



The Scottish
Government

Starting Young?
Links Between Childhood and
Adult Participation in Culture
and Science - a Literature
Review

Arts and Culture



social
research

**STARTING YOUNG? LINKS BETWEEN CHILDHOOD
AND ADULT PARTICIPATION IN CULTURE AND
SCIENCE - A LITERATURE REVIEW**

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1 EXECUTIVE SUMMARY

Background

- 1.1 This literature review considers the links between childhood and adult participation in cultural activities, including participation in science events. This includes attendance as members of an audience and participation in arts and cultural activities and as visitors at science attractions such as museums and science centres.
- 1.2 The review was commissioned by the Scottish Government from the Centre for Research on Families and Relationships (CRFR) at the University of Edinburgh.

Review of arts and culture

- 1.3 Research finds that exposure in childhood to arts and culture can demystify experiences and have positive benefits on children's education, emotional well being and behaviour as well as wider benefits for society.
- 1.4 Findings from the Scottish Household Survey Culture (and Sport) Module indicate that there may be a correlation between the differing experiences of arts and culture in childhood and participation in these activities in adulthood (Scottish Government, 2009).
- 1.5 Factors which impact on participation include: family background, exposure to arts education, frequency of attendance at events, being from a black and minority ethnic group and socio economic status.
- 1.6 There are a number of drivers for engagement in arts and culture. Encouragement from parents, positive early experiences and being from advantaged backgrounds are shown to result in greater exposure to arts and culture.
- 1.7 There is not an extensive body of research on childhood exposure to arts and culture and adult participation in these activities, particularly in the UK. There are few longitudinal studies or large scale surveys which have measured the impact of exposure in childhood and participation in adulthood.
- 1.8 Evidence from the large scale surveys of Taking Part (Oskala et al, 2009) and the Scottish Household Survey Culture (and Sport) Module (Scottish Government, 2009) will increasingly provide a valuable source of data.
- 1.9 More people are found to have taken part in arts and culture when wider definitions of participation are used. Research would benefit from a broader and more encompassing view of arts and culture.
- 1.10 There have been changes over time that can affect the level of participation in arts and culture activities, which are relevant to future research. These

include: increased opportunities to access arts and culture, more interest among young adults and greater parental awareness of the benefits of children's participation in arts and culture.

Review of informal science

- 1.11 The review focuses on informal science activities which are accessed through museums, science and discovery centres although informal science learning can take place in a range of places and environments.
- 1.12 The wide range of places where informal science learning occurs makes it difficult to identify the influence of particular factors in both childhood and adulthood. There is a need for a wider interpretation of what is informal science learning.
- 1.13 Research shows that there is a correlation between the experiences of childhood and the interests of adulthood. Adult recollections of exposure to informal science in childhood indicate that these experiences do have a long term impact on adult participation.
- 1.14 Research on exposure in childhood has focused on its influence on formal education and professional choices in adulthood. The long-term objectives of science and discovery centres are linked closely with stimulating the interest of children and young people.
- 1.15 There is not an extensive body of research on the impact of childhood exposure to informal science on adult participation.
- 1.16 There are few examples of longitudinal research which look at the impact of childhood exposure on adult participation in the area of informal science. There appear to be no studies available in the UK with some research undertaken in the US and elsewhere.
- 1.17 There is a need for robust studies which explore the long lasting impact of informal science learning in childhood on adult participation. There are challenges associated with measuring outcomes and in identifying the impact of cause and affect on participation.
- 1.18 The wide and diverse range of informal science environments and activities makes it difficult to measure the impact of informal science experiences on children, young people and adults and to isolate the influence of individual factors.

Findings on arts and culture and informal science

- 1.19 The areas of arts and culture and informal science have different dominant aims and objectives. The aims of informal science are primarily about learning and future study and career options while those most commonly identified in arts and culture tend to be about enjoyment, social capital, community and inclusion.
- 1.20 There are benefits in sharing learning from research across the areas of arts and culture and informal science in order to better understand the impact of childhood exposure on adult participation.
- 1.21 Research on the impact of childhood exposure in both areas finds that experiences in childhood *do* have an impact on adult participation.
- 1.22 The variables which influence participation and engagement in both childhood and adulthood include family support and interest, socio economic circumstances and frequency of engagement with activities.
- 1.23 There is little longitudinal research in these areas. There are few studies based on data relating to Scotland and the UK and not many large scale research studies which examine childhood exposure and adulthood participation.
- 1.24 The influence of digital media and traditional media such as television should be taken into account in research on arts and culture and informal science.
- 1.25 Researchers in the areas of arts and culture and informal science suggest that there is a need to develop a greater body of research on the long term impact of childhood experiences on adults' engagement.

2 INTRODUCTION

Background

- 2.1 The Scottish Government commissioned the Centre for Research on Families and Relationships (CRFR) in October 2009 to undertake a literature review on the links between childhood and adult participation in cultural activities, including participation in science events.
- 2.2 The background to the review is that the Culture and Sport Module of the Scottish Household Survey (SHS) includes questions for adults about their exposure to culture when growing up (Scottish Government 2009). This section was added to the Culture and Sport Module so that future analysis can establish whether there appears to be a link between exposure to culture and arts as a child and participation in cultural activities as an adult.
- 2.3 The review will also help inform the current evaluation of the four Scottish Science Centres (2008-10) of which the broad aim is to explore the impact of science centre activities on public engagement in science.
- 2.4 This literature review complements the analysis of the data in the SHS module by reviewing research in the area of exposure to, and experience of, arts and culture as a child and participation as an adult. The review also explores research on attendance at science events or museums as a child, and subsequent attendance at, and interest in, science events and museums as an adult. Both these areas are considered in order to establish any links between experiences in childhood and adulthood.
- 2.5 Research demonstrates that participation in culture and the arts can improve self-confidence and self-esteem, promote mental health and well-being, improve educational attainment, promote community cohesion, can lead to employment and further education, and result in many other beneficial outcomes to individuals and communities (see Galloway, 2008; Galloway et al, 2005; Matarasso, 1997; Oskala et al, 2009; Ruiz, 2004). Participation in science events is seen to have benefits for informal and formal science learning as well as influencing future educational and professional choices (Ecsite-UK, 2007).
- 2.6 The research that is available on the impact of childhood exposure in both areas finds that experiences in childhood have an impact on adult participation (Bell et al, 2009; Scottish Government, 2009; Oskala et al, 2009). This is influenced by a range of factors including family support and interest, socio economic circumstances and frequency of engagement. This is not an exhaustive list of contributory factors. There are many variables which influence participation and engagement in both childhood and adulthood in arts and culture and informal science.
- 2.7 Participation in a range of cultural activities, including participation in science events, can contribute to a wide range of objectives around well-being

including the Scottish Government's strategic objectives of being Wealthier and Fairer: Smarter, Healthier; Safer and Stronger; and Greener.

