaming, which is often a cause of arguments and frustration.

## 7.3 How parents characterised science

Parents in the focus group characterised science as at once important and as high status, and simultaneously as difficult and something they were not inclined to engage with. They noted the general importance of science, for example for medical procedures. In addition, they noted the importance of science at school for their children's academic success. However, in a similar manner to the views expressed by pupils (see Section 8), over half of the parents spontaneously noted that science is '*difficult*', rather than something that they feel they can understand. Overall, most parents had views of science that focus on it as a collection of facts, knowledge and terminology that is largely disconnected from their families' experiences and interests. Representative of these views one parent said:

'*Science is very important, like for medicine. It's a big part of education at the school, there are a lot of facts to learn, it's a tough subject… It's not something I know much about at all, it's not what our family talk about. It's not what we'd want to talk about really*.'
(Parent, 19.05.2016)

These views are similar to a large body of research on public attitudes towards science indicating how publics often have overarching positive general perceptions of science, such as that the facts and knowledge gained through science is important (e.g., Butt *et al.*, 2011; Department for Business, Innovation and Skills, 2014; Losh, 2010). Recent findings indicate that the UK publics hold positive views of science, but may view science as confined to biology, chemistry and physics as taught in schools (Department for Business, Innovation and Skills, 2014). Such perceptions can limit the extent to which people view science as a potentially intellectually accessible and interesting part of their lives (DeWitt *et al.*, 2013).

When asked to describe what they thought learning science involved, all parents referred to their children's education at school, and stated that it comprised understanding scientific facts and principles. They did not see science learning as something that their families might engage in as part of their everyday lives. However, when explicitly asked there was a sense amongst several parents that their children might engage in play at home that relates to scientific principles, primarily in terms of children building with construction toys, or engaging in small 'experiments', such as filling up balloons with water to see how much they can hold. In characterising these activities and their relation to science there is some evidence of gender stereotyping in that several parents noted that boys are generally more interested in them than girls. These parents made links between these interests and later interest and attainment in science at school. Overall, parents described these activities as something their children might do alone or in groups with other children rather than it being part of their family lives:

'*We don't do anything as a family that relates to science… I think when boys play with "Mega Blocks" (construction toy) or things like that it can relate to science. Girls don't play with that so much, my daughters didn't. My son played with "Mega Blocks" a lot and he did all kinds of little experiments with water and things in the house. I think that's why boys like science more*.'
(Parent, 19.05.2016)

## 7.4 Parents' views of the Science Museum and the 'Building Bridges' project

All parents spoke about the Science Museum as a very exciting and interesting setting for their children to visit with their school. Most parents stated that their children had visited the Museum with their primary schools, in addition to visits as part of the 'Building Bridges' project. In addition, three of the ten parents who took part in the focus group said that they had visited the Museum with their children. Four of the parents had never visited the Museum.

Reasons for describing the Museum in positive terms relate to it being a place for children to learn about science in more exciting and interesting ways than how science is taught in schools. All parents referred to the interactive exhibits in justifying these views. Parents described the Science Museum in relation to their children's education at school, rather than

also as a place for them to visit with their children as a family to learn science. Those parents who had visited the Museum with their children said that they had done so to see a famous London landmark with their children, or to see specific objects, primarily rockets. There was only a limited sense from parents that they might learn about and enjoy science as a family at the Museum:

'*I think that the Science Museum is great for kids to visit with school. There are the interactive things that are so exciting for them. It is very different to how they learn science at school…. When we went to the Science Museum we saw the rockets because my son was into space at the time. We didn't talk about science, we just looked at the rockets, walked around and then we went home… I'll leave the science for the school to do.'*
(Parent, 19.05.2016)

Those parents who had never been to the Museum with their children said that they might visit if there was a specific exhibition or activity that related to their interests or identities, such as content explicitly about their cultural or religious backgrounds. When asked about which settings they might visit with their children, parents mentioned parks, playgrounds, amusement parks and fairs, as well as swimming pools or sports centres. Parents said that these settings were enjoyable to all of the family in a more casual way than they thought a visit to the Science Museum might be. However, several of these parents conceded that they were not very aware of what the Science Museum had to offer, and expressed some uncertainty about what they could do and see with their children at the Museum. All parents were aware, however, that entrance to the Museum is free of charge. One parent who had never been to the Science Museum said:

'*I know it's free to get in, you don't have to pay… I'm not really sure what there is to be honest. If there was something that I was very interested in or the kids were interested in then I might go with them.'*
(Parent, 19.05.2016)

Many parents agreed that overall the Science Museum could be described as somewhat exclusive. Parents justified this description by the Museum being located in a very wealthy area of London, and because, in parents' views, it is visited primarily by wealthy and educated people. Several parents directly contrasted themselves with such people, and expressed views of the Museum and its surrounding as being a setting that they would not feel comfortable in. For example, one parent who had been to the Museum many years ago as part of a further education course outing stated:

*'The area is really wealthy. I remember these huge white houses and I saw school children with little hats on. It's really different to other places in London or here where the school is… It's just not somewhere I think I'd feel very comfortable. I don't think people at the Science Museum are snobby. It's just a bit like going to horseracing or something, just not something my friends or family would do really. It's not somewhere that I'd feel very comfortable.'*
(Parent, 19.05.2016)

These findings match research by Archer *et al.* (2016b) who document how families from under-represented backgrounds who visited the Science Museum for the first time described

other people there as 'posh'. In correspondence with the views of several parents in the focus group findings, Archer *et al.* suggest that this description is associated with feeling 'different' to other visitors at the Museum.

With respect to the 'Building Bridges' project, all parents said that they were aware of the project, and that it was an attractive and unique project for their children to be involved in. Parents said that this was because it contrasted with the more formal, lesson-based teaching of science at school, and because it offered events and resources that were developed by the Science Museum, which, as noted, was perceived by parents as an exciting and interesting setting.

Parents did not spontaneously speak about the 'Building Bridges' project as relating to families, and there was some confusion as to the involvement of families in the project when asked. Most parents said that they had seen the 'Try This' booklet, but viewed it as a resource for children to use in school or as part of guided homework activities rather than also for them to engage in activities as a family:

'*I've seen the booklet, it looks good as it's different to what the kids get at school like worksheets and things. It's great to have something directly from the Science Museum… I don't think it's for parents is it? Is it for families?... I didn't think it was for families.'*
(Parent, 19.05.2016)

It must be noted again here that the parents focus group took place before the 'Building Bridges' family event, indicating that parental views of the Science Museum and in particular of the project might have changed since the event.

# 8. Findings from the pupil focus group

The pupil focus group took place before the family event, so pupils were not able to comment on this part of the 'Building Bridges' project.

## 8.1 The importance of friends

When speaking spontaneously about their lives at and out of school the most significant theme from the pupil focus group is the importance of friends. All pupils noted that they spent most of their time at school and after school with a group of friends, most of whom they had met during their first few weeks of Year 7. Such friendship groups are extremely valuable, and pupils said that they had invested much time and effort befriending other pupils. Not being part of a friendship group, or being part of only a loosely connected group was seen by all pupils as not only undesirable, but also as a sign of vulnerability:

'*Everyone wants to be part of a group, have friends and people to hang out with. There's lots of groups of friends that hang out together here (at school), and after school, go the park and things… There's a few loners or people who don't really belong to a proper group. They'll not immediately be bullied, but I don't think it's good (to be alone).*'
(Pupil, 12.07. 2016)

Casually '*hanging out*' with friends involved sharing hobbies and interests. The most talked about interests and hobbies during the pupil focus group relate to technology and sports, with technology being the most prevalent interest noted. Technology forms an essential part of pupils' everyday lives and that of all people around them, in particular children and young people of a similar age. All pupils said that they had smartphones and that they use them '*all the time*' when then can. As already stated, the use of phones is heavily restricted at all of the schools taking part in the 'Building Bridges' project, meaning that pupils were not allowed to use their phones for most of the school day. Pupils respected this rule, but most pupils noted that the first thing they did when leaving school was check their mobile phones:

'*I'd honestly say that I use my phone all the time. I don't know when I don't use it. In the morning when I wake up I look at it to check what my friends are up to… Then when I can at school. Most of the time it's not allowed at school. Always when I leave school it's the first thing I do: turn on my phone and check what's been happening.*'
(Pupil, 12.07.2016)

The most significant element of mobile phone use for all pupils was social media, primarily as a tool to communicate with their friends. This communication included commenting on how they are feeling, what they are doing, making plans for meeting up, and messaging each other photos, videos and links that are of interest to them. Communication with friends via social media was more prevalent and more popular than speaking on the phone or using SMS. In talking about the use of technology, several pupils spoke about technology as a way of marking out their generation, and differentiating them from people of their parents' age:

'*We all use phones and computers and things all the time at school and home and just everywhere really… I think most people do, particularly our age and teenagers and younger people… The older people, the old generation don't use it so much.*'
(Pupil, 12.07.2016)

I will speak about pupils' perception that their parents have a limited understanding of young people's lives in Section 8.2 below.

Focusing on the importance of friends, several pupils also spoke about an interest in technology as defining their group of same aged pupils, and marking them out as different to others. Some pupils are particularly interested in gaming and understanding how technology works, for example in terms of programming, rather than just using technology. Such interests or not having such interests formed a defining feature of friendship groups for pupils in the focus group in shaping with whom pupils might form a group:

'*Some people are really into programming or you know, like taking apart things and gaming. They will do that together, they'll meet up and game, or talk about programming… I'm not really into that so I'll hang out with other people.*'
(Pupil, 12.07.2016)

Another important example of an interest that pupils talked about as defining their group and marking them out as different to others is football. Some pupils spoke about how they enjoyed playing football and how they played football in groups of friends during breaks at

school, and after school in the local park. This interest formed a focal point for talking to friends, and formed a bond that marked them off from others:

'*I like to play football, and there's a group of us who all like doing that… We play at school in the breaks, and sometimes we'll go to the local park after school, it's just around the corner and we can play football there… We'll talk about football too, like which teams are doing well, and we all know who we support. We don't all support the same teams, but we all like football… There are pupils here who like football and those who don't. I'll always want to be with people who like football, it's what we share.*'
(Pupil, 12.07.2016)

Pupils also highlighted how friends helped and supported them in many ways, such as with homework that parents might not be able to help with. Friends also helped each other with difficulties at school, home or elsewhere. Two pupils spoke of how they had witnessed their older siblings '*falling out*' with teachers and parents, and that this was a sign of the importance of friends who '*stand by you whatever*':

'*Friends are really important because they can help you with things like school projects and homework. Parents might now know about that… Friends can help you out if you're in trouble… My brother fell out with his teacher and with my mum, there was a massive argument and stuff. But your friends will always be there for you no matter what.*'
(Pupil, 12.07.2016)

Overall, the value that pupils attached to their friends therefore related not only to having fun and spending time together, but also in providing a means to become independent from parents and school.

## 8.2 Pupils' views of their families and family life

Pupils agreed that their families were very important to them. They not only spoke about spending lots of time with families while engaged in day-to-day routine activities, such family meals, but also that there were specific important family events. The most important of these family events were birthday and anniversary celebrations, as well as religious holidays. All pupils stated that they valued these events with their families, that they could not foresee a future in which such family events did not occur, and that spending time with friends could not replace it:

'*It's not just that you spend a lot of time with your family. You also do things like birthdays or Eid with them... I don't think that spending time with friends can replace that… It's just what families do together, and I always want to be a part of that.*'
(Pupil, 12.07.2016)

Many pupils spontaneously spoke about how much time, effort and money their parents, grandparents and other family members had put into raising them. These pupils all expressed a wish to make their families proud of them, such as by getting a 'good' job and '*staying out of trouble'* by being part of a suitable group of pupils at school:

'*I want to make my parents proud, they've done so much for me. I just want to stay out trouble and be part of a good group here at the school so we all here listen to the teachers and the rules.*'
(Pupil, 12.07.2016)

With respect to wanting to get a 'good' job, it is noteworthy that, in accordance with views expressed by teachers and parents, none of the pupils had a clear idea of the kind of job they aspired to. When asked, most pupils said they did not know, and noted that they wanted to earn lots of money and be famous, such as by being a football star or a celebrity. As I will discuss in more detail in Section 8.3 below, all pupils in the focus group, however, did express the sentiment that doing well academically at school would help them get a 'good' job.

'*I want to make my parents proud of me by getting a good job… It's important after all they've done for me… I'd like to be famous and have lots of money, like maybe a footballer or a celebrity. I'm not really sure yet... I want to do well at school and then get a good job.*'
(Pupil, 12.07.2016)

One additional important theme from the focus group was pupils' views that their parents did not understand certain parts of their lives, related particularly to the use of technology. In addition, several pupils stated that their parents' English language skills were restricted, and that this made it challenging for parents to take part in some aspects of their lives. All pupils stated that the limits of their parents' understanding meant that they occasionally relied on their friendship groups and teachers to access some types of advice, guidance and support:

'*There are some things my mum and dad just wouldn't understand. Sometimes their English isn't good enough, or they just don't know enough about how to sign up to a website or something like that… Then I'll just ask my friends, or ask at school.*'
(Pupil, 12.07.2016)

## 8.3 Pupils' views of their school, teachers and science lessons

Pupils stated that they enjoyed school almost all of the time, with lessons being fun and interesting. Pupils also spoke very highly of their school in terms of extra-curricular activities and special occasions, such as the summer fair and various evening events. Nonetheless, it had taken pupils some time to adjust to their new school at the beginning of Year 7, and this period of adjustment had not always been easy. Secondary schools are much larger, and pupils interact with lots of different teachers, take part in numerous different subjects, and are given a much greater degree of responsibility than in primary schools. Two pupils also specifically spoke about their parents not being asked to engage with the school as much as they had during the primary years:

'*I like it here (at the school), it's different to primary school… There are more different subjects and more teachers, it's all bigger. It was a bit scary at first, but now I like it… At primary school my mum used to come a lot to help with trips or bake cakes and she picked me up too. Now they (parents) don't get asked to do things so much.*'
(Pupil, 12.07.2016)

Pupils do not want more engagement from their parents at school because they do not want to be seen as different to the other pupils, because it is not part of the school ethos and because they want to become self-sufficient. There was also some sense from pupils that teachers generally only specifically called in parents if a pupil was in trouble:

'*I wouldn't want my parents to turn up at the school. It's not how the school works now, it's not what other parents do. I don't want to be the odd one out, and it's good to be more in charge of things… I think on the whole if a teacher calls up a parent to come in, it's bad news, you're in trouble!*'
(Pupil, 12.07.2016)

Pupils have a lot of respect for their teachers, such as that they are clever, hard-working persons of authority, whom they often admired. For example, three pupils said that one of their teachers served as their role model. One of these pupils noted that teachers at her school often provided inspiration and encouragement for pupils beyond the academic subjects they teach, particularly for pupils who might not have 'good' role models within their families:

'*I really like her (teacher), and a lot of the other teachers too… They are like a role model to me, and I think to a lot of other pupils too. Teachers help us and encourage us… If there's nobody in your family to look up to and to be a role model, then it's a teacher who might be that.*'
(Pupil, 12.07.2016)

One important element of such inspiration and support relates to educational and career choices. As noted, pupils in the focus group did not have specific career aspirations. Nonetheless, pupils recognised the importance of choosing a career, and the role of their academic achievements in shaping this choice. The school provides information about career options that helps pupils work towards their options, such as by providing specific guidance on how to find an apprenticeship or how to apply for a university place. Four pupils highlighted not only the careers advice provided by the school, but also the importance they placed on particular teachers. These pupils had a particular rapport with a teacher, and had great confidence in this teacher to guide them throughout their time at the school and beyond:

'*The school has like career fairs and things for us to go to… They provide lots of information on different options and what you need to do to get where you want to. For me it's Miss Smith (teacher) who is really the most important. I like her, and I think she likes me too, and I think she'll help me find my way so that I can get the grades and then help me get into a university course.*'
(Pupil, 12.07.2016)

When asked about their views on science lessons, most of the pupils stated that they enjoyed some aspects of these lessons and disliked other aspects. All pupils said that they enjoyed those parts of science lessons during which they directly engage in experiments and activities. On the contrary, all pupils agreed that parts of lessons during which they were expected to simply listen, watch or take notes were not as interesting to them:

*'I like it when we can actually do things in science, like mix liquids and do experiments. In science there's times when we're just copying things and listening and maybe writing things… That's dull, there's nothing for us to do. You just sit there*.'
(Pupil, 12.07.2016)

Several pupils also spontaneously said that science was more difficult than other subjects, and that this was the case especially for later years in secondary school. There was a feeling amongst most pupils that science is a subject most suitable for high achieving pupils because there was a lot to study and learn. Two pupils also explicitly stated that GCSE science was very difficult:

*'Science is for the clever pupils mostly… Clever people like science because it's tricky and you have to learn a lot. Science GCSE is very difficult*.'
(Pupil, 12.07.2016)

Such associations of science with being clever have been documented in prior literature. Archer *et al.* (2013) conducted research that included interviews and a survey with over 9,000 Year 6 children in UK primary schools. They found that children strongly linked science with 'cleverness', and that this link meant that some pupils did not think of science as a possible option for themselves. Similarly, Carlone's (2003) research in the US highlights the common association between science and cleverness amongst secondary school teachers and pupils. The case studies in Section 10 will more closely examine this perceived connection between science and being clever.

## 8.4 Pupils' views of the Science Museum and the 'Building Bridges' project

Eleven of the thirteen pupils who took part in the focus group had visited the Science Museum prior to taking part in the 'Building Bridges' project. Eight of these eleven pupils who had previously visited the Museum stated that they had done so with their primary school, but had never visited with their families. All pupils described the Museum as '*fun*', '*interactive*', '*lots to do*', '*interesting*', and/or '*exciting*'. Such descriptions centred on the Museum as entertaining, but there was also a clear understanding of it being about learning, such as by one pupil saying that '*there's lots to do and learn there*.'

When asked about the prime intended audience at the Science Museum, all pupils agreed that it was principally for school groups, but that adults and families could also visit. Several pupils held the view that visitors to the Museum who were not part of school groups or other educational groups had a particularly keen interest in science, such as by science being a hobby or because an adult worked as a scientist. Those three pupils who had visited the Science Museum with their families prior to taking part in the 'Building Bridges' project said that their families did indeed have a keen interest in science:

*'All of my family love space, I'd say yeah we actually really love science… When we went to the Science Museum we saw all this awesome things, like space rockets and big aeroplanes, it was so cool… The other families there loved science too. They were all really into it, they were taking photos and messaging their friends. I think the Science Museum is a very good place for people like that*.'
(Pupil, 12.07.2016)

Pupils were aware that anyone can visit the Science Museum, including pupils who are part of a school group, people who are particularly interested in science, and people who are not particularly interested in science. However, pupils also shared the view that those families who visited the Museum were not 'typical' families as they know them. For most pupils in the focus group going to the Science Museum was not a 'typical' thing for families to do:

*'Anyone can go to the Science Museum, it's like a public place anyone can visit… Families who go are into science, they like that kind of thing, they love science… I don't really know families who go there, it's not very typical I don't think*.'
(Pupil, 12.07.2016)

All pupils were exceedingly positive about the 'Building Bridges' project, such as describing it as a '*highlight of the year*', as '*really fun*', '*fantastic'* and '*much better than any other thing we did at school*'. Reasons for such positive views of the project are related primarily to having fun with science, to the novelty of the project, and the special attention that pupils received as part of their involvement.

All pupils recalled some of the activities that they had taking part in during the project, often in remarkable depth. For example, they remembered the names of the three staff members on the Science Museum outreach visit to their schools, an event that had taken place several months previously. Pupils were also able to state specific details that occurred during their visit to the Museum, such as which objects they had taken photos of in a gallery they visited.

When outlining reasons that the project was fun, all pupils mentioned the highly interactive nature of the project, and the Science Museum staff being very friendly and funny. The activities that pupils noted as particularly interactive and engaging included being able to directly take part in experiments during the outreach visit to the school, being able to interact with objects during the visit to the Museum, and being able to speak to scientists who presented their research during the visit:

*'The 'Building Bridges' project was amazing, I loved all the things we did at the Science Museum… They (Science Museum staff) showed us around, and then we got to speak to a scientists and test of tubes that she uses in her work. It was so cool, I've never done that kind of thing before… I think the Science Museum is amazing to do that for us, it's an exciting place for us*.'
(Pupil, 12.07.2016)

Pupils said that the project gave them special attention that other visitors to the Museum would not receive. There was a clear sense that a more 'normal' visit to the Museum would be different, and possible not as much fun. Most pupils in the focus group said that they were

unsure what a 'normal visit' to the Science Museum, such as a visit with the families, would involve. Therefore, it is possible that taking part in the 'Building Bridges' project might not directly translate to visiting the Museum outside of the project:

*'I really think the Science Museum is great… I don't know what it would be like to come without the activities (of the 'Building Bridges' project). It would be different, there wouldn't be all the fun things to do… I don't know what we'd do if I came with my parents. I don't think it would be so fun*.'
(Pupil, 12.07.2016)

As noted, the pupil focus group took place before the family event so pupils were not able to express their views on this event during the focus group. As discussed in Section 9 below, one important element of the family event was that it provided special attention to families.