Aim and objectives of review

2.8 The aim of the study is:

- to review research that has examined the extent of childhood exposure to, and experience of, culture and science at events or museums, and subsequent adult cultural or science participation.

2.9 The objectives are:

- to demonstrate whether there are any links between cultural participation and experience as a child and cultural participation as an adult; similarly
- to establish any such links regarding childhood experience of science events and visits to science museums, and adult interest and attendance later in life;
- to inform and provide a context for future analysis of the SHS Culture Module which provides data on exposure to culture as a child and adult participation; and to inform the Scottish Government's current Scottish Science Centres evaluation.

3 OUTLINE OF REVIEW

Definitions

- 3.1 This is a brief review of selected literature relating to engagement in cultural activities, including informal science events. This engagement includes attendance as members of an audience, participation in cultural activities and as visitors at attractions such as museums and science centres. It excludes an extensive literature on the impact of school based learning experiences which is not relevant to the scope of this review.
- 3.2 In this review, use of the term 'culture' has drawn on Ruiz's (2004) definition of culture and includes theatres, libraries, museums, art galleries, music, dance, reading, singing and playing a musical instrument. The focus is on 'arts and culture' and this term will be used throughout the review. In the area of engagement in science, the review has focused on informal science activities which include attendance at designed environments such as science and discovery centres and museums as well as participation in associated science festivals, events or centres.
- 3.3 Other types of cultural products are also relevant to explorations of engagement in arts and culture and access to informal science including, for example, television and digital media. Although these areas are relevant, they have not been considered in detail in this study. These are areas which could be considered in future research.
- 3.4 The review highlights where the evidence relates specifically to arts and culture or informal science events. It has also explored what evidence is available on a range of experiences including where people are disadvantaged by low income and poverty. The age categories of the Scottish Household Survey are followed in this review. A child is defined as aged up to 16 years of age and an adult as 16 years and over.

Accessing evidence

- 3.5 The research literature was identified through several different approaches. These included the use of bibliographic search engines as well as accessing publications through academic and professional organisations and networks. A number of experts in the areas of arts and culture and informal science were also contacted for advice on sources of additional research publications. These expert contacts provided invaluable information and additional references. They confirmed the researchers' overall finding that there was limited research on the impact of childhood exposure on adult participation in both arts, culture and informal science.
- 3.6 The bibliographic search engines included those specifically related to the specialist areas of the study. A variety of search terms were used to maximise the number of articles accessed. In the area of arts and culture, the

specialist Impact database held by the Centre for Cultural Policy Research at the University of Glasgow was searched as were other academic databases. These included the Arts and Humanities Citation Index, Social Sciences Citation Index, Assia, ERA (Education Research Abstract) and Project Muse.

3.7 Specialist journals were also searched. In the area of culture, this included the Journal of Cultural Economy and the International Journal of Cultural Policy. In the area of informal science, this included Science Education, Research in Science Education and Museum Studies. In some instances, specialist journals, particularly in the area of informal science, were not readily available and were accessed through other sources where possible.

3.8 Websites of organisations and networks with a focus on both culture and informal science were also searched. These included:

Arts and culture

Arts Council England

Scottish Arts Council

International Federation of Arts Councils and Culture Agencies (IFACCA)

Informal science

Association for Science and Discovery Centres

Centre for Advancement of Informal Science Education (CAISE)

Centre for Informal Learning and Schools

National Science Foundation (NSF)

The Visitor Studies Association Archive

Also the websites of individual science centres in Scotland, UK, US and Australia.

3.9 The review is divided into two sections. The first section considers arts and culture and the second section the area of informal science. Key themes in each area are summarised. A short review of research studies from academic and non academic literature is provided for each area. Each section concludes with a summary of key points.

4 REVIEW OF ARTS AND CULTURE

Introduction to review of arts and culture

- 4.1 This section draws on recent research undertaken by the Scottish and UK Governments and other national arts bodies which is relevant to the review.
- 4.2 The Fresh Minds (2007) report commissioned by the Department for Culture Media and Sport (DCMS) states that there are barriers to people attending and participating in arts activities and that it is important to understand what drives demand in culture. The report identifies that there are many reasons which support or inhibit participation in arts based activities. This highlights the difficulty in clearly identifying what impacts on adult participation and relating it to childhood exposure to these activities.
- 4.3 Analysis of the Taking Part survey identifies that exposure in childhood can demystify arts experiences (Oskala et al, 2009). It can have positive benefits in terms of children's education, emotional well being and behaviour as well as potential benefits to wider society. The report also points out that the arts can 'potentially' impact long term on children's interest in, and attitudes to, arts and culture (Oskala et al, 2009).
- 4.4 The impact of childhood exposure on adult engagement can be explored either through longitudinal research which measures impact over time or through adult reflections on childhood experiences which can include large scale surveys. These two approaches to gathering data are distinct. A longitudinal study is able to track participation from childhood to adulthood. Surveys (where they are not longitudinal) ask about experiences which are recalled and reported and are not able to track childhood participation. With the exception of survey data available from the Scottish Household Survey and the Taking Part survey, this study found that there was not a significant body of research in these two areas. There are other literature reviews which provide an extensive overview of other evidence on arts and culture (Galloway, 2008; Galloway et al, 2005; Ruiz, 2004).

Childhood participation in culture: evidence from Scotland

- 4.5 The Scottish Household Survey Culture (and Sport) Module in 2007/8 surveyed around 6,800 people aged 16 years and over who were asked questions about their experience of participation in cultural activities and attendance at cultural events (Scottish Government, 2009). It explored the reasons why people do and do not take part in cultural activities. The survey also considered childhood encouragement to participate in culture activities, a main focus of this review.
- 4.6 The resulting report from the survey – People and Culture in Scotland (Scottish Government, 2009) – showed that 29% of people said that they had been taken 'often' or 'fairly often' to museums and galleries (Scottish

Government, 2009). In other areas of culture, 23% had been taken to the theatre, 52% to cinema, 33% to historic sites and 48% to libraries as children. Over half of adults had been encouraged 'a lot' to read books. Under a third had been encouraged to undertake activities such as drawing, painting, writing stories, poems, plays or music, playing musical instruments, acting, dancing or singing.

- 4.7 There were differences in people's experiences according to a range of socio-economic circumstances such as the deprivation levels of the areas that people lived in at the time of the survey, their income and their level of qualifications (Scottish Government, 2009).
- 4.8 Fewer adults, who lived at the time of the SHS survey in the most deprived areas, had been taken to theatres, museums, historic sites, galleries and libraries as children than those who lived now in the least deprived areas (Scottish Government, 2009). This similarly applied to those with low incomes and those with the lowest level of qualifications. This diversity of experience was also reflected in participation in other activities such as reading books, drawing, painting, writing stories, poems, plays or music and playing musical instruments, acting, dancing or singing. The exception to the above was being taken to the cinema which was a more universal activity (Scottish Government, 2009).
- 4.9 The findings show that there has been an apparent increase in childhood exposure to culture over generations (Scottish Government, 2009). In the youngest age group of adults surveyed, the 16 to 34 age group, 40% had visited museums frequently when growing up compared to a much lower 26% for older adults. This also applies to other art forms such as going to the theatre, being encouraged to play musical instruments, act, dance or sing and similarly drawing, painting or writing.
- 4.10 This analysis of the SHS data indicates that there may be a connection between the differing experiences of culture in childhood and participation in adulthood. The People and Culture report states that this finding requires further investigation with more analysis to be undertaken in the future (Scottish Government, 2009).
- 4.11 The survey does not identify where respondents lived as children so it cannot attribute childhood experience to a demographic profile in adulthood. The report also suggests that more analysis is required to explore the individual impact of being encouraged to engage in culture as a child and subsequent adult participation. Finally, it finds that more people were encouraged to take part in these activities in childhood than do so now, suggesting that other factors which can affect adult participation should be taken into account (Scottish Government, 2009).
- 4.12 Other research has found that there are a number of ways in which participation in cultural activities can be encouraged. The Cultural Pathfinder programme in Scotland was comprised of projects which aimed to encourage participation among those who are often under-represented in cultural activities (EKOS, 2009). It found that a variety of approaches supported

participation. These included informality of approach, communities being engaged, targeting barriers to participation and the skills of those involved in delivering cultural events (EKOS, 2009). It did not explore the impact of childhood exposure on participation as adults.

- 4.13 The Scottish Arts Council commissioned surveys in 2004, 2006 and 2008 on audience participation (Scottish Arts Council, 2008). In its most recent survey in 2008, it found that approximately 90% of those aged 16 years of age and over attended or participated in at least one arts event in the previous 12 months to the survey. A lower 77% attended one or more arts or cultural event. Those who *attended* cultural events were most likely to be those in the 16 to 34 years age group, more likely to be from higher income groups, employed full time and with higher levels of educational qualifications. Those who currently lived in areas of deprivation were less likely to participate in cultural activities (Scottish Arts Council, 2008). The survey did not extend to those under the age of 16 years and did not explore the relationship of childhood exposure to adult participation.
- 4.14 There was no longitudinal information available in Scotland on childhood participation and how this impacted on adult engagement. This information might be more widely available in the future from ongoing longitudinal studies. The Growing up in Scotland (GUS) study, for example, is a longitudinal research project commissioned by the Scottish Government which is tracking the lives of a cohort of Scottish children from the early years. In its third sweep undertaken in 2007, parents were asked about the activities in which very young children take part (Bromley, 2009).
- 4.15 The GUS study found that 79% of children at 22 months had access to books or stories every day. Children from households which were less advantaged had less access to books (Bromley, 2009). At this age, 5% had been to the cinema, 17% had been to a sporting event and 73% had been to a variety of visitor attractions such as a zoo, farm or aquarium.
- 4.16 Those living in the most disadvantaged areas, with lower income, with mothers under 20 years of age or those with few or no qualifications had less access to these attractions (Bromley, 2009). The majority of parents thought that physical, education and social activities were very important. Those activities which were not rated so strongly included museum visits (18%) and watching television (6%). Children who had higher levels of activity had higher cognitive scores although the study points out that these findings might be related to a child having a social advantaged background (Bromley, 2009).
- 4.17 The People and Scotland report provides some recent research data on the potential impact of childhood exposure on adult participation in Scotland. There is no significant longitudinal data currently available; however the Growing up in Scotland study, which is focused on younger children, may provide useful data as the longitudinal study progresses.

5 RESEARCH ON ARTS AND CULTURE

- 5.1 The following section summarises studies which consider different factors impacting on childhood exposure to arts and culture on adult participation.

Surveys on childhood exposure to arts and culture

- 5.2 There are a number of studies which have analysed data from national surveys which have considered childhood exposure to arts and culture.
- 5.3 In England, the Taking Part survey has explored the area of the impact of childhood exposure on adult participation (Oskala et al, 2009). This survey is commissioned by the Department for Culture, Media and Sport (DCMS) in partnership with Arts Council England, Sport England, English Heritage and the Museums, Libraries and Archives Council. It considers adults' engagement in culture, leisure and sport. It has been running as a continuous survey since 2005 and gathers information from thousands of adults who are aged 16 years and over on an annual basis.
- 5.4 Analysis of the Taking Part survey found that there was a link between attendance and participation as a child in arts events and participation as an adult (Oskala et al, 2009). The findings from the 2005/06 survey show that being taken to arts events and getting encouragement to participate in activities as a child makes it more likely that he or she will be involved in arts activities as an adult. This is the case even when other factors such as age, gender, ethnicity, education, health, class, income and social status are taken into account (Oskala et al, 2009).
- 5.5 The analysis explored people's experiences of childhood attendance at arts events with parents and being encouraged by parents to participate in arts activities (such as drawing and painting, writing and composing, playing an instrument, acting, dancing and signing). It considered whether differences in the level of parental support for these activities were dependent on factors such as age and gender (Oskala et al, 2009).
- 5.6 The study found that frequency of exposure had an impact on adult attendance. Those who attended arts events more frequently as children were more likely to go to arts events as adults than those who went less frequently or not at all as children. The survey found that 22% of respondents had attended arts events with their parents at least once annually when they were children. This compared with 16% who attended arts events less than once a year and 63% who never attended events as children (Oskala et al, 2009).
- 5.7 Children whose parents were of higher socio-economic status attended arts events when growing up much more than those who were disadvantaged. Girls were more likely to attend events than boys. Those from black and minority ethnic groups were also less likely to have been encouraged to

participate in arts events. Younger children were more likely to be involved in these activities than older young people (Oskala et al, 2009).