Overall, the views held by pupils on the 'Building Bridges' project are clearly very positive and signal that the project successfully implemented its aims to provide an enjoyable experience to pupils. However, an important finding from the focus group is that the pupils did not spontaneously make links between the science that formed part of the project and the science that they encounter at school. When explicitly asked whether the science that they experienced as part of the project was similar to the science that they experienced during school lessons, all pupils said that this was not the case. According to pupils, science at school is primarily based on listening, watching and taking notes, as outlined in Section 8.3. The 'Building Bridges' project did not involve many such aspects, and that science as part of the project was much more '*interesting*' and '*fun*'. Many pupils also made distinctions between science on the project, and science in the workplace and in further and higher education. Such comparisons generally focused on how science as part of the project was '*special*', while other science fundamentally different and not as interesting, accessible or enjoyable:

*'We did all those fun science experiments and things for the project. That wouldn't normally happen in science at school, or if you worked with science… You'd have to do all those complicated boring things like writing lots of things*.'
(Pupil, 12.07.2016)

Such views are a missed opportunity to contribute towards a view of science as accessible, interesting and enjoyable. This missed opportunity is particularly salient in light of the finding that pupils in the focus group described science as '*difficult*', as outlined in Section 8.3. I will explore these views in greater depth as part of the family case studies in Section 10.

# 9. Findings from the family event on 13th July 2016

## 9.1 Families' views of the event

Families described the event in very positive ways. The feedback wall on which families were invited to provide a short commentary of the event on a post-it note offers a snapshot of these views. Examples include:

- *It is exciting and interactive*
- *It was really fun and amazing. I found it really inspirational and I recommend it to everyone to visit Science Museum much more.*
- *Awesome place and very interesting. Food for free!*
- *Today was enjoyable. I learnt new things and had an amazing time. Thank you!*
- *I loved everything so much! It was amazing!*
- *Seeing the museum staff friendly and not formal as other museums*
- *Very fun. There is a lot to do and all the activities are interesting*
- *Fun, lots to do, tasty food, educational. It was cool!*
- *I love it almost as much as I love Harry Potter! Come to this museum!!*
- *Fun! Fab! Fantastic! Lots to do! Lots to see! Lots to taste, lots to hear*

It is noteworthy that the comments on the feedback wall were evidently written by both adults and children. This indicates that families were keen to provide feedback and thank the Science Museum for the evening, and that both adults and children were engaged with the event and thus wanted to provide feedback. In an interview that occurred directly next to the feedback wall one parent said:

*'My son already put one (feedback post-it note) up there… Oh, I definitely want to write something too, just to say 'thank you' for the evening really and how much I enjoyed it.'*
(Parent, 13.07.2016)

Families consistently described the event as entertaining and enjoyable, primarily because of the informal atmosphere created through the music and the friendly staff, as well as the many different activities that were appealing and novel to families. In addition, the food and drink provided at the event free of charge was greatly appreciated by families, and was often noted as a contributor to them enjoying the event. All families who were asked stated that this type of food was normally very expensive and that the complimentary provision of food created a sense of the event being a party, and they were specially invited guests:

*'The free food and drinks made me feel like a VIP, you know, like we were being treated very special, like VIP guests*.'
(Parent, 13.07.2016)

The liquid nitrogen ice cream that was offered at the event was a highlight of the evening. Families saw how the ice cream was being made in a series of displays at different times throughout the evening. Subsequently families tasted the ice cream handed out in small cups. Watching the ice cream being made and then tasting it was exciting and novel to families. It was clearly an activity that had contributed to them wanting to attend the event. Furthermore, there is evidence that the activity provoked reflection amongst families on how ice cream can be made, including the science involved in this:

*'I was really excited about the ice cream when I saw it on the flyer… I never knew you can make ice cream like that. It was totally awesome… We eat it sometimes, buy it from the shop or get it out of the freezer, but you don't think much about how it's made… I didn't know you can make it like that with nitrogen*.'
(Pupil, 13.07.2016)

When provided with opportunities to speak to the Museum staff involved in making the ice cream, many families asked them questions and commented, which related not only to the flavour of the ice cream, but also more broadly to the process of creating it. The activity therefore encouraged engagement with science in a way that was entertaining and interesting to families, and linked to an experience of food and pleasure that they were familiar with.

Observation confirms that families often also milled around the other food stalls, informally chatting amongst each other, such as commenting on the food served there. Some of the foods that are not commonly available, such as snacks made with wild garlic attracted particular attention. As already noted, food is inevitably part of families' everyday lives through eating and preparing meals together, and they are comfortable and accustomed with talking about it. The unusual food encouraged informal conversation not only amongst families, but also between families and Museum staff:

*'My mum was really interested in how they'd made those wild garlic snacks… She loves cooking, and she's not had that before… She actually asked (the person at the food stall) how they were made!*'
(Pupil, 13.07.2016)

Throughout the event families took photos and posted messages on social media. The event was a very special occasion for families that they sought to capture on camera and share with others. There is also evidence that families will deepen and prolong their memories at the event by taking photos and sharing experiences at the event on social media:

*'It is a very special night for us… You don't get to see this kind of thing very often so I've been getting lots of snaps with my grandchildren. There are memories that we can share and we can look at the photos*.'
(Grandparent, 13.07.2016)

However, two families stated that taking photos at the event, and in the Science Museum as a whole is prohibited. These families therefore did not take photos even though they would have liked to. Findings from such families indicates the need to explicitly communicate the permission to take photos, and encourage the sharing of photos, such as via social media. This communication would support families' engagement at the event, link their existing interests, experiences and every-day interaction with technology to the science presented at the Museum, and is likely to support a deepening and prolonging of memories from the event.

Families often characterised the event as an education experience related to science. As noted in Section 7 and Section 8, the focus groups indicate that most parents and pupils in this study viewed the Science Museum as a setting for having fun and for learning, which to

varying degrees relates to education at school. These views from parents and pupils are reflected in families' views of the family event in that many families characterised the event primarily as enjoyable, but also as being educational. Most families referred to the Museum aiming to provide a learning experience, but were often somewhat vague in terms of what such learning experiences might include:

*'The event has been so much fun. We've all enjoyed it a lot! And the event is educational too. It's about science*.'
(Parent, 13.07.2016)

When asked what kinds of things about the event are educational, and what one might learn at the event, most families highlighted the range of different activities on offer. As explored in Section 9.2 below, this range of activities indicated the breadth of science to families.

## 9.2 How families engaged with the activities

Comments provided by families on the feedback wall refer to a large range of the activities. In correspondence with this finding, observation during the evening indicates that all families were engaged with the activities provided as part of the event, often moving from one activity to the next in a bid to see and take part in as many aspects of the event as possible:

*'There was so much to do and see, we just want to make sure we get to see it all*.'
(Parent, 13.07.2016)

The variety of different activities meant that families were able to experience a range of different aspects of the Science Museum's collections and focus. Many families commented on that they had not anticipated the Museum to contain such a diverse range of provision. In addition, the range of activities during the event highlighted the breadth of science, with several pupils saying that the activities during the event showed that science can be broader than the school science curriculum:

*'All the different activities here today are so cool… There are so many more different things to do than when we do science at school. It's not so restricted as science at school*.'
(Pupil, 13.07.2016)

Activities were particularly effective if they were set up to explicitly encourage collaboration between parents and children. One noteworthy such activity involved families making cardboard virtual reality headsets. During this activity parents and children talked to each other about their prior views and experiences, and generally worked on making the headsets together. As noted in Section 8, most pupils are interested in technology and describe it as an inherent and essential part of their everyday lives. Parents are to some extent excluded from their children's technological fluency. The virtual reality headsets activity opened up opportunities for both parents and children to talk about technology. Parents were keen to share their experiences of technology over time, which gave them ample chances to demonstrate their knowledgeable. Children were able to speak about current and possible future technologies, and how technology has changed over the past few years. In addition, the activity was sufficiently complicated for parents to feel that their help in assembling the

headset was required. This collaborative activity was enjoyable to families, and was also often associated with an intention to engage in further activities together:

*'I thought the activity where we made the VR headsets was really good… We made it together and we haven't done that kind of a craft activity in a while. It was quite tricky at times to get it together right, so we both worked on it together… It was nice to be able to talk about some really old technology stuff, it's not often that I feel that I have something to say to him (son) about technology. We should do this kind of thing more often, think of some old technology to recreate, or something like that*.'
(Parent, 13.07.2016)

It is important for parents and children to collaborate to support learning and developing a shared sense of identity across various settings (Bachman and Dierking, 2010). For example, parents might support children by recruiting a child's interest, reducing the number of steps necessary to solve the problem, marking critical features of the task, controlling frustration and asking questions (Wood *et al.*, 1976). Families might also speak about their current experiences in relation to who they are as a family, such as by referring to shared prior experiences (Ellenbogen, 2003). These accounts suggest that parents and children often learn collaboratively by building on each other's knowledge, views and wider experiences (Ash *et al.*, 2007). Adults do not simply determine the learning experiences, but rather these experiences are co-constructed within collaborative activities and interactions of all family members present.

The literature on family interactions in museums suggests that parents at times simply stand back and watch their children interact with objects and exhibits, and engage with activities rather than collaborating with them (e.g., Crowley *et al.*, 2001). In accordance with this prior literature, there were activities at the event during which parents did simply stand by and watch. These parents often said that they thought the activities were intended for children rather than for children and parents to engage in together. This was the case for example, at the drawing activity. In addition, there were situations during the event that parents did not think of themselves as having the perceived necessary knowledge, skill and understanding to engage with their children. For example, some parents did not spend much time looking at the objects on gallery because they did not know what they were, or because they did not think they could understand the interpretation. These parents viewed and appreciated the provided activities as being 'for them', but did not think of the wider setting of the Museum as being accessible to them. The impact of the event on families' views of the Science Museum is discussed further in Section 9.3.

While families enjoyed all the activities at the event, several families said that some activities were not evidently related to science, and that they were sometimes unsure which activities were related to science and which were not. In addition, some families were not certain which objects in the Museum were part of the event, and how they related to the 'Building Bridges' project. For these families there was sometimes a sense of bewilderment why some activities and objects were included in the programming of the event, even if they enjoyed the activities. While such bewilderment may in itself not have a detrimental impact on families' experiences at the event, it may contribute towards a sense of the Museum being somewhat alien and obscure to them:

*'I liked making the bag, the print making activity. It's such a beautiful bag, and I've never done that before. But I'm not sure what that's got to do with science. I'm not sure whether it's here to do just for fun or to show some kind of science… I don't really know what the Science Museum wants with the activities, it's a bit unclear to me*.'
(Parent, 13.07.2016)

With respect to the objects present in the 'Making the Modern World' gallery that the event took place, one parent noted:

*'There's lots of things displayed here, like the rockets and all the small items in the glass shelves, but I don't know what they have to do with the project… Are they something to do with what the children learn at school? Or is it what the Science Museum has here all the time? It's all a bit confusing and just not what I know about.*'
(Parent, 13.07.2016)

It is also noteworthy that one family spoke about objects in the gallery as 'statues', thus highlighting how families in this study may use language and reference points that differ from families who are regular visitors to the Science Museum and other similar settings. Another family, who are a case study family, also spoke about 'statues' at the Science Museum, which will be outlined in more detail in Section 10.

## 9.3 Impact of the event on families' views of the Science Museum

Interviews with families at the event as well as family comments on the feedback wall highlight that the event was highly effective in creating an entertaining and welcoming evening that impacted on families' views of the Science Museum. Of the seventy-seven families took part in the interviews almost one half had not previously visited the Science Museum. Many of these families spontaneously stated that without the event they would not have visited the Museum in the near future. The event provided a necessary encouragement to visit and to feel explicitly included in the Museum's programming:

*'I don't think I would have come to the Science Museum if there wasn't this event… The event is for us, for families of the project, so we feel very included*.'
(Parent, 13.07.2016)

The most evident impact of the event on families' views of the Science Museum is that it instilled in all families who were interviewed a feeling of being valued. Interviews with families highlight how families appreciated the effort that the Museum had put into setting up the event, and the special attention that they received:

*'It's great to have the event. It's such fun, and the Science Museum has clearly put in a lot of effort to welcome us like this. It's a very special occasion*.'
(Parent, 13.07.2016)

There was a clear sense from all families that the event demonstrated the Museum's commitment towards welcoming a range of visitors, including themselves. Several families explicitly contrasted their views of the Science Museum at the event with their previously held beliefs, or with beliefs that other people might hold about the Museum:

*'I would say that the Science Museum hosting this kind of an event is amazing. It really shows that they welcome lots of different people here. Clearly they want families like us to come. I think that's very different how some people think the Science Museum is more for people around here (South Kensington)*.'
(Parent, 13.07.2016)

One aspect of the event that was particularly successful in highlighting the commitment towards welcoming diverse groups is the display of the work that pupils did as part of the 'Building Bridges' project. The displays emphasises that the Science Museum values pupils' contributions, that it is willing to exhibit a range of different items, including those created by school groups, and that the 'Building Bridges' project is part of the overall Museum. Integrating elements from the 'Building Bridges' project, particularly those that are created by pupils, into the physical Museum space contributes to a view of the Museum being open-minded:

*'Putting up these displays of the children's work is really nice. It shows that the Science Museum isn't just about showing great works from famous people… I think the Science Museum is very open minded to show the children's work from the project here in this grand hall ('Making the Modern World' gallery)*.'
(Parent, 13.07.2016)

Many parents also said that this display was a reason that they attended the event, that they had been intrigued to see how the Museum might display their children's work, and that seeing their children's work displayed made them feel proud. Several pupils voiced similar views, such as one pupil saying that he had wanted to come to the event to show his mother and siblings the display.

While all families held views that the event demonstrated the Science Museum's commitment towards welcoming a diverse range of visitors, many families also highlighted that the event was an exception. Families did not think that the experiences during the event would be replicated on subsequent visits to the Museum. This view is a mixed blessing for the Museum's aim to diversify audiences. Several families said that welcoming families by hosting the event made them think very highly of the Science Museum, which was associated with an intention to visit again. However, some families also held the view that their experiences during an ordinary visit to the Museum might be less appealing, such as that it would be very busy, that they would not be able to find their way around, that there might not be suitable activities for them on offer, that food and drinks would be expensive and that staff might not be as friendly. One parent who had not previously visited the Science Museum said:

*'The event is just great, really such fun… I think a normal visit here would be very different. There wouldn't be such helpful and friendly staff around, I'm not sure we'd know where to go and what to do. There wouldn't be all these kinds of fun activities to do.*'
(Parent, 13.07.2016)

Such views highlight the challenges facing the Science Museum in explicitly welcoming diverse family audiences by providing specific events, while simultaneously being seen to be accessible to these audiences without the need to provide specific events.

# 10. Family case studies

## 10.1 Taylor family

***Background to Christ Church school and surrounding area***

Christ Church is a co-educational Church of England school in the Borough of Wandsworth that forms part of Inner London. It opened in 2003, and converted to academy status in 2015. It currently has around 930 pupils on role, and is heavily oversubscribed. The school has a music and mathematics specialism and was graded as 'good' by Ofsted in 2011. The school website describes the setting as '*caring, supportive and distinctly Christian… where Jesus Christ is reflected in every aspect of the school life*'. The school has one of the highest academic achievements in the Wandsworth Local Education Authority, and the most popular optional subject taken at GCSE is Triple Science.

The school is home to a diverse community, with White British students being the largest ethnic group. Only a few of the minority ethnic students on role are at an early stage of learning English. Overall, the proportion of students eligible for free school meals is average. Student attendance is described by Ofsted as being exceptionally high. The school has close links to the local community, such as by working in partnership with local primary schools and churches. Ofsted highlights these links as important not only for supporting academic attainment, but also for providing excellent support of students' pastoral needs.

The 2011 census suggests that the borough of Wandsworth has a population of around 307,000, around 78% of which is of White, 9.6% is of Black and is 6.9% of South Asian ethnic origin. The dominant religion is Christianity, but there are also a number of other religious communities, including Sikhs, Jews, Muslims, Buddhists and Hindus.

The borough consists of many newly built houses, as well as streets of terraced houses, older high rises, and refurbished buildings, including Battersy Arts Centre. The borough has excellent transport links, such as by being connected by underground and train from Clapham Junction. Christ Church school is located in a wide tree-lined street with terraced housing built during the 1970s. The school itself is housed in a large modern building that is surrounded by a car park and trees.

***The Taylor family's identity as a 'London family'***

The Taylor family consists of the 36-year old mother Lisa, the 40-year old father Mick, and their four children: 11-year old Michael, nine-year old Pearl, and three-year old twins Joshua and Elijah. All the children were born in south London, and on several occasions the parents Lisa and Mick, as well as their children Michael and Pearl refer to themselves as '*Londoners*' and as a '*London family*'. Both Lisa and Mick were born in Jamaica and came to London as children. They have visited Jamaica on several occasions since, the last time around five years ago. While Lisa and Mick both say that they would like to visit more often, and that the cost of such a trip is the only reason that they have not visited since the twins were born, they are both clear that they do not want to live in Jamaica and that they do not think of themselves as Jamaican:

'*When we visit Jamaica it's not like we're going home or anything, we're not even really visiting our home country. We're just visitors there.*'
(Mother Lisa, 03.05.2016)

Both Lisa and Mick highlight that they have an extensive extended family in south London, and say that this part of London is their home because there are lots of other families with Jamaican roots in the area:

'*I've lived most of my life in London and all my kids were born here. London is my home… It's my home because lots of my family and friends are here, and we all share the same Jamaican roots. So Jamaica is a big part of my life, it's part of home in London, it's where my heart is, but it's not like I'd want to live in Jamaica. I like London with a bit of Jamaican flavour, my Jamaican family are here.*'
(Mother Lisa, 03.05.2016)

Lisa explains that most of her friends have Jamaican roots, and that she refers to some of these friends as family. For example, she talks about her best friend as her 'sister', and to several friends as her cousins. Lisa has a broad concept of what a family is, which can include friends as well as relatives. Lisa's husband Mick also refers to some of his close friends as family members, often talking about two of his friends as 'brothers'. For both Lisa and Mick the concept of 'family' is to some extent one of choice in that it can include friends as well as blood relatives. This allows Lisa and Mick to establish close links with her local neighbourhood and identify as '*Londoners*':

'*Because we have family around here it's our home, our neighbourhood. We're Londoners with family here*.'
(Mother Lisa, 03.05.2016)

Lisa and Mick also have strong ties to their blood relatives in Jamaica that have a special meaning. They followed Mick's family tradition of naming their first son Michael:

'*My father was called Michael, my grandfather was called Michael, and I'm Michael and so is my son. It's a real family tradition, and lots of families do that in Jamaica. It's very important to me… I'd like to see Michael also calling his first son Michael*.'
(Father Mick, 02.08.2016)

Underlining this significance, Mick has a small picture of his grandfather Michael in his wallet as a lucky charm that bonds him to his ancestry in a country that Mick describes as being '*far away*'. While the family have settled in London and have no desire to return to Jamaica, the tradition of naming their first son Michael illustrates the parents' determination to carry on with specific traditions associated with their ancestry in Jamaica. Lisa expresses this clearly, and also refers to naming her younger sons Joshua and Elijah after uncles in Jamaica.

'*I do really want to carry on traditions from Jamaica. We named Michael to follow an important family tradition, and we also named Joshua and Elijah after uncles in Jamaica… We've never met the uncles and grandad Michael died before Mick was born so it's not like we really know them… It's a family tradition, and we wouldn't want to break that*.'

(Mother Lisa, 02.08.2016)

Without being prompted Lisa and Mick's son Michael proudly speaks about his family's Jamaican roots. He speaks of these roots as being somewhat distant and historical rather than directly influencing his everyday activities, or concept of home and identity. These roots are less important to him than his connection to London and England, both of which he describes in terms of his current and future life. In the summer of 2016 the Olympic Games were held in Brazil, and Michael was keen to speak about the teams from both Great Britain and Jamaica:

'*I've got Jamaican roots: my parents came for Jamaica and I still have family there… It's a long way to travel so you can't go often. We've got family here in London too… they have Jamaican roots too, but they're Londoners like us. We'll be watching the Olympics and some of the older people will be more interested in how Jamaica is doing. But most of the time we're supporting Team GB. We've done really well in the Olympics, we're second in the medal table!*'
(Son Michael, 02.08.2016)

When I asked if he remembers going on holiday to Jamaica five years ago Michael says:

'*Yeah, I went there when I was seven. It's a long time ago. They have nice beaches and it's sunny, and you can buy coconuts and tropical fruits. We visited lots of relatives who I didn't know and they cooked some strange food... It was a bit boring too. I like English food better, it's more relaxed and you don't have to go to see all the relatives*.'
(Son Michael, 02.08.2016)

Michael's connection to Jamaica is not one that he necessarily wants to deepen. While he acknowledges the beaches, sun and tropical fruits, he is quick to point towards the downsides of Jamaica, such as the rubbish on the streets, the limited public transport and having to visit many of his parents' friends and relatives, which can be '*boring'*. Michael expresses a clear favouritism and familiarity to England, which is reminiscent of accounts documented in the literature of how children with Bangladeshi heritage brought up in London reflect on visits to Bangladesh. While these children appreciate Bangladesh as their parents' country of origin, they identify as being from London and often experience the visits as unsettling, even unpleasant experiences, filled with unfamiliar sights, smells and customs, as well as unwanted attention from relatives (Zeitlyn, 2014). Michael's deep affiliation with London rather than with Jamaica is also evident in his description of his friends:

'*My friends are just, you know, Londoners rather than Caribbean… We'll do things together and get on well, and I wouldn't really think about if they're Jamaican or anything. It's not like I'll be friends with someone because they also have a Jamaican grandfather. I'll make friends with people because they're here in London and like the same things.'*
(Son Michael, 02.08.2016)

Overall, the findings outlined in this section illustrate the family's overarching identity as a '*London family*', and the difference between Michael's identity as a '*young Londoner*' and the identity of his parents as '*Londoners with Jamaican roots*'.