- 5.8 The Taking Part survey analysis identifies a number of reasons why engaging with the arts as a child might have an impact on adult engagement. This includes familiarity with the experience of participating and attending arts events and knowing how to behave. In addition, being exposed to the arts as a child means that the arts are then viewed as an accepted activity in adulthood. Support from parents adds to the impact of this childhood exposure (Oskala et al, 2009).
- 5.9 There are other surveys which have also explored participation in arts and culture and considered the impact of childhood exposure on adult attendance. Creative New Zealand (2009) undertook a survey of 2099 adults of 15 years of age and over from New Zealand and is an update of a 2005 survey. A survey of young people aged 10 to 14 year olds was also undertaken. The vast majority of adults (86%) were involved as attendees or participants in arts activities. Over 99% of young people identified that they were involved in arts activities.
- 5.10 The findings identified that there was a strong commitment to the arts as part of public life in New Zealand with most people viewing the arts as part of everyday life and closely linked to their sense of national identity. Adults in the 15 to 24 years age group had higher engagement in the arts than any other adult age group. The survey found that income did not affect participation, nor did whether they lived in rural or urban areas. Lack of time was the most significant barrier to participation (Creative New Zealand, 2009).
- 5.11 The New Zealand survey found that self reported childhood experiences are significant predictors of both adult attendance and participation in arts activities. The study makes a distinction between adult attendance and participation but not between retrospective childhood attendance and retrospective childhood participation (Creative New Zealand, 2009). It defines 'attendance' as attendance at arts events and 'participation' as the making or presentation of art.
- 5.12 Half (51%) of adults who said that they were taken to arts events regularly as children *attended* arts events once a month or more as adults. This compares with 35% of adults who were taken occasionally, 25% who were taken rarely, and 26% who were never taken to arts events as children and who now attend arts events once a month or more (Creative New Zealand, 2009).
- 5.13 Nearly two thirds (63%) of adults who said they were taken to arts events regularly as a child were *active participants* in the arts as adults. This reduced to around half (49%) for those who attended occasionally, 42% for those who attended only rarely, and 41% for those who never attended arts events as children (Creative New Zealand, 2009).
- 5.14 In the survey of young people aged 10 to 14 years, over 70% had attended events during the last year with family and friends with girls more likely to

attend than boys. Parents were the most likely group of adults to encourage participation among young people. Time, cost and a lack of self confidence were the main barriers to getting involved. The association between childhood experiences and adult attendance is evident across all art forms measured in the survey. One of the most important predictors of non-attendance as adults is never having been taken to arts events as a child (Creative New Zealand, 2009).

- 5.15 A number of studies in the United States have used the Survey of Public Participation in the Arts to explore the links between childhood participation and adult engagement (Bergonzi and Smith, 1996; Gray, 1998; Kracman 1996; Orend, 1988; Orend and Keegan, 1996).
- 5.16 Studies by Orend (1988) and Orend and Keegan (1996) look at pre-adult socialisation in the arts and subsequent participation using the Survey of Public Participation in the Arts. The findings for the earliest study (Orend, 1988) indicate that having exposure to arts activities during childhood and early adulthood (up to 24 years) is a strong independent predictor of adult participation in the arts. The greater the number of pre-adult socialisation experiences that an individual respondent reported, the higher was the current level of participation by that individual. There was a higher participation among those who had these experiences across a wider age range during childhood. There was a stronger relationship to current participation if the respondent was an older child or young person at the time of socialisation.
- 5.17 Orend's (1988) research found that the medium in which childhood socialisation is reported is a predictor of interest in the same medium as an adult. Socialisation in a specific art form is a better predictor of adult participation in that art form than socialisation experiences which are linked to other art forms. However, those socialised in *any* art form are more likely to participate than those with *no* socialisation experience. Older people are likely to be more interested in specific arts forms than younger people. In addition, people from different age groups may make use of their leisure time in different ways (Orend, 1988).
- 5.18 Orend and Keegan's (1996) study suggest six types of socialisation experiences. These different experiences are defined as engaging in activities that make up 'the arts'; having formal learning in arts activities; being exposed to the arts at home; participating in arts audience activities; being told that they should participate in the arts by a parent, teacher or other adult and being influenced by behaviour or pressure from peers or other groups.
- 5.19 This study found that non-school based classes are better predictors of future participation than school based classes. Services, Orend and Keegan (1996) suggest, should therefore be targeted at voluntary activities and high-school and college. Although later socialisation experiences appear to have a stronger influence upon adult participation, it is important to emphasise the importance of early socialisation because it carries more weight for individuals who do not go to college (Orend and Keegan, 1996).

- 5.20 Bergonzi and Smith (1996) used data from the 1992 Survey of Public Participation in the Arts in the US to look specifically at arts education in school and the community. The study divides adult experience into arts attendance, arts creation and arts performance. Those who had more arts education were more likely to attend arts performances. The relationship with arts education was about four times stronger than that of any other factor which was considered. More than half the initial differences in attendance associated with an individual's ability to pay were removed by considering differences in arts education. Arts education was the strongest predictor of arts creation, reducing the effect of socio-economic status substantially. Arts performance was the only type of arts participation that was not predicted by arts education despite the probable dominance of arts performance as a goal within arts education (Bergonzi and Smith, 1996).
- 5.21 Bergonzi and Smith (1996) found that arts education was the strongest influence on all types of arts participation with arts performance being the exception. Those with the most arts education were also the highest consumers and creators of various forms of visual art, music, drama, dance, or literature. Similarly, the higher an individual's socio-economic status, the more likely a person participated in arts activities. On the other hand, at least half of the effect of socio-economic status on all types of arts participation was attributable to differences in arts education (Bergonzi and Smith, 1996).
- 5.22 Kracman (1996) also used data from the 1992 Survey of Public Participation in the Arts. This analysis looked specifically at the influence of school-based arts classes on adult attendance. The study concludes that school based arts classes had approximately the same influence as community-based classes. Children's attendance at these classes was less likely to be influenced by socio-economic factors such as race and parents' education. It is suggested that school-based classes are where policy should be focussed (Kracman, 1996).
- 5.23 Gray (1998) explores whether, and to what extent, early exposure to the arts affects participation as an adult using the US 1997 Survey of Public Participation in the Arts. The paper focuses on childhood art lessons (either in or out of school) and the impact on subsequent visits to art museums. The research found that art lessons taken by children under 12 years were positively and significantly associated with adult visits to museums. Arts lessons for young adults aged 18 to 24 years indicated an even more powerful association. On the other hand, arts lessons for young people in the age group attending middle to high school had neither a strong nor significant association (Gray, 1998).
- 5.24 Nagel and Ganzeboom (2002) report on a longitudinal survey from the Netherlands which looked at the cultural participation of 1033 participants at approximately 14 and 30 years of age. The study also looked at the cultural participation of parents, siblings and school mates of participants.
- 5.25 The key findings from Nagel and Ganzeboom's (2002) research are that both schooling and family background have a significant impact upon adult cultural participation. However, the study finds that family influences were about

three times stronger than that of formal education at secondary school level. The study also finds that there was a lot of consistency between retrospective reported cultural participation at the age of 14 years and cultural participation at 30 years of age (Nagel and Ganzeboom, 2002).