***The family's home and weekday routines***

The family live in a three-bedroom flat in a large housing block on a busy road. The parents and Michael have their own room, while nine-year old Pearl and the twins share a bedroom. On my first visit to the family home, the mother Lisa somewhat apologetically spoke about Pearl not having her own room, and the difficulty this was causing amongst the siblings. In fact, neither Michael nor Pearl ever spoke to me about Pearl not having her own room. Instead Pearl was keen to show me her part of the shared bedroom that had been partitioned off with a pink curtain, and in which she had very tidily organised her things. The twins part of the room consists primarily of two small beds, most of their toys and clothes being located in the sitting room or parents' bedroom. Lisa said that she would like to move into a four-bedroom flat, but this was unlikely to be possible because of limited available housing in the area.

The house is located approximately ten minutes walk from Christ Church school, at which Michael is a Year 7 pupil. The primary school that Pearl and the twins attend is a similar distance in another direction. Both Lisa and Michael state that it is very useful to attend local schools that are within walking distance of their home. Similarly, the father, Mick, notes that it is very important for the family's routine of dropping off and collecting the younger children that they live close to the school.

The family's routine can be divided into weekdays and weekends, and is most simply described with a focus on the mother, Lisa who works as an administration assistant for an insurance company in the city. On weekdays Lisa gets up at 5.30am to make herself a coffee, and prepare dinner. The only exception is Fridays, when her husband Mick picks up chicken and chips or fish and chips after work to have for dinner. In addition to preparing dinner most morning, Lisa often also does laundry and general tidying while her husband and children are still asleep. When I ask for an interview at the beginning of the study, she says that her preferred time is 6.15am. Lisa is a '*morning person*', as she describes herself, and is also clearly very organised and committed towards a tight schedule. At 7am she wakes up her husband and children and prepares them a breakfast of toast or cereal. Her husband, Mick, dresses the twins and eats breakfast with the children while Lisa gets ready for work. She leaves the house at 7.45am to catch the underground to work. It takes her around 40 minutes to be at her desk where she eats a breakfast bar and some fruit while starting work at her computer.

Meanwhile Mick takes nine-year old Pearl and the three-year old twins to school, which starts at 9am. 11-year old Michael goes to school by himself. Mick takes a bus from the school to the carpet installation service where he works. His normal working hours are 9.30am-5.30pm. Both Mick and Lisa enjoy their work, in particular the social aspect of work, such as having lunch with colleagues. They also highlight that they are proud to be two working parents able to earn sufficiently to support four children:

'*Lisa and I are both really rather proud to be both working, to have a job and be able to pay our bills and support the four kids… I must say I do enjoy my colleagues. We have lunch most days and like chatting away. Lisa likes having lunch with colleagues and I know she likes getting away from the house and kids to talk about other things with colleagues.'*

(Father Mick, 05.01.2017)

Lisa finishes work at 4.30pm, and collects Pearl and the twins from a childminder on her way home. 12-year old Michael comes home from school by himself, and is generally playing on his games console in his room when Lisa and his siblings arrive at around 5.30pm. Lisa puts on the television in the sitting room, and heats up dinner so they can eat together at around 6pm when Mick comes home from work. After dinner one of the parents bathes the twins, and puts them to bed, which includes reading them a story. The other parent helps Pearl with homework, clears away dinner, and does general tidying. Pearl then sometimes watches TV or plays, and goes to bed around 8.30pm. Lisa explains that the time after dinner is somewhat stressful and busy, and that she and her husband enjoy taking a little time to relax after the three younger children are in bed:

'*After dinner is when it's most busy here is the house, it is a bit stressful getting the twins to bed, they are tired and can be difficult... Pearl needs help with homework, sometimes she doesn't want to do it, she just wants to watch TV. I do like to get some of the tidying done too so that we (Mick and I) can relax a bit when the younger ones are in bed. Otherwise we're just running around all day.'*
(Mother Lisa, 02.08.2016)

11-year old Michael is somewhat apart from the family's routine as he is moving towards greater independence as part of his transition to secondary school:

'*Michael is doing more things by himself now, he's at secondary school now and has a bit of a different day than the others (his siblings).'*
(Father Mick, 03.05.2016)

Michael's weekday routine starts with him being woken up by his mother at 7am. He struggles to get out of bed, and regularly does not get up until his mother leaves the house at 7.45am. Michael has a quick breakfast of toast and leaves the house at around 8.30am, which means he arrives at school at around 8.40am. He spends most of his school day with a small group of four boys, all of whom he met at the beginning of Year 7, and all of whom are interested in technology, in particular gaming. Michael's, as well as that of his family's, interest in technology will be explored further below.

Michael likes school, but says it can be tedious and boring at times too. Subjects that he is particularly interested in are PE and ICT because these are subjects that relate to his interests beyond school. Subjects he does not enjoy are English and modern foreign language, for which he is taking French. He generally speaks very highly of his teachers as people who try to help him and other pupils learn. However, it is evident that Michael enjoys school primarily because it offers opportunities to see his friends.

Michael takes part in two after-school activities organised by the school: a computing club and a football club. During his primary school years Michael went to an after-school club every day. All four boys that constitute his close circle of friends also attend the computing and football club, and it is clearly a part of the week that Michael enjoys a lot:

'*School is all right, it's ok, I like it… PE is fun and IT too. That's what I like doing in my spare time too. At school I mainly just like hanging out with my friends, I like being with them and we can talk and things. The after-school clubs are cool because you can do more what you want with your friends.'*
(Son Michael, 03.05.2016)

Michael is in a transitory life phase during which he is not yet at an age to entirely independently spend time with his friends, but clearly seeks out opportunities to engage in activities with his friends rather than family members:

'*Michael is in an in-between age... I don't want him going out to the park or anything just with friends. There might well be people there I don't want him mixing with… But he does need more independence, he walks to school and back and does have some time at the school, before and after lessons, to be with his friends… He wants to be with his friends.'*
(Mother Lisa, 03.05.2016)

Michael himself echoes his mother's views, and highlights that his parents often contact him on his mobile phone to check, for example, that he has arrived at home safely. Michael outlines this as a normal part of his everyday life and that of his friends.

'*They (parents) don't let me go to the park by myself, and they'll check on me to see that I've come home after school. They don't mind me staying at school a bit longer but they don't like me going somewhere they don't know. I'll let them know where I am. If I go to a friend's house after school they want to know… It's the same for my friends, the parents will get in touch to see all is fine.'*
(Son Michael, 03.05.2016)

On most days Michael comes home straight from school rather than visiting friends or being visited by friends at his house. He makes himself a snack, such as a sandwich, crisps or some fruits. His parents expect him to take on responsibility for his homework, and have asked him to complete his homework when he returns home after school. However, Michael generally relaxes by playing on his computer games console, watching videos online or interacting with his friends via social media. When they return home, his parents always ask him about his homework, and encourage him to complete it. At times, completing homework is a point of tension between Michael and his parents:

'*They (parents) want me to do my homework straight after school, but I like to relax first… Sometimes they get back and I haven't done it and they get annoyed.'*
(Son Michael, 03.05.2016)

Michael says that he always completes his homework, mostly after dinner. He generally spends this time in his bedroom by himself, often also looking at social media and chatting with his friends online. He generally goes to sleep around 9.30pm.

***The family's weekend routines***
The family's weekend routines differ from those during the week. The parents and younger children generally get up at around 7am and have breakfast together. Michael tends to sleep

longer and have breakfast by himself. All family members tend to eat for longer, and often they have some treats for breakfast, such as croissants, small pieces of cake and hot chocolate. On Saturday morning Michael goes to a football club that is held in the local park. His father Mick accompanies him, and they leave the house at 10am. Accompanying his eldest son to football practice is very important to Mick as it is 'special time' with him. In addition, Mick also sees football as an important way to bond with his son and socialise him into becoming a 'man':

'*I really like taking Michael to football practice and it's very important to have time together to bond… Football is a good thing for him to be into, it's part of becoming a man for me, it's the kind of thing men like and I want him to be part of that.'*
(Father Mick, 02.08.2016)

Vincent and Ball (2007) document how 'middle-class' parents make frequent use of enrichment activities, including music and sports classes. Parents in Vincent and Ball's study wanted to develop in their children interests, abilities and 'ways of being' that aligned with their own. By engaging their children in specific enrichment activities, parents to some extent aimed to pass on their own identities and interests, including knowledge and wider views related to being a certain type of person. By encouraging Michael's football practice, Mick, in a similar manner to parents in Vincent and Ball's study aims to encourage certain attributes in his son. In addition, Mick also enjoys accompanying his son to football practice because it offers him opportunities to socialise with other fathers:

'*I enjoy watching with the other dads, hanging out and just chatting and seeing what the kids are up to… It's a very social experience that I really like.'*
(Father Mick, 02.08.2016)

Following the one-and-a-half-hour football practice Michael and Mick generally stay in the park with the other children and their fathers. They talk, eat and drink, often bringing picnics in the summer months and visiting a small café in the winter to buy coffee, soda and cakes. While Michael enjoys the football practice and spending time with his friends afterwards, he also voices some displeasure at being accompanied by his father. Michael is aware of the importance that his father attaches to joining him, but he also longs for more independence in pursuing his hobby, especially as one of his friends now comes alone:

'*Yeah, my dad comes along every week… It's ok, lots of the other dads come too, but one of my friends now comes alone. You know, you don't want to have your dad coming along all the time and watching what you're doing… Yes, I think I would rather be by myself but I know he (Mick) likes coming too.'*
(Son Michael, 02.08.2016)

Michaels' mother Lisa is aware of this balance stating that while she realises that her husband enjoys attending the football practice, it is also important to give her son more independence:

'*Going to football used to be very special father-son time, but it's changing now. Michael want to go by himself so I think Mick will have to back off soon… The younger boys are getting interested in football so maybe he could take them.'*

(Mother Lisa, 02.08.2016)

In many areas of his weekday and weekend life Michael is becoming more independent, a change that is recognised and accepted by his mother, and, to a lesser extent, by his father. This move towards independence brings change not only for Michael, but also for the other family members, such as his father possibly soon no longer accompanying him to football practice and thus missing valued opportunities to socialise and have fun.

The mother, Lisa, generally spends her Saturday morning doing shopping with the younger children at a local superstore that they get to by car. Prior to leaving Lisa makes a list of dinners to cook during the week and the ingredients needed, as well as regular items such as milk, bread and cereal. It is important for her to have home cooked dinners as, according to her, they are healthier and because it is good for the children to learn how to cook and eat together. The twins enjoy the Saturday shopping trip as they can push little shopping trolleys and they each get to pick a sweet. The older daughter has once or twice said that she does not want to go, but Lisa wants her to go because it is important for her to learn about and get used to doing shopping and cooking. Nine-year old Pearl already helps with some chores, such as setting the table. Pearl shows an interest in cooking, and often bakes cakes with Lisa. There are regular cake sales at Pearl's school that the family contribute, often by baking cupcakes. However, the sales are often on Fridays so it is difficult to bake something more elaborate than cupcakes as the family does not have much time on Thursday evenings. Lisa's expresses some frustration that the school does not take into account working mothers:

'*Pearl likes cooking and baking, and I think it's important for her to come shopping to see what to buy and learn these things. We bake together: cakes, biscuits. For the school bake sales we make cupcakes. I would like to bake more elaborate things too for the sales, but they're on a Friday so it's difficult. The school doesn't think about times that we can bake. They just think: mother at home baking, but I'm at work. If they had it on Mondays we could do baking on Sundays.'*
(Mother Lisa, 05.01.2017)

Following the shopping trip Lisa and the younger children have a simple lunch while Mick and the older son are still in the park. The family spend some time on Saturday afternoons cleaning, towards which Lisa and Mick both contribute. The children are asked to help clear their toys away. There are also often social events on Saturday, such as children's birthday parties. Lisa cooks the family dinner, which they eat together at around 6pm. On most Saturday evenings Lisa or Mick will go out with friends.

Sunday is a '*day for just relaxing*', as Lisa says. In the mornings the parents like to sleep in as long as possible, which is usually until around 10am. Pearl and the twins generally wake up about 7am. Pearl turns on the TV and gets herself and the twins some breakfast, generally cereal or simple snacks. Her and the twins then watch children's programmes. Michael generally stays in his room, where he eats breakfast by himself, often in his pyjamas while gaming or using social media. I will discuss Michael's gaming and use of social media in more detail below, but it is relevant to note here that Sundays are a day that the whole family take time off from specific rules. This includes Michael eating in his room while gaming, and the younger children eating breakfast in front of the TV in the morning:

'*On Sundays we relax the rules, the kids watch several hours of TV, Michael eats while on his computer. Normally I'm not a fan of that but on Sundays we all just take some time off to wind down.'*
(Mother Lisa, 02.08.2016)

After eating a light breakfast Lisa makes Sunday lunch, and is generally helped in doing so by her husband. The parents both enjoy being cooking while not in a hurry and listen to music and chat while doing so. Generally they have a meat stew of similar, which all family members like. Around once a month Lisa and Mick invite friends or family to join them for Sunday lunch, and they and their children are similarly invited to others for a Sunday lunch around once per month. In the afternoons the parents and three younger siblings often go to the local park for a walk and to go to the playground. Michael tends to stay at home, using his computer. On occasion he also meets friends in the local park or shopping mall. When we does this his parents set clear rules, such as that he is not allowed to go to specific areas in the park that they perceive as dangerous because of others drinking and using drugs. The parents also ask Michael to be back at a specific time and sometimes contact him by phone to check where he is and what he is doing. Michael accepts these precautions, saying that his friends have comparable conditions for going out alone.

***The family's interest in technology***
The family's interest in technology warrants specific consideration as it is not only an all-pervasive part of their lives, but also an interest they all explicitly referred to during interviews and conversations. Most prominently, all family members enjoy music, and their home mostly has music playing from a small radio in the kitchen or a larger stereo in the sitting room. Michael also often plays music in his room on his phone, and the younger children have a small CD player that they use to play CDs and listen to the radio. Nine-year old Pearl expresses this enjoyment as follows:

'*We all like music. My mom loves this and dad that, my older brother is into this… There's all kinds of music, this and that, but you know we just all love music so we have it on all the time.'*
(Daughter Pearl, 05.01.2017)

In addition, the mother, Lisa states that they all enjoy music programmes on TV, such as 'Britain's got talent', or 'Dancing on ice'. Music is an important part of family life that they enjoy together, and to which even the younger children can contribute. It is related to technology in that the family have two keyboards at home on which they store, play and sing with music. One keyboard is in Michael's room, which he uses to play and digitally alter songs. It is a hobby that he has had for many years, and which he shares with his family and several friends. Michael is often engaged in several music activities simultaneously, and often links up various technological devices. Michael's interest in music constitutes an interest in technology:

'*Often I'm listening to music on my phone and also playing some tune on the keyboard, I'll try and find beats that go with the songs on the phone. Sometimes I also use this app to check for songs in different keys… There are lots of cool things you can do with musical devices, there's lots of music technology out there that is sick.'*

(Son Michael, 05.01.2017)

The family's other keyboard is in the sitting room, and is used by the parents and younger siblings. Lisa uses it primarily to play songs, whereas Mick also uses it to digitally alter songs in a similar manner to Michael. The younger siblings often play around on the keyboard, using the microphone to dance and sing along to pop songs or add instruments to the music playing in the house. None of the family members have had piano lessons or other forms of music tuition beyond what they are exposed to at school. Rather than associated with learning to play an instrument or reading music, the family's enjoyment and interest in music relates to their use and appreciation of the technology around them:

'*We're all into music. We like listening to music and messing about on the keyboards and phone. Michael also uses his computer a lot. There's lots of opportunities to play around with sounds on our devices… We've not had any lessons or anything, it's more fun, we just enjoy it rather than wanting to learn an instrument.'*
(Father Mick, 05.01.2017)

A second important aspect other than music related to the family's interest in technology are mobile phones. Both parents as well as Michael have mobile phones, and all three use their phones for a wide range of activities, including social media, instant messaging, news, music and playing games. Lisa states how their phones are essential to communicate with others, and stay up-to-date with current affairs, as well as engage in leisure activities such as music. She and her husband wanted to give Michael a simple smartphone in the summer holiday before the start of Year 7, as part of his transition to secondary school. However, Michael wanted a specific smartphone and spent almost one year in the lead-up to the summer holidays saving money he received for his birthday, for Christmas and from some chores such as washing the family car to purchase such a phone. Michael wanted this particular smartphone because of its additional functions:

'*My phone can do more things than the old thing my parents wanted to get… It has quick detection and access keys to all the stuff I want. It's just a better phone… It's got much more RAM and much better speed! I've been reading up about different functions and all that, it's cool, you've got to have a look at all the things some of the phones can do.'*
(Son Michael, 02.08.2016)

Michael is clearly interested and knowledgeable about various smartphone functions and associated technologies. However, being in possession of a particular phone is a status symbol, in that such a phone is appreciated and admired by others, giving him access to a desired social group:

'*I want a phone that looks good, like other people will like it too, it's got to look good so I can also be part of friends who have a cool phone… I don't want to lose out because I have a crap phone, it's just not cool.'*
(Son Michael, 02.08.2016)

His parents, in contrast, focus on the practical purposes of Michael's phone. Lisa says that it is important for Michael to have a phone so that he can be contacted. She explains that the

use of mobile phones with her son and her husband give her a sense of security, and that without mobile phones she would not be happy for Michael to go out with friends unsupervised. However, while Lisa stresses the safety aspect of having mobile phones within the family, she is also keen to highlight the social value that can sometimes be overwhelming and 'addictive'. With specific respect to Michael, she is concerned about him spending too much time using his mobile phone, which she believes has negative consequences for his interactions within the family, face-to-face socialising outside of the family and education. As directly expressed by Mick, Michael's mobile phone use is associated with him isolating himself from other family members, leading to on-going frustration and sometimes arguments between him and his parents:

'*Michael uses his phone to retreat into his own little world, often just looking at his phone and not talking to us. I think it's a bit addictive and it annoys us all, it can be quite frustrating… Sometimes Lisa and I have arguments with him: we ask him not to use his phone so much, but he just keeps on using it.'*
(Mother Lisa, 02.08.2016)

Both parents are unsure about what amount of time and what situations are acceptable for Michael to use his mobile phone. They are aware of the potential benefits of phones for doing school work, such as looking up information online, and a Whatsapp group that Michael says he uses to chat about homework. However, both parents express doubts about the benefits of Michael using his phone to the extent that he does:

'*I just feel out of my depth with his (Michael's) phone use. I don't know what he uses it for. Is it for school or what is he doing? It's important to use for school but it's not all about that… He's isolating himself and doing all kinds of things on it. I don't know when and where and how much he should be using his phone.'*
(Mother Lisa, 02.08.2016)

These parental uncertainties about Michaels' phone use resonate with other accounts in the literature documenting how parents and their children, in particular adolescents, often have different views of acceptable amounts of technology use (Vaterlaus *et al.*, 2014). The literature also highlights how, reflecting Lisa's explanation above, parents feel uncertain and uncomfortable about what their children are doing on-line (Alvarez *et al.*, 2013).

A final important element related to technology in the Taylor family's household is Michael's interest in gaming. As previously stated, when Michael comes home from school he generally spends time interacting with his games console. Michael says gaming is a hobby that he enjoys for reasons that he says he cannot explain easily, but which appear to be associated with immersion into different virtual words. In addition, Michael enjoys gaming because it is an activity that his friends enjoy too, but also because he can play alone at home rather than having to engage with his family. It can be said that Michael enjoys gaming partly because it is an activity that provides opportunities to retreat from family life around him at home:

'*My friends all like gaming too, we play together sometimes and we talk about it at school… I also like it at home by myself, it's not what the others (family members) do, I just do it by myself and that's nice to get away.'*

(Son Michael, 02.08.2016)

As with his interest in mobile phones, Michael's interest in gaming relates to his overarching interest in technology in that he reads about latest games and their technical specifications on various websites, and in that he talks about these specifications with his friends:

'*I just like the technology of gaming. There are so many cool things about it, like you can see how the characters move and how the different layers work. It's all interestingly designed.'*
(Son Michael, 02.08.2016)

Gaming, including the technology of gaming, is an interest shared with his friends rather than his family, and it is clear from comments by his parents that they are at times bewildered and annoyed by the amount of time Michael spends gaming. In contrast to the previously explained use of mobile phones, his parents do not think of gaming as a necessary part of Michael's life, or as something that could be a useful skill or interest. Gaming is an activity that his parents discourage, which has been associated with conflicts with Michael:

'*I don't get the gaming thing, it can't be that interesting but he (Michael) spends so much time gaming. It's not useful to be able to game, and I don't see that it can be that much fun either… I tell him to limit it constantly, but he just doesn't. I can get quite annoyed, and he's got angry at me too. It's definitely a sore point, but what can I do? I can't control him, but I do hope it's a phase and he'll find something more useful to do soon.'*
(Mother Lisa, 02.08.2016)

Overall, all Taylor family members share an interest in technology with respect to music, but Michael's interest and very frequent use of mobile phones and gaming is also a point of tension between him and his parents.