- 5.26 Robson (2003) analysed activity diaries kept by young people aged 16 years of age and survey data (of those aged 29 years of age) from the British Cohort Study of 1970. This research has a unique perspective as this data on childhood exposure was not collected retrospectively but was undertaken as part of a long term study. The paper looks at the interplay between cultural capital of young people aged 16 years of age and the social and economic capital of those aged 29 years.
- 5.27 By considering research data in the context of Bourdieu's theories of cultural capital, Robson (2003) identifies that children who are exposed to and participate in cultural activities have knowledge and familiarity which makes it easier for them to incorporate such activities into their lives. The author suggests that some discussion about whether being 'exposed' is sufficient or whether an individual also needs 'skills and abilities' to activate this capital. 'Habitus' is defined as the capital (investment in time) plus the skills and abilities needed to make use of the capital built up. Robson (2003) finds that there is evidence of how cultural engagement over time then impacts on adult economic and social capital. Robson suggests that capital can be 'converted' from the cultural to social or economic.

5.28 Although there is not an extensive body of survey based research, there are a number of examples of studies which use survey data and identify that there is a correlation between early experience and adulthood engagement. These studies identify that a number of different factors impact on participation in different ways including family background, exposure to arts education, frequency of attendance, socio economic status and being from a black and minority ethnic group. Some of these factors are not constant in their influence such as the impact of socio economic status (Creative New Zealand, 2009; Oskala et al, 2009).

Early socialisation and childhood exposure

- 5.29 A number of studies highlight the importance of parental interest on childhood engagement. Zakaras and Lowell's (2008) report on cultivating demand for the arts in the United States explores research which has looked at the links between young people's learning and participation in the arts as adults. Their analysis of small scale research studies confirms that positive experiences in childhood in the home, in the community and school, support an interest in these experiences as an adult.
- 5.30 Zakaras and Lowell (2008) also highlight that a broad-based approach to arts education will result in encouraging long-term involvement in the arts as opposed to an approach focused solely on arts production. They suggest that there needs to be greater connection made between arts learning and

participation. The report also suggests that there are gaps in research with more needed on the family factors that may influence participation in the arts (Zakaras and Lowell, 2008).

- 5.31 McCarthy et al (2001) assert that participation in the arts increases as a result of adults being exposed to the arts as children. In a guide to the literature on participation in the arts in the US, the authors state that arts participation increases as education improves and when more adults have experience of being exposed to the arts when they are young. The guide points out, however, that it is not known why some people continue attending as adults but others do not. There is not a wide understanding of what are the determinants of individual taste (McCarthy et al, 2001).
- 5.32 Studies from the 1980s and 1970s highlight findings which are relevant for this review. Bamossy (1982) surveyed audiences at dance performances in Utah, US in order to examine a number of variables relating to childhood experiences in order to predict whether or not an individual is likely to become active in attending arts events. It was found that parental interest and non-interest correlated with self reported childhood interest and non-interest. This parental interest also had an influence on childhood attendance and childhood participation in arts activities. Music and dance classes taken as a child appeared to influence attendance rates as a child, but art and art appreciation classes did not. As the variety of classes attended as a child increased, so did the variety of arts events attended as an adult (Bamossy, 1982).
- 5.33 Morrison and West (1986) reporting on a survey of audiences attending arts events in Ontario found that 57% had been taken to the theatre when growing up and 72% had been involved in arts activities such as drama, dancing or learning a musical instrument in school. The authors suggest that this demonstrates a link between childhood and adult experience. However, they also state that there was little to affirm a direct correlation between exposure as a child and adult demand. They point out that there are problems in bias of sampling in surveys undertaken in the 1980s. Their conclusion is that child participation emerges as more important than child attendance at arts events (Morrison and West, 1986).
- 5.34 DiMaggio and Useem (1978) undertook research on the influences on arts participation although not specifically the link between childhood and adulthood participation. The authors suggest that arts consumption varies by social class and that there is, generally, intergenerational continuity in consumption. Socialisation and education help to explain the continuity between generations. Family socialisation is important for ensuring that class-related traditions in relation to the arts are maintained between generations. In addition, cultural capital is used as a means of enabling class mobility and is converted into economic capital (DiMaggio and Useem, 1978). Although this research is from the 1970s, other research findings in this review indicate that the arts and culture is still accessed predominantly by those from less disadvantaged backgrounds (Oskala et al, 2009).

- 5.35 Georg (2004) considers the impact of cultural capital on educational achievement. The article suggests that cultural capital may be a factor that contributes to maintaining social inequalities. This happens because schools assume a certain level of cultural capital. Children who do not have certain cultural experiences fall behind in school because they do not have the assumed knowledge.
- 5.36 The relevant finding for this review is that a ‘follow-up’ study of students (mean age at first survey 16 years and at second survey 35 years) found that orientation to formal culture is very stable between adolescence and adulthood (Georg 2004).
- 5.37 Research shows that encouragement from parents as well as positive experiences and being from advantaged backgrounds results in greater exposure to arts and culture. Early socialisation is important to developing long term interest and engagement in arts and culture.