***The family's views and interaction with science, The Science Museum and the 'Building Bridges' project***

When I first asked the Taylor family about what they think about science the mother, Lisa, looked at me curiously, then laughed and stated:

'*We don't look like we're thinking much about science, do we? We're busy and get on with our little lives.'*
(Mother Lisa, 03.05.2016)

Then, after a brief pause she added:

'*The kids do science at school, I'm not sure what Pearl does, but Michael does biology, chemistry and physics.'*
(Mother Lisa, 03.05.2016)

Her son, Michael, agreed that the family does not have hobbies or interests related to science. In a manner that reflects views about science documented in Section 7.3 from the parent focus group, the Taylor family characterise science primarily as related to school, and do not think of themselves as engaged with science during their everyday lives or science being

something that they might find interesting. In addition, again as views expressed by parents, the Taylor family unanimously spontaneously describe science as 'difficult' while simultaneously recognising the achievements brought about by science:

'*Science is really difficult, it's given the world many inventions and great achievements. My little brain couldn't cope!*'
(Father Mick, 03.05.2016)

As already stated in Section 7.3 such findings are common across the literature. It is interesting however, that Michael spontaneously states that technology is part of science, but that this kind of science that the family is interested in differs from science at school:

'*Technology is a part of science. We're all interested in technology, but it's very different from the science at school… we don't write things down or have to learn anything, we're just having fun.*'
(Son Michael, 03.05.2016)

Michael's comments with regard to the differences between his family's interest in technology and science at school extend to his views of the Science Museum and the 'Building Bridges' project. Prior to taking part in the project, Michael had visited the Science Museum twice with his primary school and once with his family three years ago. Lisa explains that this family visit to the Science Museum was organised by a local community centre that she often went to while on maternity leave with the twins. Michael says that he remembers going to the Science Museum but cannot remember what they did there. Similarly, Lisa is somewhat unsure about where in the Museum they went, saying that she remembers only the many lights and sounds, and that they attended a show at the Museum with the community centre group. Overall, Lisa describes this visit in positive terms, but as an activity that was specifically organised by the community centre, rather than an activity that her family initiated. Lisa has never considered visiting the Science Museum on her own accord, primarily because she thinks of the Museum as a place most suited to organised group visits.

'*The community centre organised the visit, they suggested this show that we all went to… I'd say that the Museum is more for educational groups to learn about science, I wouldn't know where to go and what to do. It's better to come as a group on an organised visit.*'
(Mother Lisa, 03.05.2016)

When asked, Lisa and Michael both agree that an app that guides families through the Museum and suggests which galleries to visit and activities to take part in might support a potential visit to the Museum. Michael is keen on the idea of using his phone while in the Museum, being guided to specific exhibits based on his interests, and being able to access information that is relevant to his schoolwork. Based on his previous experiences using apps, Michael has high expectations of such a potential app, such as the inclusion of augmented reality:

'*It would be very cool to have an app that presents how people might have used the objects, like how they flew the rockets and things… You could be able to develop your own way around*

*the Museum or suggest things for other people to look at because you thought they were good.'*
(Son Michael, 05.01.2017)

Michael's mother Lisa is also initially keen on the idea of an app to support families' visits to the Science Museum, primarily to engage older children and teenagers. However, she also highlights that this age group is notoriously difficult to engage in museum visits. She notes that while Michael was keen to join the visit to the Museum three years ago, he would be unlikely to want to join such a visit now. Michael himself agrees with this sentiment, saying that he prefers to engage in activities without his parents or younger siblings, if possible. In addition, he stated that the 'Building Bridges' family event would most likely include activities akin to those that are part of science lessons or the school visit to the Museum. Michael, in a similar manner to his parents, associates the Science Museum with science at school rather than his interest in technology. Based partly on these views expressed by Michael, the Taylor family did not come to family event:

'*I don't really like the idea of going there (Science Museum) with my parents and siblings, I prefer doing things with my friends… I'd be doing the things there in science lessons anyway, and we did the things at the Science Museum too. I wouldn't need to go to the Science Museum again with my family.'*
(Son Michael, 05.01.2017)

Michael liked the 'Try This' booklet and had briefly shown it to his parents. However, they had not done any of the activities, citing time as the primary reason. In addition, as with respect to the family event, Michael stated that he would be doing the activities with his teachers at school and therefore did not see a need to engage in the activities with his family. On the whole, Michael places the 'Building Bridges' project firmly in the realm of school, rather also as a potential part of his family life. His mother, Lisa, agrees in that she is positive about the project as an enrichment activity at school, but does not see it fitting into their family life:

'*I think the project is good because it gives the children enrichment… The Science Museum is a good place for schools to take children. I think it's better for the school to take them (children) to the Science Museum and do the activities. It fits with what they're doing at school.'*
(Mother Lisa, 02.08.2016)

***The family's accompanied visit to the Science Museum***
When I asked Lisa whether the family would like to visit the Science Museum with me she immediately said '*yes*'. The visit took a while to organise, which is indicative of the family's busy schedule. But, eventually we found a suitable Sunday in August (2016), which was a date after the family event that the Taylor family did not attend. The son, Michael, also immediately agreed to the accompanied visit, saying that he wanted to see some of the things that had been part of the family event. He had heard about the family event from other pupils, and was somewhat disheartened when I explained that most of the activities at the event would no longer be available at the Museum, but that other activities would be. Nonetheless, Michael agreed, possibly in part because I suggested that we have lunch together in one of

the Museum cafés, and that the family would not have to pay for this. Nine-year old Pearl was invited to a birthday party, and the father, Mick preferred to relax at home.

I meet the family at South Kensington underground station, and when walking to the Museum from there Lisa remarked how smart it is. The family seemed at ease and enjoyed the sunny morning, with the twins walking along the pedestrianised road chatting away, while Michael and Lisa talked about a film they recently watched together on TV. On approaching the Museum Lisa and Michael somewhat abruptly stopped talking, and waited for me to take the lead in walking to the door. Their sense of being at ease changed and they were both disconcerted by the entrance gates and asked me which queue they should join. Lisa walked behind me, ushering her children in and quietly telling them to stay close together. In a later interview she said that she does not remember the entrance gates from her previous visit, and did not see a sign stating how much to pay. It is evident that the entrance gates are not only disconcerting to her, but also reinforce the family's previously documented views that the Science Museum is most appropriate for organised visits rather than individual families:

'*For groups you'll get ushered in, but if you're a family it's not so easy at the gates. I think it's better if you're part of a group with someone who knows where to go.'*
(Mother Lisa, 14.08.2016)

Beyond the entrance gates, the family again expected me to take the lead, this time in suggesting where to go. I asked if there is any particular part of the Museum they would like to see. Michael was excited about the IMAX film but this turns to disappointment when he and Lisa realised the associated cost. Lisa was quick to ask me what parts of the Museum are free of charge, and studied the Museum map to understand which galleries are associated with a cost. In a later interview she explained that she had thought all of the Museum was free, and that she should have checked before coming which activities are not.

After explaining to the twins that the IMAX film is too expensive, Lisa suggested that we walk along the ground floor to see the Space gallery. The gallery is of some interest to the twins who marvelled at the size of the rockets overhead. Lisa spoke to the twins about the rocket and other items on display, and in doing so referred to the giant globe and a model of a space man in the gallery as 'statues'. As noted in Section 9, another family also referred to objects in the Museum as 'statues'. This is interesting as most people who are familiar with museums would arguably refer to such items as 'objects', with the term 'statue' being reserved for works of art that depict a human or other animal figure and that are generally larger than life. There is no precise distinction in the literature between an 'object' and a 'statue', but overall the latter term is often referred to as a subcategory of the former. While further research on visitors' conceptualisation of objects and statues in science museums is needed, I suggest that families in this study referring to statues in the Science Museum is at odds with current language used by museum professionals, researchers and regular visitors. The use of the term 'statues' thus highlights these families' difference from such individuals and illustrates how they do not always conform to or know the norms and unspoken 'rules' in the Museum. Families in this study used different reference points than others. While this difference does not necessarily pose a barrier, it does contribute to some families feeling out of place at the Museum and that their ways of speaking and thinking are fundamentally at odds with content

and the presentation of content. Consider, for example, Lisa's response to my question what objects, statues and interactives at the Science Museum might be:

'*I'm not so sure, they're words I don't use much. What do they mean by something interactive? It says that it's an interactive gallery here* (on Science Museum map)*. Something you can touch? Statues you can't touch. I think that's a difference. I think that objects are things that the people use in life, like a table is an object, but I don't really know.'*
(Mother Lisa, 14.08.2016)

While in the Space gallery Michael spent most of the time looking at his phone, and later says that he already came to the gallery on the school visit. I suggested that we visit a gallery on the second floor, hoping that some of the exhibits associated with technology there might capture the family's interest. However, the twins were already approaching the Pattern Pod gallery, and enjoyed the lights there so much that Lisa preferred to stay. Michael continued to look at his phone, and declined my offer to visit another gallery with him. Lisa was clearly torn between staying in the Pattern Pod gallery and going to another gallery that might be more appealing to all the family. She studied the Museum map, but was uncertain about which parts of the Museum are most suitable for families. After some thought and after asking me, Lisa suggested visiting the Energy gallery because Michael was interested in the large ring that the family saw when entering the Museum. However, Lisa had difficulty finding the Gallery, and after around ten minutes of searching for the gallery, Michael said he no longer wanted to go there. I decided to quickly guide them to the Gallery, but as soon as we arrived there the twins seemed tired and Michael was hungry.

Unexpectedly, Lisa said that she had sandwiches for us all that she wants to eat on benches outside of the Museum. While she had previously welcomed the idea of having lunch in the café, free of charge for the family, Lisa had changed her mind before coming to the Museum because she was not sure if the cafés would be suitable for the twins. She was uncertain about the overall appropriate conduct in the café, including the behaviour of her children, where to queue, when to pay and where to sit:

'*I'm not sure about going to the café with the twins. I'm not sure if they'll sit still and be good, they can get a bit restless and I don't want other people there to be disturbed.'*
(Mother Lisa, 14.08.2016)

Michael was a little annoyed by his mother making sandwiches and stated a preference for the café food. I therefore suggested that he and I buy some additional foods and drinks in the café while Lisa and the twins wait for us in the Energy Gallery. Having purchased the additional supplies we left the Museum to eat and drink on a bench outside, as suggested by Lisa. The twins greatly enjoyed the mime artists performing there, and Michael was immersed in his phone. Lisa talked to me about various things, and it was clear from the overall mood of the family that they were not keen to return to the Museum.

Overall, the accompanied visit was similar to other accompanied visits documented in the literature in that families struggled to find their way around the museum, were uncertain which parts of the museum were suitable for them, did not perceive many elements in the museum to directly connect to their prior interests and experiences, and felt in many ways

different to other visitors (Archer *et al.*, 2016b). With particular respect to the cost of visiting museums, Dawson (2014) outlines how under-represented audiences, such as those from minority ethnic backgrounds and low SES statuses, did not experience visits to museums that did not charge an entry fee as 'free' of charge. For example, costs associated with visits to these museums included travelling there, buying food and drinks in cafés, as well as gifts in shops. Dawson outlines that it is difficult to avoid some of these costs, and that such costs can inadvertently provide signals to some under-represented audiences that museums are not 'for them'.

A finding from the present research that adds to the prior documentation of accompanied visits in the literature is that taking part in the 'Building Bridges' project was not associated with the Taylor family feeling more inclined to or confident in visiting the Science Museum. Rather, for this particular family, the project had the effect of situating the Science Museum clearly as part of the son's time at school rather than family time. While the Taylor family did not attend the family event, the provision of such an organised event for families further supported this view, as is evident from Lisa's comment at the end of the accompanied visit:

'*I enjoyed today, but it was also very tiring and difficult to know where is best to go… I think next time we'll come along to the organised event… We should have just gone to the family event, it's better if it's organised for families so that they know where to go and what to do… It's a bit of a jungle otherwise, so it's clear they (Museum) want you to come with a group or special event.'*
(Mother Lisa, 14.08.2016)

## 10.2 Miller family

***Background to Saint Joseph's school and surrounding area***
Saint Joseph's is a co-educational Church of England secondary school with academy status that opened in 2009, and has a specialism in science. It is located in the Royal Borough of Kensington and Chelsea and its buildings received an architecture prize in 2010. The population of the borough is multicultural and multilingual. At the 2011 census, the borough had a population of 158,649, which consists of 71% White, 10% Asian, 5% multiple ethnic groups, 3.4% Black African and 2% Black Caribbean. Figures released in 2013 found Kensington and Chelsea to have the greatest imbalance between high and low earners, with the borough being home to some of the most expensive residential districts in the world, as we well as having districts with high levels of social housing and poverty (London's Poverty Profile, 2013).

Many of Saint Joseph's pupils live in the housing estates surrounding the school, some of which are newly built and some of which are older estates. Housing is of great concern in many areas of the borough, which includes long waiting lists for social housing and overcrowded accommodation (London's Poverty Profile, 2013). There is a considerable amount of building work in immediate proximately of the school, this work consisting primarily of commercial developments.

The proportion of pupils from minority ethnic heritages at the school is high. The number of first languages spoken other than English is extensive, and many pupils only learn English during their primary and secondary school years. The proportion of pupils known to be eligible for free school meals is high. Ofsted judged the academy to be 'outstanding' in 2014, and with specific reference to the school's science specialism highlights that the school helps students to develop and apply independent enquiry skills, and inspires students to develop a deep curiosity beyond exam content. The school's mission statement includes a vision of the science specialism as encouraging all students to develop an understanding of the importance of the global and local ecological, environmental and ethical impact of science.

***The family's home and identity as 'religious, spiritual people'***

The Miller family consists of the mother Sandy, her 12-year old daughter Vanessa, and her two-year old daughter Polly. They are of White British origin, with Sandy also describing herself as '*born and bred in London*', '*a proud single mother*' and '*working class*'. Sandy's mother lives in Essex, and Sandy has no contact with her father. She has one sister who lives in Manchester with four children, and one sister who lives in London with no children. While Sandy speaks in positive terms about her mother and sisters, she is also explicit about having only fairly little contact with them, and does not generally draw on them for help and advice, or to socialise.

Sandy and her two daughters live in a two-bedroom flat on a council estate, which Sandy has lived in since her eldest daughter was three years old. The estate is surrounded by quiet residential streets with expensive terraced housing, and larger streets with several expensive furniture shops and restaurants. Sandy states several times that she is extremely grateful to live in her current flat as she has many close friends on the estate and considers the flat and the estate to be her '*home sweet home*'. On first meeting Sandy she shows me around the estate, pointing out a small shop, a café and a launderette that she frequents. We meet several people on the estate whom Sandy knows, and when we have a cup of tea in the café the waiter immediately greets her by name. Sandy is known and liked on the estate, and her social life and that of her children is primarily based here. She says that the estate is where she spends almost all of her time as she feels safe and valued here. This contrasts with her experiences in the roads surrounding the estate, which she describes as '*very different because there are lots of posh people and posh shops that we don't ever go to*'.

The estate that the family live in is closely connected to their identities as '*religious, spiritual people*'. Sandy explains that the most important part of the estate is a small Salvation Army building that is their '*church and spiritual home*'. It is a place that she visits almost every day to take her younger daughter to a playgroup held there and to chat with friends and the vicar. Sandy also explains that the vicar and other people who attend the church are a great source of support, information and guidance to her, including related to choosing a secondary school for her older daughter, as will be explained later. The family regularly attend a Sunday worship and other religious services and events at the church. Religion and spirituality is not only extremely important to the family, but also an integral part of how they see themselves and how they want to be seen by others:

'*We're religious, spiritual people, it's who we are at our core. We don't just practice religion, we're very spiritual in what we do, and I try to show that to other people around us... It's very important to all of us.'*
(Mother Sandy, 16.12.2016)

Sandy invites me to visit a Sunday service at the church, which demonstrates the importance of this setting not only for Sandy to socialise and access information and support, but also to have deeply meaningful experiences. On entering the church Sandy and Vanessa touch a Maria figure located in one corner of the church, with Sandy then spending some time standing in front of the figure with her eyes closed and frequently touching the figure and smiling. On a visit to the family's flat, Sandy shows me a small wooden Maria figure there that she has placed above her bed, saying that it is a gift from her grandmother when she was a young adult. Her late grandmother, maybe more than her mother, is an important person in Sandy's life, introducing her to religion and spirituality. The Maria figure is not only a symbol of Sandy's religion and spirituality, but also a connection to her grandmother and associated family identity:

*'My grandmother was very spiritual and introduced me to religion when I was very young… She gave me Maria, and now when I'm in her (Maria's) presence I'm instantly connected. I can feel my grandmother, and it's like I'm with her again, I feel quite calm and happy.*'
(Mother Sandy, 16.12.2016)

Sandy's engagement with the Maria figure at church, and most likely also similar experiences she has at home can be framed as luminous or flow experiences. Latham (2013) describes luminous experiences as a nod or beckoning from the gods. Latham (2013) explains how objects can 'pull' people in and serve as a connection to the past, or a portal to the meaningfulness of the past. Such an experience is linked to feelings of satisfaction and delight that are often very personal. Similarly, Csikszentmihalyi and Robinson (1990) describe the sensation of flow as a psychological state of optimal experience, which can be elicited through objects. For example, flow experiences can be associated with a person intensely focusing their attention on an object, absorbing the object in their mind, and, in the process, loosing attention of their surroundings. The person may ascribe human qualities to the object, such as that the object is aware of their presence. Sandy's engagement with the Maria figure is clearly deeply meaningful and important to her. She not only intently focuses all her attention on the Maria figure in the church, but also says that she sees happiness in the figure's face when she spends time with her. This deep connection is important as it serves as a focal part of Sandy's life and the family identity that she wishes to pass on to her children:

*'My time with Maria is very holy to me. It's really a big part of my life, and the children know that already… I'm hoping that they will engage in the same way when they're just a bit older.*'
(Mother Sandy, 16.12.2016)

While Sandy engaged with the Maria figure, Vanessa sat with her younger sister. Sandy then joined them and they all sat to listen to the vicar speak, joining in with prayers and songs. Following the service Sandy and her daughters spoke to the other people there. They were all at ease, laughing and chatting, and sharing small biscuits while leaving the church. Following this service, which is generally attended by around 20 people, Vanessa joined a

small Sunday school run by the vicar in an adjacent small room with three other children aged between 6 - 14 years. Vanessa enjoys the Sunday school, describing it as a place that she feels very at home, as well as being understood by the other children and vicar.

When I asked Vanessa if she would describe herself as very religious, she hesitated and then said that she is '*more than just religious, I'm also spiritual*'. She explained that she and her family do not follow a specific set of religious rituals or guidelines, but rather that they are '*spiritually aware in everything we do*'. Sandy explicitly set her family apart from other people who visit church only for specific celebrations, such as Christmas or Easter, and to socialise rather than for religious or spiritual beliefs:

'*There's a lot of people out there going to church because they want to celebrate, like Christmas or Easter or a nice wedding. But they're not spiritual, they're not even religious. They want to socialise, and they do things like buy new clothes to come to church and look good... We're spiritual and go to church to connect with spirits and prey.'*
(Mother Sandy, 16.12.2016)

Vanessa extended her mother's comments by offering the following description of her school in relation to her family's identity as religious and spiritual:

'*Lots of schools say they are religious but actually they're not. They just say that, but people there don't believe. At my school, there's not many people who are even religious, and none of the class are spiritual like us. I think they just sometimes like to be religious, like going to church for Christmas because it's nice.'*
(Daughter Vanessa, 16.12.2016)

Religion is an all-pervasive part of the family's life, and played a significant part in deciding Vanessa's secondary school. There is a primary school immediately next to the estate that she went to, along with all other children from the estate. In contrast, the choice of secondary schools was more difficult:

'*All the children go to the primary school here, you don't have to choose or anything. It's right here… For secondary schools its more complicated. You have to go round and have a look at the schools and think about what you want for your child. There's lots of information that you can read on the Internet and you can go and see, but who knows what they show you? It's quite confusing, I can't rely on that. People here have children in many different schools… A friend here told me about Saint Joseph's, she doesn't have a child there but she heard it was good. Then he (priest at the estate church) recommended it. He said it was a good place so we went with that.'*
(Mother Sandy, 09.08.2016)

Sandy's comments regarding the influence that the vicar had on the school choice for Vanessa are indicative of the importance of local networks that the family draw on to make important decisions. Sandy is somewhat suspicious and perplexed by information regarding secondary school choices and places more value on local networks, such as the vicar and people she trusts in the estate. It is particularly telling that Sandy had never visited the school before Vanessa started there, has only been inside once since, and did not know that the school had

a science specialism. For her, the school is clearly recognised as an important part of Vanessa's everyday life, but not a place that she feels inclined or able to be part of, placing her role instead firmly within the estate, particularly the church:

'*The school is of course a big part of Vanessa's life, and that's important. But it's not where I go, it's not for me to share that part of her life. My life and our life together as a family take place here (in the estate) and especially in our church.'*
(Mother Sandy, 09.06.2016)

While Sandy is clear that the school is not part of her everyday life, it is important to highlight that she is very ambitious for Vanessa, and that Vanessa herself shares these ambitions. Vanessa responded to my question about what profession she would like when she grows up with '*nurse, doctor or teacher*', and was quick to explain that such professions require having good grades at school and working hard. Her mother encourages good grades and working hard:

'*My mum is always telling me to work hard and get good grades at school… I know that I'll need good grades to get a good job and my mother wants me to get a good job so she's encouraging me to read my school books and do my homework.'*
(Daughter Vanessa, 09.06.2016)

These ambitions are associated with the family's religion and spirituality:

'*I think that you should try and do the best you can, you shouldn't just be sitting around, but you should be helping others and trying to do good. I want to work hard to be a nurse and help others. It's part of what my religion and our spirituality guides us towards doing the best we can.'*
(Daughter Vanessa, 09.06.2016)

As explained below, these ambitions shape the family's routines.

***The family's routines***
On weekdays the Miller family get up at 7.30am, have breakfast together, and then Vanessa leaves for school at around 8.30am. While Vanessa is at school Sandy does household chores, including shopping, cooking, cleaning and washing clothes. During the summer of 2016 the family's washing machine had broken so Sandy was washing the family's clothes in the launderette that is part of their estate. Sandy said that the washing machine is old, difficult to repair and that she is unsure when they will be able to afford a new one. While Sandy spends time doing these chores Polly often plays, watches television or accompanies her mother on errands outside of the house. Sandy also makes a point of spending time playing with Polly and taking her to playgroups that are held in the Salvation Army building on the estate. Sandy explained that this is important for Polly's intellectual, social and physical development, including her language acquisition and her overall curiosity. Sandy is ambitious for her younger daughter and views her development as influenced by parental actions:

'*Taking her (Polly) to playgroups and spending time really playing with her are important. She will learn and develop better, and she'll do better at school later on. I really want her to do well, like what I want for Vanessa too.'*
(Mother Sandy, 09.06.2016)

These comments and others, demonstrate that Sandy's views of parenting align with what can be termed 'concerted cultivation' in that she believes that her parenting actively shapes her child's development (Lareau, 2003). Sandy's views with respect to this aspect of parenting differ from those voiced by parents in the focus group outlines in Section 7, and shape her views on science and the 'Building Bridges' project outlined later.

When Vanessa arrives home from school at around 4pm, Sandy has prepared a snack, such as biscuits, a muffin or toast for the family to have together. Sandy explained that this is an important time of day when she asks Vanessa about her school day, including what homework she has. As previously mentioned with respect to Polly, Sandy sees herself as having an active role in her daughters' education, and has ambitions for both to succeed at school. She believes that such success is gained by working hard, in particular by paying attention during lessons and completing homework carefully. When I asked Sandy about how activities beyond those set by the school might be important for her older daughter's learning and academic achievements she said that she prefers to focus on learning activities set by the school because she does not think she has the knowledge needed to engage in less structured learning activities:

'*If you work hard you get good grades and do well, you can go to university and get a good job… I prefer to stick with what the school says. I don't know about the subjects enough to do anything unstructured with Vanessa so it's better to follow the teacher's lead.'*
(Mother Sandy, 09.08.2016)

While Sandy is keen to help with Vanessa's homework, this is neither an easy feat for her nor for Vanessa. It appears that Sandy's efforts to support Vanessa are becoming increasingly incompatible with Vanessa's wish to become more independent. While Vanessa is keen to achieve highly at school and mentioned her ambitions to go to university several times, she is also clear that her mother's efforts of support are unhelpful:

'*She (Sandy) tries to help with my homework, but it's difficult. She doesn't know what we're doing at school and it's annoying to have to talk about it all the time. I want to just get on with it, and not talk about it all the time. I think, yeah, she wants me to do well and that's great, but she's not helping. I don't want her hanging over me like I'm a small child.'*
(Daughter Vanessa, 09.08.2016)

Vanessa frames her own ambitions as associated with her religious beliefs in that she views such beliefs as guiding her towards striving to achieve highly in life. However, Vanessa also highlights the challenges of such ambitions in that she describes them as being somewhat incompatible with being popular at school:

'*I'm a believer in myself. We're a religious family, and we've always tried to do the best we can. I'm trying my best at school and want to do well. I think it's important to do well even if*

*you don't have so many friends and aren't so popular… I really want to have lots of friends, it's what it's like at school: everyone wants to have friends. But really, when you're older you just want a good job, and I want to be faithful to my religion, so it's important to do well at school.'*
(Daughter Vanessa, 09.08.2016)

As for pupils in the pupil focus group outlined in Section 8, Vanessa places importance on having friends. However, she believes this to be of lesser importance than doing well at school and her identity as religious and spiritual.

After completing her homework Vanessa spends time using her phone, such as watching short clips on Youtube, messaging her friends or listening to music. She also plays with Polly while her mother prepares dinner. They all eat dinner together at around 7pm, subsequent to which Sandy brings Polly to bed while Vanessa generally spends time using her phone, watching TV and relaxing. Vanessa goes to bed around 9.30pm, and her mother at around 10.30pm.

Vanessa does not take part in after school clubs, with both herself and her mother stating that it is preferable to spend more time on homework rather than after school activities. I will explore these opinions as part of the families' views of science and the 'Building Bridges' project below.

On Saturdays, the family does not have a scheduled set of activities, often spending the morning relaxing at home, then spending time outside on the estate or going to a local park by bus. In addition, Vanessa sometimes goes to birthday parties or meets friends. If this is the case Sandy brings Vanessa to the party venue or place where she is meeting friends. As already indicated, Vanessa is becoming more independent, which includes spending time with friends at the weekends without the presence of adults. Sandy is happy for Vanessa to do this, but has clear boundaries for where Vanessa should be and when she should return home. Vanessa and Sandy agree that these arrangements work well.

As already outlined, the Miller family attend a church service on Sundays, which is followed by Vanessa attending a Sunday school. Subsequently the family have a large family meal that Sandy prepared in the morning. Every first Sunday of the month people who attend the church share a meal there, with everyone bringing food. Sunday afternoons in the Miller household generally involve watching TV and playing with Polly.

Around once every three weeks Polly spends the weekend with her father who lives a 30-minute drive away. Sandy and Vanessa have less contact to Vanessa's father. He occasionally phones and sends cards and money for Vanessa's birthdays and Christmas, but does not regularly visit. On weekends that Polly is with her father Sandy and Vanessa engage in activities that they would not if Polly was with them, such as going to the cinema or spending longer time with friends on the estate, including having dinner together in their or their friends' houses.

***The family's views and interaction with science***
Sandy stated that science is a very important part of Vanessa's education at school, and she highlighted that the reason for taking part in the present research is because she hopes it will

help Vanessa in science lessons at school. However, while both Sandy and Vanessa realise that science is part of learning at school, they both express uncertainties and contradictions about how engaging with science might form part of their everyday lives. On one occasion Sandy said that she is interested in how science relates to religion and spirituality, and on another occasion she stated that science is not something that she wants to learn about because it is so complicated. Focusing first on Sandy's interest in how science relates to religion and spirituality, she has a collection of books related to the science of spirituality. She also asked me on several occasions for my 'scientific' views about the existence of spirits and life beyond planet earth. Similarly, Vanessa stated that she is certain that scientists will discover '*intelligent life*' on other planets. These family interests made for interesting discussions, and highlight how the Miller family's identities as a religious and spiritual family could connect to an interest in science, given appropriate support.

However, on a subsequent occasion when explicitly asked how science might be part of their everyday life Sandy and Vanessa stated that science is '*difficult*', '*not easy to understand*', and '*not something that we (family) talk about*'. Reflecting views voiced by both parents and pupils in the focus groups (see Sections 7 and 8), Vanessa and Sandy placed their engagement with science firmly as part of school, rather than also as part of family life:

'*We (family) don't talk about science normally at all… I do science at school and for homework assignments, so then we might talk about it, but not otherwise. It's a school subject or what people do at work, like scientists, but not something families or friends talk about.'*
(Daughter Vanessa, 16.12.2016)

With respect to science at school, Sandy stated that Vanessa is interested in science lessons at school, in particular lessons that focus on plants and nature. It is evident that Sandy has encouraged such interests, mainly because she aspires for her daughter to do well at school, and recognises that doing well in science is an important part of this. Vanessa, initially agrees, saying that she enjoys learning about nature and, in particular, animals. However, she later backtracks and stated that she does not like science much. While she could not give a specific reason for this, her comments point towards a disconnect between her perceptions of the kind of person who is interested in and 'good' at science, and her perceptions of herself and associated aspirations. While Vanessa is academically ambitious, even to the extent of stating that it is more important to do well at school than to spend time socialising, as previously noted, she does also not want to be '*nerdy*':

'*I don't like science lessons, they're tough and nerdy and there are some really geeky boys who are all into maths and science… I'm not that kind of clever. I prefer like English and PE and other things at school too… There are girls who are into science, they are very academic and are really clever. They're just different… They have lots of friends who are into science too, and parents who like that kind of thing. I think there's a girl in Year 8 whose father is like a professor.'*
(Daughter Vanessa, 09.08.2016)

Vanessa's views of people who like science, and her disassociation from these people corresponds to prior research that teachers, pupils and parents in primary and secondary schools often make associations between science and 'cleverness', and that social class and

gender influences such associations (Archer *et al.*, 2013; Carlone, 2003). Carlone (2003) found that US secondary school teachers often made links between science and being clever in a way that reinforced gender stereotypes of science being 'male'. For example, Carlone explains how teachers spoke about boys being more naturally able at science, even though girls tended to achieve higher grades. Archer *et al.* (2013) highlight how social class plays a part in these associations between science and perceived cleverness. Archer *et al.* suggest that expressions of femininity amongst UK working class and lower-middle-class girls in Year 6 underlines the distance between themselves and science in a way that is not observed amongst middle class girls. Science for these working class and lower-middle-class girls is 'unthinkable' because it is associated not only with being male and 'clever', but also with exhibiting characteristics that are apart from their class origins. On the other hand, girls from middle-class backgrounds are more likely to develop and sustain aspirations related to science by drawing on their families' practices, values and science capital (Archer *et al.*, 2016a). Clearly, based on this research, there is a complex set of interacting factors that influence perceptions of being able to achieve highly in science as improbable for some children, even if they might enjoy science.

I would argue that Vanessa enjoys science but, as girls in the research by Archer *et al.* (2013) and Carlone (2003), resists overtly engaging with science at school and beyond because it does not fit with the image she has of her family and friends, and it does not fit with the image that she aspires to create for herself. As already noted, Vanessa's mother, Sandy, tries to encourage her daughter's engagement with science at school, but her efforts are largely in vain. As outlined below, one reason for this limited success is associated not only with the family's somewhat restricted views of science, but also with their perceptions of how experiences beyond lessons can form part of learning science. As a final point for this section, it is noteworthy that the contradictions expressed both by Sandy and by Vanessa with respect to science also highlight the importance of research that goes beyond one-off encounters to understand the complex views of how science relates to families' identities.

***The family's views and interaction with the 'Building Bridges' project***

Sandy and Vanessa's views of science pave the way towards their views of the 'Building Bridges' project in that they speak about the project exclusively in terms of learning science at school, unless explicitly asked. Sandy is very positive about the project, stating that she hopes it will encourage her daughter to do well at school, and that it will show her the importance of science at school. However, in itself she does not link the project to her daughter engaging with or understanding science that is relevant to her academic achievements, based on her restricted views of what science is:

'*The project is great. I think it can make her (Vanessa) more interested in science at school… I wouldn't say that what they do on the project, like from the book and the visits and things, is about the science that she does at school. I think it's quite different from what I can tell.'*
(Mother Sandy, 09.08.2016)

Sandy spontaneously mentioned the 'Try This' booklet, stating that she likes the booklet and has done the banana activity with her younger daughter Polly. She stated that it is a fitting activity for children because children often like bananas and it is a common, easily available and cheap fruit. Vanessa also likes the booklet, but has only completed the activities that

were part of her school preparing for the Science Museum visit, namely taking apart an alarm clock. She enjoyed this activity, but said that it is markedly different to ordinary science lessons at school. Overall, while Vanessa enjoyed the project, in particular the trip to the Science Museum and the outreach shows at the school, she expressed a clear divide between the project and science lessons at school. Vanessa likened the project to an after school or holiday club that is fun but not directly related to learning during lessons, a statement that her mother agrees with. Based on this view, and her previously noted ambitions to achieve highly academically, Vanessa focuses on homework set during lessons rather that information and activities provided as part of the project:

'*What we do at school in science is very different to what the project is about… In the project there were all the shows and we got to do lots of things... In school we don't do that, it's more like sitting around and learning. The project is more like an after school or holiday club, it's not that relevant to getting good grades so I'd rather do the homework.'*
(Daughter Vanessa, 09.06.2016)

The Miller family attended the 'Building Bridges' family event, in part because I explicitly invited them and said that I would be there. Vanessa had already visited the Museum with her school as part of the project, and had also previously visited with her primary school. When I first meet the family Sandy stated that she and Vanessa had also once visited together a few years ago. However, Vanessa cannot remember this, and Sandy later said that they might have visited another science museum in London, but is unsure which one. Sandy also came to visit the Science Museum as part of a school visit when she herself was a child in the 1980s, but never came with her parents.

The Miller family had no problems getting to the family event and were engaged in a bag-printing activity when I saw them at the event. Sandy and her two daughters were creating the print together and liked the occasion. Reflecting findings from other families at the event (see Section 9), Vanessa stated that she most liked the food and drink, in particular the ice cream. She also highlighted that many of the activities were exciting, novel and interesting to her, this being particularly true for the planetarium and making virtual reality headsets. The family enjoyed engaging in these activities together as a family, felt welcomed at the Museum and at ease with taking part because the event suited their interests and needs:

'*The event is full of fun, interesting science that we can do together. We've enjoyed it all. The Science Museum really feels like a welcoming place and we can just do what we liked without feeling like we have to do anything or people trying to tell us what to do.*'
(Mother Sandy, 13.07.2016)

However, in accordance with their previously noted views, the Miller family viewed the 'fun, interesting science' they encountered at the event as inherently different from activities that might take place during science lessons at school or that might be relevant to such lessons:

'*I don't think anything here this evening is about the science that Vanessa does at school.'*
(Mother Sandy, 13.07.2016)

While Vanessa stated that some activities at the event do relate to science lessons, overall she has a similar view to that of her mother that the event does not provide explicit links to science lessons:

'*There's no real connection between the activities and what we do in science lessons… We've never made headsets or seen a planetarium during lessons. It's just not something that you do in lessons, there's no connection.'*
(Daughter Vanessa, 13.07.2016)

The Miller family stayed together during the event, and, according to their own recollection, did not interact much with other families at the event. Vanessa stated that she saw one other family from her school, but did not spend time talking to them. In addition, while Vanessa took some photos with her phone in the planetarium and also in the gallery that the event took place in she intends to look at these mainly by herself or with her mother and sister, rather than also with friends. For Vanessa, as for Sandy, the event is primarily an occasion for her immediate family in that she does not make links to experiences at school or her friends. The Miller family did not see the display at the event featuring work done by pupils on the project, including Vanessa's class. Sandy said that she did not realise that there was such a display at the event, while Vanessa did not think it would have been very interesting for her mother and sister.

***The family's accompanied visit to the Science Museum***
As outlined above, the Miller family felt welcomed and at ease during the family event. Based on these experiences they were keen to take part in an accompanied visit with me to the Museum on another day.

'*It was nice to come (to the family event) so we'll definitely come again!'*
(Mother Sandy, 13.07.2016)

The accompanied visit took place three weeks after the family event. At Sandy's suggestion I met the family at the main entrance at 10am. Sandy took the lead in walking through the entrance donation barriers without hesitation. When I later asked her if she thinks that these barriers might be disconcerting to some visitors she agrees, saying that many visitors might feel compelled to pay a donation or not know how much to pay. For Sandy, however, the barriers are simply part of arriving at the Museum and do not indicate that a donation is required to enter.

Once inside the Museum Sandy picked up a map and spent some time looking at it to find something that is of interest to her. She then asked me if there is something in the Museum on religion or spirituality. I suggested visiting the 'Who am I' gallery as Vanessa said that she had visited this gallery with her school and is keen to visit again. At their request I guided them to the gallery, and on the way, while I was speaking to Vanessa, Sandy asked a security person for the nearest toilets. On arriving at the gallery, Sandy handed out sandwiches as snacks to eat, without hesitating to think whether it may not be permitted to eat there. In contrast to the Taylor family, the Miller family's visit was not marred with the same insecurities and uncertainties about behaving in a certain way. But, as explained below, their

visit is nonetheless shaped by misunderstandings about the Museum's 'rules of the game' and an inability to meaningfully connect their 'funds of knowledge' to the Museum content.

Sandy, Vanessa and Polly all enjoyed the lights at the entrance to the 'Who am I' gallery, with Polly jumping around, and Sandy and Vanessa smiling. Sandy then moved over to the exhibits, looking at several objects and reading the associated information. Meanwhile Vanessa walked over to the interactive displays, briefly engaging with several of them, including the exhibit 'What sex is your brain?'. This exhibit asks visitors a series of questions that supposedly indicate whether their brain is 'male' or 'female'. Vanessa duly answered the questions, and when the final score allegedly revealed that she thinks more like a man than a woman she expressed her annoyance to me and her family:

'*Why is it saying that I'm a man? My brain isn't like a man's! How stupid, it's a silly thing to say… What do the questions have to do with it anyway?'*
(Daughter Vanessa, 02.08.2016)

In response to her daughter's frustration, Sandy read parts of the exhibit and explained to Vanessa that men and women think differently so their brains are different. However, Vanessa had already disengaged, walking off and looking at her phone.

Approximately a month later a media discussion arose around this exhibit, which several people, including journalists and scientists providing similar criticisms of the exhibit to those provided by Vanessa[8]. When I informed the family that Vanessa's disapproval of the exhibit reflected comments made by several scientists, Vanessa was largely uninterested and Sandy simply said that her daughter '*didn't understand the exhibit, and I couldn't explain it*' (29.09.2016). The Miller family's experiences at this exhibit and their subsequent reflections on these experiences indicate how Sandy is unwilling and unable to critique information provided in the Museum, taking it as a definitive source of authority rather than an opportunity to discuss and reflect on information:

'*There's lots of scientists working with the Science Museum so they'll know the right information. It's just a fact of science, if you like it or not. I don't think it's right for us to come along and think we know better.'*
(Mother Sandy, 09.08.2016)

Such comments indicate the challenges faced by Museums and other settings to encourage a more critical reflection amongst visitors of information rather than simply taking it at face value.

Overall, the outlined views and the activities of the family's visit illustrate Sandy's overarching confidence in situations that she is unfamiliar with. However, in a similar manner to the previously noted ambitions for her daughter to achieve highly at school, such confidence does not always translate into what she herself describes as '*success*':

[8] See, for example: https://www.theguardian.com/world/2016/sep/14/science-museum-under-fire-exhibit-brains-pink-blue-gender-stereotypes

'*I'm really a confident person, even in new situations and places. I don't feel I have to pay a donation, and I ask for directions if I'm lost. But I still didn't get the success I wanted in the Museum. I can come here to the Science Museum and try and find something that's interesting, but I couldn't explain the information to Vanessa… It's not easy for me there.'*
(Mother Sandy, 02.08.2016)

In addition, the family's visit is shaped by differences in perceptions between Sandy and Vanessa. While Sandy is confident during the visit and not easily disconcerted, Vanessa is very aware of the social situation, often appearing uncomfortable with her mother's actions and ways of talking. In addition, at several other exhibits in the 'Who am I' gallery and elsewhere in the Museum Sandy provided brief comments or attempted explanations of content provided to both Vanessa and Polly. At times Vanessa simply did not respond, but at other times she noted '*that's not what you're meant to look at*', '*that's not for young kids*', and '*it's better if we go on*'. There are several occasions during the visit when Vanessa felt awkward and uncomfortable as a result of her mother's behaviour. In a later interview Vanessa stated:

'*Sometimes my mum is really annoying… In the Museum she kept on trying to explain things and did all the wrong things. It's embarrassing.'*
(Daughter Vanessa, 09.08.2016)

While such comments could be passed off as typical adolescent views of parents, they also point towards how the family were unable to blend in at the Science Museum and play by its 'rules of the game'. As outlined in Section 2, Archer *et al.* (2016b) suggest that some families do not understand the 'rules of the game' in museums, such as that they are unsure which objects and exhibits one is allowed to touch, and whether it was necessary to remain quiet. Even the overt confidence presented by Sandy did not prevent the family from feeling 'different' to other visitors, in terms of being unable to explain information presented and how to talk and behave in the Museum.

In an interview with the family around four months after their accompanied visit to the Museum I asked them whether they think that a Museum app would have helped their visit, and could encourage and support future visits. I suggested that such an app could include maps of the entire Museum space with suggestions of routs around the Museum for different visitor groups. In addition, I suggested that the app could provide questions, games and information tailored to families to do in the Museum. Sandy and her daughter Vanessa are both keen on this idea, suggesting that an app would be an enjoyable part of a visit to the Science Museum. Vanessa is already familiar with many types of apps, using them for example to chat with her friends, share photos and play games. Sandy suggested that Vanessa might use such as app in the Museum by herself to access more information than she as a mother would be able to provide, in particular when accompanied by her younger child. In addition, Sandy highlighted that her younger child might spend most of the time looking at the app rather than at objects and information in the Science Museum. While she does not have quite the same apprehension with respect to her older daughter, Sandy voiced some scepticism about the idea of introducing yet more technology into their lives:

'*I do think that we all use so much technology already, I'm not sure if I really want more. Do we really need an app in the Museum? I'm just not sure*.'

(Mother Sandy, 16.12.2016)

## 10.3 Kelly family

***The family's house and surroundings***

The Kelly family consists of the mother Siobhan, the father Greg, and their three daughters: 17-year-old Sian, 16-year-old Aileen and 12-year-old Chloe. Siobhan speaks of herself as a '*full time mother*', and she sometimes takes on part-time administrative work to cover for other people's holiday leaves in the garage where her husband works as a car mechanic. The three daughters attend Christ Church secondary school. The background to the school and the surrounding area was described earlier in Section 10.1. The Kelly family live very close to the Taylor family, but not on the same estate. The children of the two families know each other, but not very well. The parents of both families said that they did not know each other.