Factors which support engagement

- 5.38 Culture on Demand, a report by Fresh Minds (2007) and commissioned by the UK Government’s Department for Culture, Media and Sports (DCMS) is based on a study which explores what motivates people to engage with culture. It suggests ways to tackle non-engagement, focusing on drivers for demand for culture among people with disabilities, people from black and minority ethnic (BME) communities and people from lower income groups. It provides insights and evidence which are particularly useful for this review.
- 5.39 The report identifies a number of key drivers for these groups. These include practical factors, negative experiences, the desire to feel ‘normal’, developing a sense of confidence and therapeutic and health benefits for disabled audiences (Fresh Minds, 2007: 9). For black and minority ethnic groups, issues of identity, being ‘cultural relevant’ and culture activities which involved children, family and socialising were important drivers. For those from lower income backgrounds, socialising was a significant factor along with culture relating to local identity and interest, social networks and community engagement.
- 5.40 The report emphasises the importance of childhood exposure as having an impact on later engagement with culture. Attention is drawn to the importance of active participation compared with attendance at culture events when young. The implication is that ‘efforts should be made to foster amateur groups and to include active participation in a child’s educational journey’ (Fresh Minds, 2007:10).
- 5.41 According to the report, a number of areas reoccur in examinations of cultural engagement (Fresh Minds, 2007). There are, for example, different understandings of what is culture. These, in turn, impact on how cultural engagement is measured. The report highlights that there is a lack of original research as well as a tendency to rely on standard socio-economic

classifications. In addition, existing datasets are relevant only for particular groups or cultural activities. Crucially, and as has been found in this literature review, there is a lack of sufficiently large studies which explore motivations for engagement with culture, with most evidence derived from small scale studies (Fresh Minds, 2007).

- 5.42 In order to explore this area, the authors of the report have developed what are called sub drivers to identify demand. The drivers include children, family and networks: socialising and social networks, identity, place, experience and trust. Under the category of experience, childhood exposure is identified as 'driving adult demand for culture. Positive and enjoyable experiences can lead to a cultural habit' (Fresh Minds, 2007: 54). This is seen to have medium applicability for disabled groups, high applicability for BME groups and medium applicability for lower income groups.
- 5.43 Thirty drivers are identified which determine demand for cultural activities (Fresh Minds, 2007). There are several which have an explicit or obvious link to the impact of childhood exposure on adult participation. These include arts education, developmental factors, positive and negative childhood experiences, formal education, previous experiences, socio cultural access and social networks including family.
- 5.44 The Culture on Demand report states that experience appears to shape engagement. Positive experiences overcome 'soft barriers' while negative experiences reinforce these barriers. Childhood exposure supports children by providing them with the 'tools by which culture is consumed and understood' (Fresh Minds, 2007: 52). The report points out that parents engage with the arts in order to educate, entertain and support their children. Parental influence in childhood is important for attitudes to culture in adult life (Fresh Minds, 2007).
- 5.45 Culture on Demand finds that people who are from BME backgrounds will have had more negative experiences of culture at school. Their parents may not have had opportunities for extensive cultural engagement. There is a connection between negative experiences in childhood and lack of adult engagement in arts and culture (Fresh Minds, 2007).
- 5.46 A report on attending heritage sites was commissioned by English Heritage and draws on data from the Taking Part survey (Centre for Economics and Business Research, 2007). It explores people's reasons for attending and not attending heritage sites. It focuses on social-economic factors, demographics, opinions and personal information, and geography. It finds that being taken as a child to a heritage site had a stronger correlation with attendance as an adult than other factors that are studied. The analysis also found that those who were encouraged to both read and write as children and were taken to other places of interest were more likely to attend heritage sites (Centre for Economics and Business Research, 2007).
- 5.47 PLB Consulting (2001) undertook a review of existing evidence and literature to examine how small and medium-sized heritage organisations might better encourage people from under-represented groups to engage with their

heritage and to participate in heritage-oriented activities. The review emphasises the importance of positive initial childhood experiences, citing research that a significant number of adult non-attenders of museums state that they had a negative experience of museums in childhood (PLB Consulting, 2001). In addition, people who rarely or never visit museums perceive these institutions as being exclusive and think that they do not have the skills to understand the displays (PLB Consulting, 2001).

- 5.48 The report states that research has shown that some people do not access heritage activities and places 'due to a residual feeling from childhood that museums, galleries, historic houses et al are dull and boring.' (PLB Consulting, 2001: 72). This suggests that some groups of people believe that museums and other heritage visitor attractions 'are not for them' and that this may be related to lack of childhood exposure. It also suggests that the quality of exposure is also important and that negative exposure might indeed have a poor impact on adult attendance or participation (PLB Consulting, 2001).
- 5.49 Walker et al's (2002) survey of cultural participation in five communities in the United States looks particularly at individual and community factors that influence participation and using a broad definition of cultural activities.
- 5.50 Walker et al (2002) found that those who attended cultural activities as children attended more cultural events as adults than those who did not have this previous experience (Walker et al, 2002). Those who had participated in arts classes, both as children and adults, were also more likely to attend arts events. Being taken to cultural events as a child was one of five factors which influenced adult participation in the arts. The study found that early experiences made a difference in adult participation even when income and education background were considered. Walker et al (2002) state that parents taking children to cultural activities increases children's participation skills as well as expectations of involvement in culture if these cultural activities are seen to have social status. Some communities are more 'opportunity rich' than others and these opportunities can be more diverse and therefore accommodate a wider variety of interests (Walker et al, 2002).

5.51 There are a number of drivers for engagement in arts and culture. These include family, early experiences and quality of event. There are different understandings of culture and some people have had a negative experience of culture and see it as 'not for them'. In addition, some groups, such as BME groups, are under-represented in participation in arts and culture. Positive early experiences are found to be a significant driver in adult engagement in arts and culture.