The Kelly family's home is a three-bedroom terraced house with a small garden at the back. The house is part of a larger estate with terraces and taller buildings with flats. The older daughter, Sian, has her own bedroom, while the younger daughters, Aileen and Chloe share a bedroom. Sian is in her final year at school and plans to take up an apprenticeship in hairdressing when she finishes school, and move out of the family home, if possible financially. 16-year old Aileen is looking very forward to taking over Sian's bedroom. However, the mother Siobhan explained that it might not be possible for Sian to move out of the family home immediately when she finishes school because of the very high cost of doing so. Siobhan hopes Sian will be able to take up the desired apprenticeship and eventually move out of the family home when she had sufficient money to do so. Until then Sian can stay in the family home, and have her own room as she does now. Siobhan was very clear that as long as her daughters are in education or training they do not have to pay rent, but that she would expect them to pay some rent, expenses or food once they earn enough money. Sian highlighted that she is very lucky to have understanding parents:

'*I'm very lucky because my parents wouldn't just say: you have to move out or pay rent if I don't have the money… They know it's hard and expensive and I want to move out but it might be difficult because of money.'*
(Daughter Sian, 03.08.2016)

***The family's identity as 'Irish'***

The family describe themselves as 'Irish', and have a strong identity associated with being Irish even though none of them have lived in Ireland. However, the parents of both Siobhan and Greg were brought up in Ireland and moved to England in the early 1970s. Siobhan and Greg have visited Ireland a few times, once with their two older daughters. 12-year old Chloe has never been to Ireland, but also describes herself as 'Irish' based on her family's ancestry:

'*I'm Irish because that's where my family are from, my grandparents lived there.'*
(Daughter Sian, 03.08.2016)

The parents state that being Irish means being hard-working, and they are both keen to stress that they have always earnt money rather than relied on support from the state. Siobhan said

that her husband has a '*good job*' and can support his family. In addition, if needed, such as if her husband was laid off or had a pay cut, Siobhan would take on more work. Both she and Greg are clear about the importance of earning sufficient money for themselves and their daughters, and they frame this view as differentiating them from other families:

'*The Irish are hard-working people. I mean*, *Greg's got a good job, he works hard in the garage and he can support our family… We'll never want to rely on the state, I wouldn't do that... There's lots of families that take lots of state handouts and I don't want to be like that.'*
(Mother Siobhan, 03.08.2016)

Linked to the family's identity as being 'Irish' is their description of themselves as 'Catholic'. However, they do so to distance themselves from other families who are Muslim, Hindu or Anglican rather than to associate themselves with other Catholics. For example, the family do not regularly visit a Catholic church or socialise with other Catholics. When asked if they are religious, they said that they are '*a bit religious*':

'*I think we're a bit religious. We're Catholic because that's what Irish people are. There are lots of Muslims and Hindus around here, on the estate and at the school too… The school is actually Anglican. We're different to that too because we're Irish Catholics.'*
(Daughter Sian, 20.07.2016)

The mother, Siobhan mentioned a series of coffee morning and classes for parents at Chloe's primary school that she was invited to last year because Chloe received pupil premium. Siobhan attended one coffee morning, but did not feel comfortable there because the other parents were from many different ethnicities, spoke different languages and identified with different religions than she does. Despite the effort put in by the teachers, she did not know what to talk about and felt somewhat isolated and out of place at the coffee morning. Siobhan suggested that the teachers and the school as a whole try to learn about and be inclusive towards various religions and ethnicities, but that being 'Irish' or 'Catholic' does not feature in their considerations.

Chloe expressed a similar view of herself as different to others based on being Irish and Catholic. There are no other Catholics in her class, and while she has many friends at school from different backgrounds her family will always be her '*best friends*'. She highlighted the difference between her family and others at the school in a manner that reflects her mother's views:

'*I've got friends from all different backgrounds at school, there's lots of families with heritage from all different countries and religions… We're quite different because there's no other Catholics or Irish in my class so my family are always going to be my best friends.'*
(Daughter Sian, 20.07.2016)

Overall the family can be described as rather insular in that all family members prefer staying at home and socialising amongst themselves rather than also with other people. Their identities as 'Irish' are a means to frame this preference.

***The family's routines***

The family weekday routines centre around the daughters' school days and Greg's work. Their mornings start at around 7am when they get up and have breakfast together. All three girls generally get up by themselves. Siobhan, the mothers, makes a packed lunch, generally sandwiches, fruit and biscuits for Greg and the girls, who all leave the house around 8am. It takes Greg around 50 minutes to get to work on two busses. The girls walk to school in around 15 minutes. The parents are happy that all daughters are now at the same school so that they can walk together. Siobhan spends time cleaning the house, doing laundry, ironing, shopping and cooking while her children are at school. She also sometimes reads lifestyle magazines and watches some TV, if she has time.

None of the girls are enrolled in after-school activities, with them all saying that they prefer to come home to relax and do homework. Based on their different timetables, they do not finish school at the same time so they walk home with friends or by themselves. The mother describes all her daughters as '*very sensible*' and is happy for them to walk home alone and use their mobile phones if they have any problems. 12-year old Chloe has had a mobile phone for about one year, and since this time she has been walking to school without her parents, first to the local primary school and now to the secondary school.

When the girls come home Siobhan spends some time talking to them to find out about their day. This is sometimes difficult, particularly with her youngest daughter, Chloe, who is often reluctant to say much about what she did at school. Siobhan remembers her older daughters being similar at this age, and says that starting at secondary school is a big change and that it takes time for children to adapt, meaning that they might not initially talk much about their experiences. Siobhan accepts this and does not push her daughter. However, she is strict with homework in that she expects all her daughters to complete their homework straight after school so that they do not get distracted with television or their phones. Siobhan does not generally help with homework, stating that she would not be able to and that it is good for her children to take responsibility for their own learning:

'*Starting secondary school is a big deal, it's a big change. Sian doesn't say much about her day when I ask about school… It's ok, I don't push her on that, but I'm strict with homework. I'll get her to do it right after school, they all (daughters) have to.'*
(Mother Siobhan, 20.07.2016)

Siobhan often prepares dinner during the day when her daughters are at school, but leaves the actual cooking for when her daughters are at home in the late afternoon. All daughters enjoy cooking with their mother, and this is an important time for Siobhan to speak to her daughters about healthy eating and for her daughters to learn how to cook. When Chloe was ten years old her primary school sent a letter home from the school nurse saying that Chloe was overweight. Since then Siobhan has made a large effort to cook healthily, such as replacing chips with mashed potatoes. Her daughters are all very aware of their weight, for example by saying that they are '*a bit chubby*', and '*want to lose some weight*'. Siobhan tries to focus her daughters on healthy eating and steer them away from eating disorders that she has seen some other teenagers in the neighbourhood suffering from. The older daughter Sian speaks about the pressures on girls to be slim and that some of the other girls at the school have taken medication to reduce their weight. Siobhan is worried about her older daughters'

thoughts about weight and aims to focus all daughters on being healthy rather than their weight:

'*I want them to be healthy, to be happy and eat healthy food, not think about their weight all the time. Sian and Aileen worry about their weight all the time, I'm trying to focus them all on eating healthy things.'*
(Mother Siobhan, 20.07.2016)

The father, Greg usually comes home at 6.30pm, and the family then sit down for a family meal. In addition to preparing and eating meals, the main family times for socialising during weekdays are watching television after dinner in the living room. They enjoy a range of television programmes, including those that can be described as including a focus on science, such as medical and crime programmes. I will speak about the families' views of science and the extent to which science features in their everyday lives in the subsequent section.

While the girls sit in the living room watching TV they also simultaneously use their phones to chat with friends from school. They also continue to use their phones for chatting and engaging with social media when they go to their bedrooms at around 9.30pm. At this time the parents generally continue watching TV and relaxing. They generally do not go out on weekday evenings or have friends over. Siobhan and Greg say that they are unsure what their children are chatting about with their friends, and why their children seem to prefer chatting with their friends on social media rather than talking to them in person at school. However, neither parent is very concerned about their children's mobile phone use, with Greg on one occasion explicitly stating that most other teenagers use their phone more than his daughters do, and that his daughters '*aren't getting up to anything strange on their phones*'. Siobhan expresses this view with regards to her daughter's phone use:

'*I've no idea what they're doing with their phones really, I've no idea about the different apps and what they're using at the moment. Phones are a big part of their lives, they use them all the time. If they get on with their school work ok, and they do sit down and eat with us and talk then it's fine, I don't mind (them using their phones).'*
(Mother Siobhan, 03.08.2016)

Chloe explained that her phone is important to socialise with friends, to stay up-to-date with events and that she also uses it for homework assignments. She said that most people of her parents' age do not understand the importance of mobile phones for young people:

'*I use my phone all the time for everything. I speak to my friends, I check what's happening, and I use it for homework too… Most people who are my parents' age don't use their phones so much, they don't understand that young people need it all the time.'*
(Daughter Chloe, 20.07.2016)

The Kelly family have three cats, which feature heavily in their everyday lives. On a visit to the family's house the father was sitting watching TV while stroking two of the cats, and Chloe was rolling a ball back and forth to the third cat. The family enjoy playing with and caring for the cats, such as buying small toys for them, preparing their food, and building a scratching post. One year ago one of the cats had kittens, and the family took joy in watching the kittens

grow and develop. They even weighed the kittens regularly and wrote down their weight in a notebook to make sure that the smallest kitten was getting sufficient milk. On occasion Chloe would hold this smallest kitten to make sure she got priory access to the mother cat's milk. The mother, Siobhan explained that having pets gives her a sense of calm, and companionship during the day when Greg and the girls are not home. She also thinks that pets are a good way for her daughters to learn about animals, and show compassion and commitment in looking after them.

The family's weekend routine is shaped by spending time relaxing and doing household chores that are not done during the week. For example, the mother, Siobhan '*catches up on household work*' during the weekends, such as doing laundry and cleaning. Overall however, the Kelly family spend their weekends relaxing, such as watching TV, reading, and listening to music. In addition, the mother cooks with her daughters during the weekends. As already noted, the mother is keen to cook with her daughters as a social activity, for them to learn to cook and also to encourage them to be healthy. At the weekends there is more time, and the mother uses this to cook more elaborate meals that the daughters enjoy making:

'*There's more time for cooking at the weekends, so we do that too. We cook more complicated things than during the week. My sisters and I and my mum enjoy it a lot!'*
(Daughter Chloe, 20.07.2016)

The older sisters also sometimes spend time with their friends at the weekends away from the family, visiting local shopping malls, going to the park or '*hanging out*'. The parents and the older sisters have established clear boundaries and rules to be able to do this. For example, the parents set a specific time for the daughter to be home by, and have also stipulated where they do not want their daughters to go. The daughters observe these regulations and conflicts are rare. The younger daughter is only just starting to spend time away for adult supervision, and this has included one or two hours with friends in the park or at a local ice skating rink. She said that her parents are fairly relaxed about her going out by herself, a feature that she believes is based on her parent's experiences with her older sisters. As previously noted, the Kelly family can be described as rather insular with all family members stating that they enjoy spending time at home rather than going out.

On addition to spending time relaxing indoors at the weekends, the family also enjoy spending time outdoors gardening. While cooking is primarily an activity shared amongst the mother and the daughters, gardening also involves the father:

'*We really all enjoy gardening. It's quite funny because I don't think that many people in my year are into gardening. It's not something many of my friends are into. But we love it, in the good weather we can all go out into the garden and enjoy it for hours. My dad loves it too and keeps getting new seeds and things from colleagues at work.'*
(Daughter Chloe, 20.07.2016)

Around once a month the mother's sister visits, generally with the two youngest of her four children who range in age from 13 to 20 years. On these visits the family have lunch together, talk and sometimes do gardening or go to the park. The mother, Siobhan, does not mention her sister as a specific source of information or guidance, but it is nonetheless clear that she

speaks to her sister about issues that are of concern to her. For example, they speak about which mobile phones are best for teenagers, and what food is good to take on a packed lunch. When I ask if her sister helps or guides her, Siobhan said that this is the case because she has four older children:

'*She's got four children... They are a bit older too so she's got a lot of experience and thoughts on everything with the kids. She's helped with mobile phones for the kids, I hadn't got a clue about that a few years ago.'*
(Mother Sian, 03.08.2016)

***The family's views and interaction with science and the Building Bridges project***
The Kelly family's views of science reflect views of many other parents in the project, as outlined in findings from the parent focus group (see Section 7). The family think about science primarily as a school subject, which all three girls describe as being '*difficult*' and '*for the clever people in the class*'. The parents echo these views, such as by the father saying that science is '*complicated*'. As already outlined, the Kelly parents encourage their children to take responsibility for their own schoolwork, and they give this as a reason for not regularly helping with homework. It is noteworthy, however, that the parents explicitly state that they would not be able to support their children with science homework:

'*I'd be completely lost with their (daughters') science homework. There is no way I'd be able to help with that.'*
(Father Greg, 03.08.2016)

Science is not an overt interest that the family have, or an activity that they seek out, neither together nor individually. When asked to what extent engaging with science might feature as part of gardening or caring for animals, all family members agree that these activities are related to science to varying degrees. However, when talking about their own engagement with gardening or caring for their cats they consistently frame these activities as not related to science. These views are summed up by 12-year old Chloe:

'*There's science involved when we're gardening or looking after the cats, but it's not real science like we do in school. We're not so interested in science. It's not something we think about at home, and I don't think we really expect to find it in our lives at home.'*
(Daughter Chloe, 03.08.2016)

Such views are reminiscent of accounts by Zimmerman (2012) who outlines the case of a teenage girl who is engaged in various activities and interests that could be viewed as related to animal science, but who characterised her activities and interests as 'caring for animals', and consistently denied any relationship to science. While various aspects, including gender and age, may have contributed to these findings, Zimmerman's research demonstrates how people may re-frame their science-related activity as non-scientific. In contrast to these views that caring for animals or gardening are not 'real' science, the academic literature generally does frame such activities as 'everyday' science talk in that they are infused with normalised expectations and beliefs about the world. These may, for example, include the belief that animals belong to particular groups, have babies, and need food (Ash *et al.*, 2007).

The Kelly family's views of science featuring in their lives primarily as part of the daughters' education at school shapes their views of the 'Building Bridges' project. The family does not think of the project as being intended for families, or that they, as a family, might understand, relate to or enjoy the information and activities provided. For example, the parents were aware that the 'Try this' booklet is intended for families to engage in science activities together, but they felt it more appropriate for Chloe to do the activities at school with her teachers. This parental view is partly based on the increasing independence of Chloe, which includes the expectation that she completes schoolwork by herself, and the view that science is not part of the family's lives or interests:

'*I think it's better for Chloe to do the activities (from the 'Try this' booklet) at school… The teachers know what they're doing, and I think it's better for Chloe to get on with her schoolwork independently from us (parents). I'd also say that science just isn't something that we're interested in as a family.'*
(Father Greg, 03.08.2016)

The Kelly family did not attend the family evening event that was part of the 'Building Bridges' project, the reason given by the parents being that Chloe had already visited the Science Museum with her school. Both parents explained that Chloe's visit with her school would be a more fruitful learning experience as the teachers would be able to explain the content provided and relate it to learning at school. Neither parent viewed the Museum as a setting in which their family might spend time.

Chloe herself has similar views, and did not explicitly ask her parents to go to the event. She suggested that it would not have been interesting to her parents, and that, as a family, they would not have known what to do or what to talk about, and would rather stay at home. Chloe also directly stated that her parents would not feel comfortable in the Science Museum as they have never been and would not know what to do. When I asked Chloe what might entice her family to visit the Museum she stated again that her parents would be unsure of what to do, and would not enjoy the experience. For these reasons Chloe herself would rather visit with her school friends and teachers.

The family politely declined to come on an accompanied visit to the Museum, giving reasons similar to those that they provided for not attending the family event. Overall, the Kelly family view science, the Science Museum, and the 'Building Bridges' project as part of the realm of school, to which they have little connection as a family, and do not see potential for such connections to be established. There might, however, have been potential to engage the family with the Museum a few years earlier:

'*A few years ago I might have begged my parents to go to the Science Museum, to take me there to play with the all the exhibits and things, but not now… I'd rather go with my class. It would be a bit embarrassing with my parents, they'd be so out of place.'*
(Daughter Chloe, 20.07.2016)

'*If Chloe had been really keen on going on the event ('Building Bridges' family event) I would have gone with her, and I think Greg might have too. But she wasn't that bothered. To be honest I don't think she really wanted us to go.'*

(Mother Siobhan, 20.07.2016)

## 10.4 Gomez family

***Background the family, the school and surrounding area***
The Gomez family consists of the mother, Maria, and her 11-year old son Fernando. They are the only case study family in this research who are regular museum visitors. They are of South American decent, with the mother having lived in London since she was 12 years old. They speak Spanish and English at home, and the mother encourages her son to speak Spanish as this is beneficial for his education at school. The family live in a two bedroom flat in a high-rise building in Southwark that is close to a busy junction and has a bus stop directly in front. The mother, Maria describes the family's home in very positive terms:

'*We're very happy to live here. It's brilliant because we have a bus stop from where we can take busses all over London*.'
(Mother Maria, 28.06.2016)

Maria's parents live around a half-hour bus journey away, in the flat that she grew up in with her two older sisters. The family's house is a five-minute walk from the school that Fernando attends. The school, called Saint Mary, is a Catholic co-educational secondary school that was graded as 'outstanding' by Ofsted. It became an academy school in 2012, was modernised throughout in 2014, and describes itself as having strong moral values and a traditional approach to discipline. Around 52% of the approximately 830 pupils on role at the school do not speak English as their first language, and around 44% are eligible for free school meals.

***The Gomez family's routines***
The Gomez family's day starts at 7am when Maria gets up to make breakfast and wake her son Fernando. They have breakfast and leave the house together at 7.45am. Maria catches a bus to work from directly outside the house, while Fernando walks the short distance to school by himself. Maria has worked as a teaching assistant at a primary school for the past two years. The school is located around 40 minutes by bus from her house, and she starts work at 8.30am and finishes at 3.30pm. She enjoys her work, and speaks about it being rewarding to see children grow and develop. Currently she is working with children in a reception class, in particular with two children who do not yet speak English. This and other work as a teaching assistant has made Maria realise the importance of children's home lives for education at school, a realisation that has influenced her everyday life with her son:

'*From my work as a teaching assistant I can really see how the children live at home. What their parents do is so important for them, what they can understand and do at school… I really try and take some of it on board for Fernando. Even at his age it's important to connect what he's doing at school with our home life… I try to talk to him about school every day, what he's done at school, what he learnt, what homework he's got*.'
(Mother Maria, 28.06.2016)

Maria started working as a teaching assistant when Fernando was three years old, based on her interest in children and education. Prior to Fernando being born she worked at an estate

agent, and was then not in employed work for three years after Fernando was born. She described this time as difficult, in part because of the relationship breakdown to Fernando's father. Finding interesting work that allows her to spend some time with Fernando in the afternoons was '*a blessing*'. Maria and Fernando currently have no contact with Fernando's father, for which Maria tries to compensate for, such as by offering Fernando varied learning opportunities. Maria has a broad view of learning that includes experiences in everyday life:

'*Fernando's father isn't around so I try to make sure I do all the things a mother does and all the things a father does. I talk to Fernando about football because he likes that, about his computer things, and just generally try to make sure I've done as much as I can to help him develop and learn*.'
(Mother Maria, 07.07.2016)

Fernando attends a breakfast club at school. As he prefers to eat at home he normally engages with various activities rather than eating the toast and cereals on offer at the club. These activities include board games, drawing, and varying projects that the pupils can engage in on a weekly basis. Fernando enjoys taking part in these projects, and has several friends at the breakfast club with whom he completes them. Of most interest are projects that focus on technology, such as building a small solar panelled car or re-wiring an old computer. Fernando explained that such projects do not directly relate to regular school subjects, but are often of relevance. These views illustrate Fernando's broad conception of learning that mirrors his mother's, and which differs from the views of many other families in this study:

'*I like the things with technology at breakfast club best. We once did a project where we built a car from scrap metal and Lego with solar power. That was very cool… I don't think the club is related to the school subjects, but you can learn a lot and it's all important for learning at school.*'
(Son Fernando, 28.06.2016)

Fernando spends most of the regular school hours with two other boys who are this best friends and with whom he also attended the local primary school. They are all interested in technology and, according to Fernando, are often seen as '*geeky*' by other pupils. Fernando's mother Maria outlines that these friends are interested in learning in a same way that Fernando is, and that she is happy that they continue to be friends at secondary school. While Maria does not know the boys' families well, she has met their parents on several occasions and said that they come from '*good families*'. Maria tries to foster the connection between Fernando and these boys in part to keep him away from other groups of pupils whom she describes as being uninterested in school and '*trouble*'.

Fernando's favourite school subjects are science and music, both of which his best friends also enjoy. Three times a week Fernando attends after-school activities at the school, which are a football, a guitar and a science club. Fernando also played football at his primary school, but has only started learning guitar in Year 7. The school run a programme for pupils to borrow guitars to learn at home, an offer that Fernando has taken up. Maria encourages this instrument learning, and has borrowed several books from the local library on how to learn to play the guitar. While she has not regularly practiced the guitar herself, she has learnt a view chords and tries to help Fernando by listening to him play. Similarly, Maria regularly

engages with her son's science and football club, such as by asking questions, donating material, and attending football matches.

On the three days that Fernando attends after-school activities his mother Maria meets him at the school and they walk home together. Maria enjoys coming to the school, often spending some time looking at the displays presented in the entrance hall, and speaking to the receptionist and, on occasion, other parents. Around once a month she also goes into the rooms where the after-school activities are held so see what the pupils are doing and speak to the supervisors, some of whom are teachers. This engagement allows Maria to understand what her son is doing and talk to him about it more:

'*If I can see what Fernando is doing at school, if I can be there and talk to some of the pupils or see what's displayed at the school I can understand it all better, and I can talk to Fernando about it more*.'
(Mother Maria, 28.06.2016)

On the days that Fernando does not attend an after-school club he walks home by himself. He generally eats a snack, and then spends time relaxing, doing his homework, listening to music, practicing guitar or playing games on his computer. He also chats with his friends on social media, although he tries not the spend too much time doing this. When his mother gets home she cooks, and they eat together at around 7pm. Afterwards they sometimes watch a film or read. Maria keeps the time immediately after dinner free from household chores to spend time with Fernando.