6 SUMMARY: ARTS AND CULTURE

- 6.1 The review has found that there is some research which considers the impact of exposure to arts and culture as a child, on adult participation. Studies do suggest that childhood exposure is important in relation to adult participation in the arts (Bamossey, 1982; Creative New Zealand, 2009; Fresh Minds, 2007; Morrison and West, 1986; Orend, 1988; Orend and Keegan, 1996; Oskala et al, 2009; Robson, 2003; Walker et al, 2002). Although these research studies indicate that there is a link between childhood exposure and adult engagement, there is not an extensive body of research in this area. This is particularly the case in the UK.
- 6.2 Discussions about participation often refer to debates on cultural capital (DiMaggio and Useem, 1978; Fresh Minds, 2007; Nagel and Ganzeboom, 2002; Robson, 2003). Matarrasso (1997), for example, lists 50 social impacts of arts participation. Cultural capital is viewed as being about both knowledge and skills. Research highlights that access to cultural capital can impact upon social and economic capital and educational achievement (DiMaggio and Useem, 1978; Robson, 2003).
- 6.3 Studies show that early exposure, often identified as socialisation, is important in developing skills, experience and knowledge in accessing culture (Orend and Keegan, 1996; Bergonzi and Smith, 1996; Nagel and Ganzeboom, 2002; Walker et al, 2002). Encouraging participation is key to overcoming barriers. Frequency of participation and exposure as a child is shown to establish habits of attendance which are continued in adulthood (Bergonzi and Smith, 1996; Creative New Zealand, 2009; Kracman, 1996; Orend, 1988; Robson, 2003).
- 6.4 There are differences in early experiences and access to arts and culture which are related to particular circumstances such as low income, family and educational background, disability and being part of a BME community (Bromley, 2009; DiMaggio and Useem, 1978; Fresh Minds, 2007; Nagel and Ganzeboom, 2002; Oskala et al, 2009; Scottish Arts Council 2008; Scottish Government 2009). In these circumstances, adults may not have had the same access to arts and culture or may have faced barriers in accessing culture as children. As a result, they may not participate in culture as adults (Fresh Minds, 2007; Oskala et al, 2009; Scottish Government, 2009).
- 6.5 Research points out that there is a distinction between participation and attendance and arts based learning (Bergonzi and Smith, 1996; Morrison and West, 1986; Orend and Keegan, 1996). Some research shows access to arts based learning in schools or in the community negates the negative influence of socio-economic factors (Bergonzi and Smith, 1996; Kracman, 1996; Walker et al, 2002).
- 6.6 There are few longitudinal studies or large scale surveys which have measured the impact of exposure to culture in childhood on participation in arts and culture in adulthood, particularly in the UK. However, there is a prevalence of small scale studies (Fresh Minds, 2007). Analysis of the

- Taking Part survey (Oskala et al, 2009) and the SHS survey data (Scottish Government, 2009) will increasingly provide a valuable source of data on recalled childhood and present adult cultural participation for further analysis for both England and Scotland.
- 6.7 The gap in research in areas of arts and culture is confirmed by the work of other reviews and studies. Ruiz (2004) identifies that there are few longitudinal studies which evaluated the impact of the arts over a period of time. Galloway (2008) points out that those who have looked at the evidence have noted that there is little evidence of the impact of cultural activities on communities, local neighbourhoods or across groups of people. Galloway et al (2005) highlight that there is little empirical research around quality of life and culture and sport.
 - 6.8 There is more research on childhood exposure and adult participation in the United States, where a number of national studies on participation in the arts have been undertaken (McCarthy et al, 2001). However, McCarthy et al (2001) in their review identify only a small number of studies which have explored this particular area. They suggest that more research is required which also controls for other factors which might influence adult participation. Studies from the Netherlands (Nagel and Ganzeboom, 2002) and New Zealand (Creative New Zealand, 2009) have also analysed the impact of childhood exposure on adult participation and provide useful insights which are relevant to Scotland and the UK.
 - 6.9 The nature of participation can include a variety of different forms of engagement from regular participation, to less frequent or one off engagement (McCarthy et al, 2001). It *may* be that the impact of infrequent attendance at or participation in, cultural events and activities as a child might be sufficient for triggering long term interest in arts and culture (McCarthy et al, 2001). Matarasso (1997) points out that the outcomes of arts participation are complex and multi-dimensional. It is therefore difficult to identify which factors have a particular impact on participation as an adult.
 - 6.10 In addition to the lack of a significant body of research, it appears that there are a number of challenges inherent in identifying the impact of childhood exposure on adult participation. Analysis of the Taking Part report (Oskala et al, 2009) highlights that the ability to accurately recall childhood experiences decreases with age. In addition, participation in arts based activities can change during adulthood (Orend, 1988). Future research would have to take these age-based differences into account.
 - 6.11 There may also be wider changes taking place in participation in cultural activities which need to be considered in future research. Recent research such as the Scottish Household Survey (Scottish Government, 2009) and analysis of the Taking Part survey (Oskala et al, 2009) appear to show that more children and young people are accessing arts and culture than in the past. The survey of arts in New Zealand shows that young people access more culture than older adults (Creative New Zealand, 2009). These changes might be due to a number of different factors, such as increased opportunities to access the arts, more interest among young adults in the arts and greater

parental awareness of the benefits of facilitating children's participation in arts and culture. Walker et al (2002) note that people are found to have participated in more arts and culture when wider definitions of participation are used. This is applicable to those from more disadvantaged as well as advantaged backgrounds (Walker et al, 2002). This suggests that a broader and more encompassing view of arts and culture is needed in research.

7 REVIEW OF INFORMAL SCIENCE

Introduction to review of informal science

- 7.1 The second part of this literature review considers the impact of childhood exposure on adult participation in the area of informal science. The review focuses predominantly on informal science activities which are accessed through museums, science and discovery centres although informal science learning can take place in a range of places and environments. This emphasis is partly because there is a greater body of research associated with the activities of museums, science and discovery centres.
- 7.2 The environments which can foster informal science include the home, museums or centres, community organisations, outdoor places, participation in clubs and the media (Bell et al, 2009). The breadth of activities that have potential for informal science include those that are 'designed' (or take place in designed locations) and those that occur 'naturally' as part of (or as a by product of) day-to-day life (Bell et al, 2009; Falk et al, 2007; Sladek, 1998). McCallie et al point out that people's understanding of science is informed by 'knowledge and perspectives from non-science domains' (2009:11). This range of influences creates challenges when researching the impact of particular environments on people's engagement with informal science.
- 7.3 A significant body of the research on the impact of informal science is focused on science and discovery centres and museums. These environments present informal science in a variety of ways although they share the same general aims. A report produced by the House of Commons Select Committee on Science and Technology (2007) states that museums house collections while science and discovery centres do not. Ecsite-UK (now the Association for Science and Discovery Centres) groups 'science and technology museums, zoos, aquaria, and science centres' as Science and Discovery Centres (Ecsite-UK, 2008). The overarching common objective of these attractions is that they promote science learning outside a formal classroom context. Science and discovery centres provide interactive exhibitions and programmes, encouraging 'active personal exploration and enquiry' (Ecsite-UK, 2008: 5).
- 7.4 Science and discovery centres are very popular with substantial numbers visiting these organisations. The Ecsite-UK (2008) report on the value of science and discovery centres in the UK identifies that over 19 million people visited UK science and discovery centres in 2005-06. Persson (2000) draws attention to the substantial global increase in science centres. There is a growing body of research which examines the impact of science and discovery centres and museums. The increase in the numbers of science and discovery centres in the last 10 to 15 years suggests that research on the impact of these centres is still growing in line with their development.
- 7.5 Informal science is commonly associated with educational objectives and professional choices in careers. STEM is the acronym used for science,

technology, engineering and mathematics. There has been a strategic focus on encouraging young people to take up study and career options in these areas. The Select Committee into Science and Technology (2007) identifies that the key objectives of science and discovery centres include encouraging young people to take up careers or study in the STEM areas as well as providing a stimulus to children in the areas of science.