On weekends the Gomez family sleep in, and have a late, drawn-out breakfast that often involves treats, such as croissants or buns. Maria and Fernando then often go to cultural events across London, which Maria has spent time during the week searching for. I will outline the family's museum visiting in more detail below.

On Sundays Maria and Fernando visit Maria's parents who live around 30 minutes away. Sometimes these trips include attending a church service, on the initiative of Maria's parents. Maria herself is not very religious, but her family background is Catholic, and she said that it is important for Fernando to learn about Catholicism and attend church services. Maria is happy that Fernando's school is Catholic, with an emphasis on Catholic values and discipline, but she would have sent him to another school if the local Catholic school had not been a '*good*' school.

Fernando used to really enjoy spending time with his grandparents, but has recently sometimes said that he does not want to join his mother on these trips. In line with the views of all other parents in this study Maria outlined that Fernando is becoming increasingly independent. While she would like Fernando to continue to visit his grandparents with her, Maria acknowledges and accepts her son's growing independence and described it as a normal part of adolescence. With respect to her and Fernando's visits to museums, however, she provided a somewhat more nuanced account, which illustrates the importance of these visits as 'special time' with her son that she would like to preserve and which she would rather not include others in:

'*I think it's really important for Fernando to come and see his grandparents. But I can see that he's becoming more independent, he's said a few times now that he doesn't want to come every week... That's fine, it's part of becoming an adolescent… We've been going out together to museums and events and things all his life, mainly on Saturdays. I think he still enjoys that, I'd feel really sad if that special time stopped, if he didn't want to do that with me any more… He might ask for a friend to come but that would change our special time together*.'
(Mother Maria, 15.12.2016)

***The family's identity as museum visitors***
As noted, the Gomez family are regular visitors to museums, cultural events and similar activities in London. The mother, Maria, regularly searches for activities to take part in with her son:

'*I spend some time during the week looking into what's on in London. I look at different websites, and I've subscribed to some things, and I pick up leaflets or write things down when I see things in the places that we go to… After a while you start to know what's on where. At the moment the Southbank Centre has a lot of things for children that we like. If we don't like something we'll not go again. It doesn't matter, it's not a big deal… I'll filter for free activities, and there's a lot. We take the bus there, even if it takes a while. I have a bus pass and I'll always bring food and drink and things we might need… It doesn't cost us hardly anything*.'
(Mother Maria, 07.07.2016)

Maria has become accustomed to searching for family events and museums since Fernando was born. She never visited museums with her parents, and cannot remember visiting a museum with her school either. She first visited a museum when Fernando was a baby, a time when she was not working, and started appreciating the free events and museums London has to offer:

*'I was alone with him, and not working, and had a lot of time. I didn't have much money but I did have a bus pass so I thought I can use that to get to places around London… That's how it started. I just went to the London sights: to St Paul's, or past the parliament. When Fernando was a toddler he loved nothing more than being on the top deck of the bus… I remember in winter going to Tate Modern with him for the first time. It was just this huge place for him to run around. I think it wasn't until he was maybe four or five that I started looking into what's on, and actually planning a visit… Now I'm working and I try to be organised, I'll look things up to do and book them if necessary.'*
(Mother Maria, 07.07.2016)

Prior to regularly visiting museums Maria visited a local library when Fernando was a baby. The interaction with the staff there provided her with the information and confidence to visit museums. It appears important to Maria that the library staff were familiar with the Gomez family's local area and circumstances:

*'When Fernando was a baby, a tiny baby I pushed the pram around here, there's not many places to go. I went to a small local community library. I'd never been before, I'd not heard about it. I didn't borrow a book or anything at first, it was more just a place to go with a baby… One day I was chatting and one of the people working there said that there are museums that*

*are free and great to go with a baby. I don't think I would have thought about going otherwise. I didn't know they were free, but also I wouldn't have thought they are good for me with a baby, it's not the kind of thing I had on my horizon… The thing was that the lady knew who I was, she knew the area I live in, that I was a single mother with no job. And then I thought that if she thinks I should go, I'll give it a try.'*
(Mother Maria, 15.12.2016)

The Gomez family have an identity as 'museum visitors' in that they view themselves and are viewed by others as interested and somewhat knowledgeable about visiting museums. Maria and Fernando said that their friends and family do not go to museums, and that this has created some divisions in that she and Fernando do not fit in easily with some friends and family. In addition, Maria also draws distinctions between her family and middle-class wealthier museum-visiting. Overall, it can be said that Maria has built up the 'capital' to go to museums with her son. But, even though the Gomez family have become museum-goers, they are still subject to the socio-cultural norms that render museum-going as middle class. Maria outlined that this is one reason for why some families do not feel comfortable in museums, and might not consider it as a place to visit. In Maria's eyes, visiting museums is a middle-class habit that simple does not feature as a possibility for many other families. It is not a place these families could image going to:

*'I'll sign Fernando up for events and things at museums, most are free. Most people around here, their kids just go to school. Then that's it, they just come home and watch telly and do homework… They don't do much else in the holidays, they're not interested, not even in the free things. Their kids just sit around and play by themselves. My friend and I were talking about what our kids would be doing in the summer holidays… I said that Fernand and I would go to a museum or two, that they have activities for kids in the summer… She said "oh, that's posh, isn't it?" I'd say we're different to most families who come to museums. They don't have to think much about spending money there, and they have all their friends and family coming to museums. For them, visiting museums is normal, it's just what they all do. It's different for us because we're the only ones round here who go. Most people just wouldn't think it possible to go, like there is some kind of invisible fence stopping them. Even if they know it's free they wouldn't go.'*
(Mother Maria, 16.08.2016)

In a similar manner to the other parents in this study, Maria is aspirational for her son, such as by wanting him to go to university and get a '*good*' job. However, in a somewhat different way to most other parents, Maria places explicit significance on visiting museums and engaging in other extra-curricular activities to encourage such aspirations. For example, she values museum visits as educational, looks for activities in museums that relate to her son's school curriculum, and draws links between their experiences in museums and school. Maria also has much broader views of learning and education than many other parents in this study, a difference that she appears aware of. The follow interview extract illustrates this point:

Maria: '*I'd like him to go to university!*'
Naomi: '*Do you think doing all the things you do, like going to museums, could help him with that?*'

Maria: '*Yes, it's all the information and skills he can get by not just sitting around, and he takes in what he sees and experiences. Most of his interests in things at school come from things he's seen in a museum… I'll try and make connections: if we see something in a museum that is about something that he's done at school or might do then I'll talk to him about it, make sure he's understood that.'*

Naomi: '*Is it difficult for you sometimes to do that? I find it difficult sometimes, I'm not an expert in science.*'

Maria: '*Yeah, but I think there's mostly something you can say, if not we'll just move on to something where I feel I can… It's not always about making links to school. It can just be interesting and it encourages Fernando to read about it or think about it so then it's educational.*'

Naomi: '*Do you think other families at Fernando's school, or your neighbours would also think of a museum as educational, as supporting aspirations they might have for their children, like going to university?*'

Maria: '*I'm not so sure, I don't think so… I think they see school as education and not so many other things. If you don't go (to museums), you don't know what there is and how children can benefit.'*

(Interview extract, 16.08.2016)

***The family's views and interaction with the Building Bridges project***

The Gomez family are very positive about the 'Building Bridges' project, with Fernando saying that it has been '*very interesting and exciting*'. His mother, Maria similarly described the project as an enrichment in that it provides the pupils taking part additional experiences related to their learning at school that they would otherwise not have. In contrast to many other families in this study the Gomez family frame the project as relating directly to the curriculum, albeit with the welcome inclusion of more practice-based activities and information from the Science Museum. Fernando and Maria also both spontaneously note that the project offers families opportunities to engage in activities together, such as provided by the 'Try this' booklet and the family evening. Maria consistently speaks of the interactions between parents and children on the project being educational, with parents having an important role in their children's learning experiences, including at home:

*'The project is such an important opportunity for parents to engage with their children's learning. Parents can take part in activities with their children, parents can find out what their children are interested in. Parents can help their children understand things… It's about having fun with science at home and at school. By having fun children learn science because they're tinkering with things, they're thinking about things in new ways, and they're asking questions that help their understanding… Parents can have a really big role in the project and they can learn too.'*

(Mother Maria, 28.06.2016)

The family attended the 'Building Bridges' family event for reasons that align with their views of the project overall as an opportunity to jointly engage with science that feeds into Fernando's learning at school.

'*I think the event (family event) really gets families to take part in activities together. It's a great way to have fun together and be a part of all the things the children have done on the project (Building Bridges project).*'
(Mother Maria, 14.08. 2016)

In a similar manner to their regular visits to museums, attending the family event sets them apart from other families at the school. Records from the Science Museum indicate that no other families from Saint Mary school attended the event. Maria explained that other families from the school might not have known that the event would be such fun, that there would be so many other families like them at the event or that they do not need to know about science or the museums to come. Fernando added:

'*Some people (pupils on the 'Building Bridges' project) kind of don't want to go out with their parents really, it could be kind of awkward if families don't know about museums.*'
(Son Fernando, 14.08. 2016)

These comments by Maria and Fernando align with reasons given by the Taylor and Kelly case study families as to why they did not come to the family event.

***The family's accompanied visit to the Science Museum***

The Gomez family were keen on visiting the Science Museum with me, even though, as previously noted, their visits to museums are 'special time' that they do not normally share with others. The accompanied visit to the Science Museum in August 2016 with the Gomez family is markedly different to the visits with the other case study families in that they had previously been to the Museum many times. They feel confident in the Museum space, they have been to the main galleries and know how to get there.

Even though Maria had looked up what the Museum is offering in terms of special activities and events, the visit consisted primarily of spontaneous joint decisions about what to see in the Museum. In addition, the family spent some time simply wandering around and taking in what attracts their attention. During this wandering Maria encouraged her son to lead the way and to speak about how some of the objects and information encounter relate to their experiences in everyday life. For example, at a cut in half Mini car presented in the 'Making the Modern World' gallery Fernando talked about how the car is so much smaller than cars he has travelled in, and how such small cars are hardly ever on London streets any more.

Fernando also made connections between objects and information presented in the Museum and things that he has learnt at school, such as about different sources of energy in the Energy gallery. Maria was keen to elaborate on such connections, mainly by asking Fernando to elaborate on his comments, or by her asking questions. In doing so Maria encouraged her son to be the 'expert', rather than herself providing information. In contrast to parents in the other case study families, Maria does not feel the need to be able to explain information provided in the Museum to her son. In addition, also in contrast to the other case study families who came on accompanied visits the Gomez family do not feel pressured to experience anything special:

*'We don't have to see everything today, we can just walk around and see what we find… We*

*can come again. It's not that big a deal for us to see something special.'*
(Son Fernando, 16.08.2016)

On a more practical note, the Gomez family, through their prior experiences in the Science Museum and other museums can be described as knowing the 'rules' in the Museum, such as that they can take photos, which objects they can touch, and where they can picnic. The family have also developed a joint understanding with regards to the Museum shops and café:

*At first we ate our picnic outside. Sometimes we'd come back in, and sometimes we didn't. There weren't the entrance checks then so it was easier to come back in… After many visits I realised that we could eat our picnic here inside the Museum, and that many other families where doing the same... We've been to the Museum so many times that there's no question now about the café, we just don't eat there. It's the same with the shops, Fernando wouldn't ask because he knows that I wouldn't buy anything. If he wants to use his pocket money that's fine, he has done that a few times. He bought a bouncy ball and a game. But normally he doesn't buy anything. It's not an issue for us.*
(Mother Maria, 15.12.2016)

Archer *et al.* (2016b) outline how a family from a migrant background that is under-represented in museums successfully navigated the museum space and social norms there based on the father's pre-existing educational 'capital', including a university degree. Archer *et al.* suggest that this ability to navigate space and social norms, based on pre-existing 'capital' allowed the family to access and capitalise on science learning at the museum. Findings from the Gomez family highlight how a family can gradually build up such an understanding based primarily on direct experiences at the Museum rather through pre-existing 'capital'. The mother, Maria, did not go to university and started working as a teaching assistant only after the family were already regular museum visitors. I would argue that the family did not have much pre-existing 'capital'. Rather, simply by visiting the Science Museum and other museums over the years the Gomez family have built up 'capital' related to museum-going that allows them to successfully navigate the space, social norms and access learning opportunities.

When I ask to meet the family in December 2016, they suggest going to the Science Museum. The Museum, as indeed many other museums in London, is a setting that Maria and Fernando feel comfortable in. On this second accompanied visit with the family they show me some work that Fernando has done in a chemistry after-school club that he now takes part in. Fernando has a small notepad in which he has jotted down some of the things they have done in the club. Maria encouraged him to look in the notepad and think any parts of the Museum that might be particularly relevant to the things he had jotted down. As on the previous accompanied visit Maria encouraged her son to take the lead on the visit, such as by asking him '*where do you want to go?*' or '*what's most interesting today?*'. The family were again confident in navigating the Museum space, in linking experiences to their everyday lives and Fernando's experiences at school, and in viewing the Museum visit as 'special' family time rather than feeling pressured to learn anything specific. Echoing her son's comments on the previous accompanied visit, Maria sums up this sentiment as follows:

*'We have a really nice time at the Museum; that's special to us. I wouldn't want us to think*

*we have to do anything here. It's not about leaving and thinking we've learnt something specific. That's too much pressure.'*
(Mother Maria, 15.12.2016)

When I ask the Gomez family whether they think that an app provided by the Science Museum could encourage and support visits from people who are infrequent or absent museum visitors they are unsure whether this provision might prove successful or might create a further hurdle to visiting museums for some families. Maria explains that an app could provide information that is tailored to the diverse interests and needs of families, in a manner that would be difficult to achieve in the Museum. For example, Maria suggests that an app could provide information in different languages and could provide information relevant to children's specific ages. However, in addition, Maria suggests that an app could be seen as a hurdle by families who are not familiar with museums for a variety of reasons: families might think that downloading the app is a requirement to visiting; families might be unsure if the app costs money or uses up their phone credit; their use of the app might make them feel more compelled to donate or otherwise spend money in the Museum; and the app might be confusing or difficult to use, especially for older family visitors and those less used to new technology:

*'I think for lots of reasons an app might be another hurdle (for families who are irregular or absent museum visitors)… Even if the app is free people might feel compelled to pay a donation… The app might just be confusing if people don't have new phones or for older people visiting with families.'*
(Mother Maria, 15.12.2016)

With respect to the hypothetical provision on an app it is also interesting to note that the Gomez family themselves say that they would prefer to spend more time looking at the exhibits and objects in the Museum rather than using an app. While they might use the app at home in preparation of a visit, or to follow up experiences during visits, they would be unlikely to use it much during visits:

*'When we're in the Science Museum I'd rather look around what's here... I might look at information before we come, or afterwards but I think it wouldn't be so nice during a visit.'*
(Son Fernando, 15.12.2016)

## 10.5 Cross-case conclusions

The four family case studies outlined above provided insights into families' homes, routines, identities and interests, as well as their views and interactions with science, the Science Museum and the 'Building Bridges' project. All families come from backgrounds that are under-represented at the Science Museum and other museums. Three of the four families do not, or only very rarely visit museums while one family are regular visitors. These aspects exemplify how different the families are; it is not possible to speak about 'under-represented' families as if they were one homogenous group. Nonetheless, it is possible to draw some cross-case conclusions that are important to gain an in-depth understanding of why some families do not or only infrequently visit museums, and provide suggestions for the Science Museum and beyond to think about and address issues of under-representation.

As in previous research (Atkinson and Mason, 2014) family time in this study can be split into weekdays and weekends. Most after-school time was spent at home, with children spending less time in structured after-school activities than they did in primary school. Children often spent time 'hanging out' with their friends unsupervised or engaging with technology. Year 7 children were developing towards greater independence, and their parents and other family members are adjusting to the changes and associated responsibilities and rules. While acknowledging their children's drive towards increasing independence, parents often sought out 'special time' with their children, for example as part of a shared interest in football or music. Special time cannot be conceptualised merely as families enjoying each other, but must rather be framed as deeply meaningful time. Parents often explicitly spoke about this special time as non-negotiable, and that their children generally respected this.

Families predictably spent more time together at weekends, but they also spent a lot of time spent together in the evenings, particularly as part of evening meals. In addition, cooking, watching television, listening to music and, for some families also engaging with technology and gardening were activities that families engaged in together. Technology was an important part of all children's lives in this study, and often a part that parents felt excluded from and bewildered by. Most families did not view their interest in technology as possibly forming part of an interest in science. In addition, most families either did not recognise or drew clear distinctions between their everyday engagement with science and science as taught in schools or elsewhere.

All families had clear identities that encapsulate who they are, who they want to become and how they want to be seen by others. Identities of families in this study relate to cultural and national heritage, religion and location, such as their housing estate or south London. Identities also relate to local communities that families are part of in that they provide opportunities to socialise, develop interests and gain valuable information and advice, including regarding school choices. Links to local communities were often forged through shared national, cultural or religious backgrounds, such as being from a 'Jamaican background', and often included extended families. The case study families often trusted, respected and relied on these local communities more than on official information and guidance, such as provided by local governments, education authorities or schools themselves.

Families' identities and interests, and how they relate to their local communities, are important as prior research (e.g., McDonald, 2011) suggests that people are highly motivated to engage in heritage activities that they find directly relevant to their own specific interests, culture or history. However, families in this study often did not associate or identify with one dominant group, and instead had mixed, blended identities that complicate developing specific provision in museums.

Three of the four case study families did not think of the Science Museum as having direct relevance to their specific interests, culture or history. Families spoke about visits to the Science Museum and other museums as a welcome and enjoyable part of school provision. Those families who had visited museums had done so as a one-off visit, such as something that one had to do with visiting extended family or friends who came to London. Families often did not see the Museum as a place they would go to with any regularity or as a way to

engage with the content at the Museum. These families have limited time together and want to use this time to engage in something that is either explicitly fun, such as visiting a restaurant, or something that they perceive as directly supportive of their children's school work, such as helping with school projects. All case study families have high aspirations for their children, such as by wanting their children to do well at school, including in science, and get a 'good' job. Having such aspirations is common amongst migrant families who often see it as a means to increase their social mobility (e.g., Archer *et al.*, 2016b). Three of the case study families do not view the Science Museum as either a venue for them to have 'fun' at, or as a setting in which they could support their children academically. One case study family, the Gomez family, highlights how families can build up capital to visit museums and successfully engage with content provided based on simply visiting museums rather than having pre-existing capital.

Families generally framed the 'Building Bridges' project as part of school, and often did not think of it as being intended for families, or that they, as a family, might understand, relate to or enjoy information and activities provided as part of the project. During the accompanied visits families did link elements encountered in the Museum to their identities, such as making links between their own cultural backgrounds and science content. However, they often also experienced some of the challenges described in the literature (e.g., Archer *et al.*, 2016b), such as uncertainties about which objects to touch. Overall, most families were not necessarily more inclined to visit the Science Museum or explicitly and purposefully engage with science as a result of taking part in the project. Families drew a clear line between science on the project and science at school; they often did not see the two as connected or as addressing similar themes. Families described science on the project as interesting, enjoyable and relevant, while they described science at school and elsewhere in less favourable terms.

When asked, the case study families mentioned a range of potential benefits with respect to the provision of a Science Museum app for families. These benefits included the provision of information in several languages, tailoring information for specific ages and interests, and providing access to more detailed resources than would be possible to display in the Museum, and which families could use during as well as before and after visits. However, families, in particular children, have high expectations with regard to an app that might prove challenging to fulfil. In addition, families voiced potential drawbacks of providing an app. These include that an app might be difficult for family groups to use and might increase older children using it by themselves and not engaging with the rest of their family groups. Parents also noted that children might spend a lot of time looking at screens and being distracted rather than looking at and interacting with the objects and information in the Museum. These parents were also apprehensive about their children spending yet more time using technology. It is also evident that providing an app might create a hurdle for some families: families might think that downloading the app is a requirement to visiting; families might be unsure if the app costs money or uses too much of their phone credit; their use of the app might make them feel more compelled to donate or otherwise spend money in the Museum; and the app might be confusing or difficult to use, especially for older family visitors and those less used to new technology.

# 11. Conclusions and suggested action points for the Science Museum

The 'Building Bridges' project brought families in contact with the Science Museum, and, for some families on the project, also on visits to the Museum. Families were overwhelmingly positive about these experiences. It now appears important for the Science Museum to expand on these experiences to foster families' longer-term engagement, and ensure that they continue to engage with the Museum. Based on the research findings, the suggested action points below aim to support this task.

## 11.1 Fostering a welcoming learning environment and longer-term engagement

Archer *et al.* (2016b) argue that there is an inherent problem in widening participation initiatives that aim to change 'non-traditional' groups to suit unchanged institutional offers. Such efforts can be seen to 'blame' the 'non-traditional' groups and fail to acknowledge or address the institution's role in preserving inequalities related to participation. Grounded on this argument Archer *et al.* put forward suggestions to support science museums in developing more inclusive practice. These include providing an introduction and orientation space for 'first time' visitors. Archer *et al.* also suggest encouraging a sense of ownership and belonging across social groups and communities, such as though the explicit inclusion of a broad range of languages and cultural references throughout museums. The 'Building Bridges' project is a move towards addressing the points raised by Archer *et al.* in that it provides families with a 'special provision', particularly as part of the family event. However, taking part in a Science Museum project, such as 'Building Bridges', and visiting the Museum as part of such a project does not seem to translate into visiting the Museum independently. It is therefore now important for families to become 'ordinary' independent visitors, rather than visiting only as part of a 'special provision'. I suggest that all Museum departments continue to work together to continue to and increase the promotion of the Science Museum as open and accessible to all. This could be achieved through working collaboratively with schools over longer time periods, and, in doing so working with family liaison officers or similar members of staff at schools to encourage engagement of teachers, pupils and families. In addition, promoting the Museum as open and accessible could be achieved through publications readily available at the entrance and in external marketing material, such as more explicitly communicating its largely unspoken norms and 'rules' and providing practical guidance, as outlined in Section 10. Care must be taken not to instil a sense that some families are made to feel 'different' from other visitors, or that they are only welcome and able to visit the Museum on specific occasions or as part of organised groups.

Families in this study viewed the Science Museum as a learning space, and their interest in the Museum was shaped by this view. While they were overwhelmingly positive about the Museum, they did not primarily think of it as being a 'fun' setting. According to families, such 'fun' settings were venues that more explicitly and exclusively focused on entertainment, such as theme parks, or activities centred around eating a meal together or shopping. Attempts to market and promote the Science Museum as 'fun' might therefore not be in line with families' existing beliefs. This is the case particularly as many of the activities that families do perceive as 'fun' at the Museum are charged for rather than free, such as the simulator rides that could be compared to theme park rides. Marketing the Science Museum as being free and as being fun might therefore create unrealistic expectations. Rather, marketing the

Museum as a setting in which families can learn together in an interesting and unusual environment may be more appropriate.

It seems important to embed messages about learning at the Science Museum, as well as that it is open, accessible and welcoming to all people, into on-going programming of events, activities and content. The 'Building Bridges' project demonstrates the success of a multi-nodal approach whereby there are numerous points of contact with teachers, pupils and families. Without this multi-nodal approach, families' engagement with the Museum would be much more restricted. It thus appears important to replicate, build on and capitalise on the success of a multi-nodal approach within the Museum's other provisions.

Findings suggest the significance of families being invited to share their experiences of science. For example, activities at the family event were particularly engaging if parents and children were encouraged to engage in activities together and speak about their views and prior understanding. It seems important for the Science Museum to explicitly acknowledge the existing resources and interests that families have, even if these do not directly relate to normative science. This acknowledgement builds confidence and trust, and thereby shapes a mutual learning environment that encourages families to learn independently and recognise their experiences as valuable and relevant to science, rather than perceiving the Museum as an authoritative force that simply provides them with knowledge. Families could be invited to share their everyday experiences related to activities such as cooking and gardening during 'get togethers' at the Museum. This type of activity could focus on families learning together rather than parents being placed in the role of facilitators who help their children's learning. The research indicates that being a facilitator of their children's learning is intimidating to some parents as they do not always think of themselves as having the perceived necessary knowledge and skills to provide support. The Science Museum as a learning environment for families might be most powerful if it is explicitly framed as a mutual learning space for both parents and children.

The 'Building Bridges' project is inevitably influenced by the physical Science Museum space. On visits to the Museum the school groups and their families taking part in the project encounter this space, and their experiences and views of the project are influenced by it. The entrance barriers at which visitors are asked for donations when entering the Museum were noted by many families as disconcerting and not welcoming. Families were also often confused about if and how much they were expected to pay. In a quote that closely aligns with findings by Archer *et al.* (2016b), the Taylor case study family said '*the barriers when you go in, they aren't nice, they (the Science Museum) don't seem to want you to walk in … I don't know how much we should pay for all of us… (Referring to the sign stating "Suggested donation of £5 per person") Do the kids have to pay too? Are they a person or are they free?*'

Families in this study were also unsure about whether they were permitted to picnic inside the Museum or whether they were expected to buy food from one of the many food outlets that were all described as '*expensive*'. Several parents noted that it was difficult for them to avoid these food outlets or the gift shops. Even if parents did bring their own food and did not want to buy a gift, they felt compelled to buy something for their children. Clearly, families did not experience the Museum to be 'free' of charge as one way or another they spent money there. In the absence of being able to remove the entrance barriers or limit the

number of food outlets and gift shops, and the cost of purchases there, it may be appropriate to provide families, and other visitors, with a guide on how to limit spending money at the Science Museum. This guide could, for example, include a clear statement that donations are voluntary, show where the picnic areas are, and highlight that many visitors do not use the food outlets or make purchases from the gift shops.

## 11.2 Thinking beyond the 'nuclear' family

As stated throughout this report, it is not possible to speak about on homogenous group of 'under-represented' families. Instead, these families, as all families, are diverse and it would thus be a mistake to assume that there is a one-size-fits-all approach to their engagement with the Science Museum. Families in this study draw on many social, cultural and religious networks in their everyday lives. When aiming to engage families it is important to consider these networks rather than simply viewing families as insular. The families in this research are more inclined to visit the Museum as part of a group that they are familiar with. While schools can be an important part of families' networks, secondary schools are a lesser part of such networks than primary schools. Reaching out to families through secondary schools might therefore be difficult as neither the schools nor the families are used to engaging much with each other beyond specifically curriculum-related or discipline issues. The Science Museum could therefore tap into alternative networks to contact and stay in communication with families. Findings from this study indicate the importance of building long-standing partnerships with community and religious groups that the Museum aims to reach. In particular, the Museum could reach out to the leaders in such communities to tap into existing networks of support, trust and respect to promote the Museum as a welcoming place and encourage Museum visits and participation in activities. This might be possibly by, for example, creating activities that link the history of science and communities, and working directly in partnership with community groups in creating these activities.

The research indicates that facilitating families in socialising with friends is likely to support their engagement with the Museum and its resources. Friendship groups are important for Year 7 pupils as they move towards greater independence from their parents. Encouraging pupils to visit the Museum and use resources provided with their friends and their families acknowledges and builds on this increased independence. Family engagement need not be isolated from encouraging friendship groups to engage with the Museum. Rather, creating activities that, for example, pupils can accomplish with their friends and then share with their families is likely to facilitate family engagement. This sharing could involve the use of social media as pupils enjoy it and are frequent users.

## 11.3 Organisation of the project

The main organisational element of the 'Building Bridges' project is working with schools, in particular working with the teachers who are the project leads at their schools. These project leads are not necessarily the class teachers of the Year 7 class taking part in the project, and therefore they do not necessarily accompany the class on their Science Museum visit. It seems important to explicitly engage the class teacher to understand the needs, aspirations, abilities and interests of pupils, and to foster the integration of the 'Building Bridges' and similar projects into classroom practice and the wider school environment. For example, teachers could be encouraged to put up displays related to project activities across the school, showcase photos from Science Museum visits and family events. The projects could also be

discussed during assemblies, open days, on school websites, newsletters and form a part of science weeks or science festivals at the schools. Teachers already use many ways to communicate with parents, including email, phone, text messages and face-to-face contact. This existing communication could be utilised to promote and explain the projects. The further integration of Science Museum projects into communication with parents and classroom practice and across the school is more likely if there is explicit 'buy in' from the schools' senior management teams. This 'buy in' is likely to help promote the overall projects within the individual schools and beyond, and possibly also provide the class teaches with additional time and resources to integrate activities offered by the projects into lessons.

Overall, there is a chance for the 'Building Bridges' and similar projects to become a greater integral part of the school year, beyond the individual classes taking part in the project. The 'Building Bridges' project schools for the 2015/16 academic year can be described as having a whole school ethos approach in that they promote science across the school, offer after-school science clubs and took part in the 'Building Bridges' project. For future projects, it is worth considering how the Science Museum can become a larger element of such an ethos. Inviting all Year 7 pupils and their families to the family event in the 2015/16 academic year is one useful approach worth replicating as part of future projects. In addition, proving the 'Try This' booklet to all Year 7 pupils and their families, rather than just to the class taking part in the 'Building Bridges' project is an important aspect that occurred in the 2016/17 academic year. Future projects at the Science Museum and elsewhere can build on this approach to provide project resources to the largest relevant audience group, thus encouraging a wide reach of projects.

With respect to the individual classes taking part in Science Museum projects, it may be worth providing schools with a clear steer as to how to select the classes that take part in the project. For the 'Building Bridges' project there was no systematic way that schools selected which class took part. It would therefore, for example, be possible to suggest that schools select a class that has the largest number of pupils who are eligible for Pupil Premium to encourage visits to the Museum from pupils and their families from low socio-economic backgrounds. Alternatively, it would be possible to encourage schools to select a class from the middle or bottom sets rather than a class from the top set as the top sets appear more likely to already be engaged with science.

To gain a better overall understanding of pupils and their families it is important to engage the welfare officer, ESOL (English Speakers of Other Languages) officer, family liaison officer or similar, if schools employ such members of staff. These staff members are likely to be responsible for pupils and their families who form part of visitor groups that are under-represented at the Science Museum. It therefore appears important for Science Museum project teams working on relevant future projects to identify these staff members, to then encourage them to promote the project amongst families at the school and to provide the project team with information about how to engage these families. Welfare officers or other members of staff at the schools with similar responsibilities are likely to provide more information about families that is relevant to the project aims than teachers.

As noted in Section 11.2, engaging only with schools may not be sufficient to reach out to all families. Engaging only with schools to promote the Science Museum and its projects is

effective primarily for families who are already interested in the Museum, confident in visiting, and engaged with the science and its communication there. It is therefore worth considering how to engage with other, more prominent networks that are part of families' everyday lives, including community groups. Engagement with such groups could form part of a project's longer-term approach, for example by having on-going contact with these groups and tapping into them to reach families for specific projects, activities and events, as well as a broader engagement with the Science Museum. In working with schools and community groups it is important to invest in longer-term relationships rather than relationships lasting only for the duration of one project year or only for the duration of the 'Building Bridges' project. Establishing a longer-term relationship could occur by the Museum providing regular events and activities, for example every six months or every year. The regularity of events and activities, even if not very frequent, would encourage the Museum to become a more sustained part of families' lives.

Findings from this research indicate the importance of capturing a good time to initiate being such a sustained part of families lives. The transition period between primary and secondary school is a particularly important time for families, during which pupils are gaining more independence but are still in closer contact with their parents than during their later time at secondary school. For example, at the very beginning of Year 7 parents regularly accompany pupils to schools, and families are often keen to make new social connections with other families. This is therefore a good time to get in touch with families and engage them in projects, such as the 'Building Bridges' project. It is worth considering holding events, such as the 'Building Bridges' family event at the beginning of the academic year rather than at the end. It appears that at this time pupils are more inclined to take part in activities with their families, whereas later in the academic year pupils often seek independence from their parents and other family members. Families could be provided with resources, such as the 'Try This' booklet at the event, thus encouraging family engagement from the outset of the project. The event could include activities that form part of the booklet to demonstrate the value and interest of the booklet to families, its links to the school curriculum and associate the event with activities that families can take part in at home. Providing parents with a clear role during such activities, highlighting their importance in learning *with* their children might further promote an active participation of families from the beginning and throughout the project.

A final point regarding the organisation of the 'Building Bridges' project is that in the 2015/16 academic year ten of the 17 schools taking part in the project are 'faith schools' in that they have an explicit Christian ethos[9]. In addition, 11 of the 17 schools have been graded as 'outstanding' by Ofsted, with five schools receiving the grade 'good', and one school being 'inadequate'[10]. While I acknowledge the difficulty of this, for future projects it might be worth recruiting more schools that are non-faith schools, and that have not been graded as 'outstanding' for future projects.

[9] 26% of state maintained secondary schools in London are 'faith schools'.
[10] Around 21% of state maintained secondary schools in London are graded by Ofsted as 'outstanding' in 2015.

## 11.4 Activities and resources

The activities and resources that formed part of the 'Building Bridges' project are a great asset to engage families with the project and science more widely. Of particular relevance are those activities and resources that directly or indirectly relate to families' existing interests and everyday experiences, such as technology, cooking, shopping, sport, and religion. The 'Gallery Explorer' activities that pupils took part in when they visited the Science Museum included asking pupils to find items in the 'Making the Modern World' gallery with which people cooked across different times in history. This activity encouraged pupils to speak to their families about the activities, which is an outcome of the project that could be more overtly facilitated. In developing activities and resources it may be worth giving families an active role in co-creating them. For example, workshops with selected families who are part of the project and school family liaison officers could be run to co-create activities and resources that are then used as part of the on-going project. Co-creation recognises families' existing skills, knowledge and interests, and can nonetheless stretch and challenge their understanding and views related to science.

With respect to the existing activities and resources provided as part of the project, I will now discuss suggestions for improving the 'Try This' booklet and the family event on 13th July 2016. As noted, both these features of the project were very effective, but they could nonetheless be further enhanced. While the existing hard-copy format of the 'Try This' booklet is good, several teachers, parents and pupils stated the usefulness of providing an easily accessible, widely publicised and mobile-friendly electronic copy of the booklet. This electronic availability would ensure that pupils who have lost or misplaced the hard copy can nonetheless access the booklet, it would allow schools to promote the booklet amongst all classes and relevant year groups, and could enable to Science Museum to encourage a wider distribution than is currently possible. For example, electronic versions of the booklet could be user tested with various audience groups and then made accessible to the general public. The 'Try This' booklet could be promoted in the Museum and on the main Science Museum's website as part of its overall approach to family science engagement, thus maximising the impact of project resources.

Pupils, parents and teachers perceived the resources provided by the booklet as interesting, relevant and suitably different to existing classroom resources. There was a suggestion to include additional resources with a focus on technology as this topic is of particular intrigue and enjoyment to many pupils. For example, it would be possible to include more resources that centre on gaming, video, mobile phones and social media. To encourage an even wider use of the booklet amongst pupils, and to boost its use amongst families several teachers and parents suggested completing some of the activities as part of homework assignments or school work. For example, one teachers suggested requiring pupils to complete a suitable activity with their family as a homework assignment. This requirement could set out clear roles for parents and children to work collaboratively, thus ensuring that more families read the booklet and complete an activity together. It would address the challenge discussed in Section 7.4 that parents often did not recognise resources provided by the Science Museum as being of direct educational benefit to their children. There is no evidence to suggest that pupils' enjoyment and enthusiasm for the booklet would be diminished by asking them to use it for a homework activity.

As discussed in Section 9, the family event was an overarching success in that it was enjoyable, interesting and inclusive, especially for those families who had not previously visited the Museum. Suggested action points for the Science Museum arising from the findings therefore centre on replicating and expanding this success. The family event is a very important part of the 'Building Bridges' project, and its possible addition to other projects is thus very worthwhile. The most important action point for changes to the family event is considering holding it at the beginning of the project year, as noted in Section 11.3. This organisation change could be emulated by other projects that provide family events.

As noted in Section 9.2 displaying work that pupils had done as part of the 'Building Bridges' project was effective in that parents were intrigued by their children's work, and pupils were proud to show it. This success could be expanded through more prominent displays, such as using larger boards at the Museum entrance. Displays could also feature written questions and comments by pupils to explicitly stimulate discussion. For example, the question '*have you ever done this as a family?*' could be displayed next to information about activities pupils did.

A further suggested action point is to carefully reflect on how the family event is promoted. The use of fridge magnets as invitations for families worked well in that they were often prominently visible in families' homes. Additional suggested ways to promote the family event and thus possibly increase attendance are to more directly involve schools in promoting the event by asking them to include information about the event on their websites, newsletters and other communication with families.

As discussed in Section 10, families who have never visited the Science Museum, or who have visited the Museum only with a school, often find getting into the Museum challenging and off-putting. This includes directions to the correct entrance, as well as passing the donation barriers. It may therefore be worth advertising the event as suitable for groups of families to travel to together, or asking teachers to group families to travel together. Similarly, for some schools it might be appropriate for the Science Museum to provide coaches. However, a balance must be struck between facilitating travel arrangements and taking over arrangements to such an extent that families cannot develop sufficient independence. For example, it would be detrimental to the outcomes of the 'Building Bridges' project if families were left feeling that they are not able to travel to and enter the Museum by themselves. Instilling such a feeling goes against aims to promote the Museum as accessible to all.

Requesting families to register for the 'Building Bridges' family event was a problematic in that this was perceived by some families as potentially time consuming and difficult. Even though the event was explicitly promoted as being free of charge, there was also suspicion amongst some families that they would be asked to pay, or would receive unwanted communication from the Museum, including being asked for donations. Two families said that they had almost forgotten to register for the event and that they therefore almost had not been able to come. These comments highlight that some families might not have come to the event because they had forgotten to register. However, asking families to register for the event might encourage those families who did register to then actually attending on the day. For example, one family said that they had registered for the event and as part of the registration added the event to their diaries to remind them of it.

As discussed in Section 9, while observation at the family event indicates that parents and children frequently engaged in activities together, parents at times also simply sat back and watched their children. This was partly because parents did not think of themselves as having the perceived necessary resources to learn collaboratively with their children. It might therefore be worthwhile to more explicitly focus on the role of parents as collaborators in their children's learning in future family events. Such an explicit focus rejects the view amongst some parents that the Science Museum provides information primarily for their children to learn independently.

Building on the enjoyment and intrigue expressed by families at the family event it is worth considering how to promote subsequent engagement. For example, if the family event is held at the beginning of the project year, providing families with the 'Try This' booklet at the event might support such subsequent engagement. This encouragement could be strengthened by providing some activities from the booklet for families to take part in during the event. It might also be useful to send an email thanking families for coming to the event, and providing a link to photos taken at the event. In a similar manner to involving schools more directly in promoting the event, schools could also be involved more in encouraging subsequent engagement. For example, schools could be asked to post photos of the event on their websites, on social media and to use such photos as displays across the school, or encourage pupils and teachers to speak about the event during assemblies or parents' evenings. Similarly, it would be worth encouraging families to take photos during the event and share them via social media or other means to support their own engagement, and promote the event and the Museum to their friends, wider family and beyond. Some families in this project did not realise that taking photos is permitted during the event or at the Science Museum, suggesting that explicitly encouraging them to take photos is important.

As discussed in Section 10, there are potential benefits, but also potential drawbacks from providing a Science Museum app for families. It is therefore worth the Science Museum carefully considering these possible benefits and drawbacks, as well as the resources available to develop and maintain an app that would satisfy the needs and expectations of families.

### 11.5 Use of 'science language'

Sections 7, 8 and 10, outlined that families in this study often framed science primarily in terms of school subjects, and, to a lesser extent, science careers to which they had limited experience and understanding. All families expressed some interests and activities that can be viewed as relating to science, such as engaging with technology, cooking or gardening. However, they often did not think of and recognise these interests and activities as being possibly related to science. The 'Building Bridges' project is an opportunity to challenge these views and to encourage families to characterise science in a way that includes activities that form part of their everyday lives. Close attention must continue to be paid to valuing wide forms of participation and engagement with science from a wide range of diverse people. The research indicates that this will encourage families to recognise that their identities need not conform to specific stereotypes, such as those related to gender or social class, to embrace science as part of their lives and as feasible educational and career aspirations. Ensuring that Science Museum projects include members of Museum staff from various backgrounds, such as minority ethnic groups, as well as men and women is likely to help change views of science

and of the Museum as limited to a specific type of person. In addition, project events, such as the family event in the 'Building Bridges' project, could provide opportunities for families to interact with scientists from various backgrounds. For example, providing sessions for families to speak to scientists from minority ethnic backgrounds is likely to broaden families' views of who is and can become a scientist.

Such a changed view might not only support the overarching welcoming learning environment at the Science Museum, but would also support efforts across the informal science learning field to broaden science education and what counts as legitimate engagement with science in museums and beyond (e.g., Callanan *et al.*, 2013). In addition, as outlined by DeWitt and Pegram (2014) with respect to a natural history museum, families recognising and appreciating their science encounters may encourage a wider engagement with science beyond the museum, to perceive science as relevant to their lives and to envisage a place for themselves in science. Findings from research on the 'Building Bridges' project suggest that technology is of great interest to pupils and families, and that the use of technology, in particular mobile technology, features as a frequent, valued and indispensable part of their everyday lives. Including technology as a more pronounced and explicit element of the project could encourage families' engagement with science as part of their existing interests and experiences.

On a pragmatic level the 'Building Bridges' project could support families to develop a more positive association with science by carefully considering how activities and resources are described. As outlined in Sections 7 and 8, pupils and parents often had ambiguous and somewhat negative views of science. The project, and similar future projects, is an opportunity to explicitly encourage a perception of science as exciting, interesting and accessible. This might be possible by, for example, linking words such as 'experiments' and 'activities' that indicate a playful and informal approach to science at school and the workplace. Stating that science in these settings draws on informal approaches might encourage a perception of science as being more relevant and appealing to families.

As a final contemplation, many pupils, parents, case study families, and several of the teachers were unsure what the project name 'Building Bridges' meant. An association of the project with engineering was common, but pupils, parents, families and teachers also recognised that the project was broader than the discipline of engineering. There was also discussion about the bridges that visitors could build in the former 'Launch Pad gallery', a part of the Museum that many pupils had visited with their primary schools, and that many teachers were familiar with. These kinds of uncertainties about the project name may not necessarily negatively impact on the outcomes of the project, but they do highlight the potential to more explicitly highlight its central aims to link schools, families and the Science Museum. In addition, as outlined in Section 9.2 with respect to the inclusion of some activities at the family event, such uncertainties can also contribute to a sense amongst families of the project and the Science Museum being alien and obscure. It might be possible to establish names for future project as part of a co-creation activity with a select group of families, as described in Section 11.4. This co-creation would ensure that project names coincide with the language and terminology that is used and understood by the target audience.

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