- 7.6 As in the area of arts and culture, the impact of childhood exposure on adult engagement can be explored, either through longitudinal research which measures impact over time or through adult reflections on childhood experiences which can include large scale surveys. Although there are a range of useful studies which provide insights into this topic, this review found that there was not a significant body of research which drew on either longitudinal studies or adult reflections on childhood experiences.

8 RESEARCH ON INFORMAL SCIENCE

Role of informal science

- 8.1 The aims of informal science are to facilitate a variety of experiences including extending learning, increasing understanding and promoting interest in different areas of science. In order to do this, science centres provide opportunities which can motivate, excite and improve attitudes to science (Barriault, 1998). Bell et al (2009) suggest that outcomes associated with learning science in informal settings include 'inspiring emotional reactions, reframing ideas, introducing new concepts, promoting deep experiences of natural phenomena, and showcasing cutting-edge scientific developments' (2009:41).
- 8.2 A substantial body of the research on impact in informal science is focused on its influence on formal education and professional choices. Learning is seen as cumulative with earlier experiences impacting upon later experience, leading potentially onto further enquiry (Bell et al, 2009; Javlekar 1989, Stevenson 1991). Falk et al (2007) highlight that there is still not a great deal known about the motivations associated with what they call 'free-choice science learning' (Falk et al, 2007: 456). The House of Commons Select Committee on Science and Technology (2007) draws attention to the importance of public engagement in issues around science. Persson (2000) states that there is a need for research in order to better understand informal learning and its relationship to wider society.
- 8.3 The long-term objectives of science and discovery centres are linked closely to stimulating the interest of children and young people in order to influence future study and career options. Trautmann and Lewenstein (2009) point out that the main audience for science centres is pre-adolescent children and their parents and carers. Centres are seen as family friendly environments (Ecsite-UK, 2008). A report on the impact of millennium science centres commissioned by the Wellcome Trust identified that five UK science centres were perceived as mainly educational organisations targeted at children (CRG Research Ltd, 2006). Science centres also have a valuable role in supporting teachers and formal learning (HMIE, 2007). This emphasis on learning, career options and professional development suggests that there may be less focus on adult participation which is unrelated to children's learning and engagement.
- 8.4 The focus on adults is often associated with their roles as family members and professionals facilitating children's access to informal science. A growing number of studies such as those by Falk et al (2007) and Bell et al (2009) consider a wider range of reasons for accessing informal science opportunities. Bell et al (2007) point out that adults who engage in informal science learning come from diverse settings and backgrounds. Falk et al (2007) explore learning across the life course. The authors point out that lifelong scientific enquiry does not necessarily mean lifelong attendance of science centres or other informal education settings. It can include a variety of activities (Falk et al, 2007).

- 8.5 It is suggested that informal science does not always have clearly articulated shared aims (Gammon, 2009). Others point out that it is difficult, however, to have clear aims because many of the impacts are unintended and grow out of the flexibility and responsiveness of the experience (Bell et al. 2009). McCallie et al (2009) suggest that understandings of what is engagement vary considerably across the areas of informal science education and public engagement in science. These perspectives suggest that it is difficult to explore the impact of childhood exposure on adults' participation because of the diverse range of aims of informal science and the different understandings of engagement and therefore participation.
- 8.6 Research studies highlight that there is a lack of evidence, including longitudinal data, on the impact of informal science (Bell et al, 2009; Frontier Economics 2009, House of Commons Select Committee, 2007; Trautmann and Lewenstein 2009). The Wellcome Trust's impact assessment of five UK science centres notes that centres collect data in different ways and that only broad comparisons can be made between them (CRG Research Ltd, 2006).
- 8.7 Studies also highlight the challenges of research in the area of childhood exposure and adult engagement (Ecsite-UK, 2007; Frontier Economics, 2009; Gammon, 2009; Rennie and McClaffery 1996). Trautmann and Lewenstein (2009) state that it is difficult to evaluate long term impact as the relationship between cause and effect might not become apparent for many years. Frontier Economics (2009) identify that is challenging to identify the impact on professional choices in adulthood due to the number of factors that can influence people's decisions. Bell et al (2009) point out that there are not effective outcome measures available to assess goals associated with informal science settings. They suggest that it is important to improve the quality of evidence that is available and for research to be undertaken on how informal learning experiences develop over the short, medium and long term. In order to do this, it is important to explore what factors motivate informal science learning (Bell et al, 2009).
- 8.8 The following section summarises findings from studies which are relevant to the impact of exposure in childhood on adult participation in the area of informal science.

Impact of informal science

- 8.9 A review of studies on the impact of science and discovery centres (Ecsite-UK, 2007) draws on research from around the world into the impact of science and technology centres, museums and zoos. It finds that interactive science exhibitions do increase the knowledge and understanding of those that visit these attractions. It also states that there is a body of evidence which indicates that science and discovery centres provide learning experiences which can impact on attitudes and behaviour in the longer term. In addition, science and discovery centres bring a range of personal and social benefits and encourage inter-generational learning. They also appear to have an impact on their local areas economically and encourage greater trust and understanding between the wider public and professional scientists (Ecsite-UK, 2007).

- 8.10 Research into learning in science and discovery centres focuses on learning outcomes. It identifies that there is, at a minimum, an increase in learning in the period immediately after visiting centres (Ecsite-UK, 2007). However, the ambition of changing the public's attitudes through visits to science centres is often seen as too simplistic and does not take account of an individual's own 'knowledge, attitudes and behaviour' (Ecsite UK, 2007: 6). The evidence, although it appears to be focused on short term outcomes, indicates that science and discovery centres can 'elicit powerful emotions, which help create memorable learning experiences' (2007: 6). The report suggests that these experiences can have long lasting impacts.
- 8.11 The Ecsite-UK review highlights a wide range of studies which have measured impact but these predominantly focus on the impact of childhood learning rather than the longitudinal impact of childhood exposure on adult engagement. The review suggests that future research could explore the area of sustained and long lasting impact (Ecsite-UK, 2007).
- 8.12 Frontier Economics (2009) undertook research looking at the value of science centres in England relating to the UK Government's science and society agenda. This agenda aims to increase the numbers of young people studying STEM subjects as well as strengthen high level engagement with the public on major science issues. In addition to these objectives, there is an emphasis on ensuring that people from a diverse range of social backgrounds can participate. This involves targeting 'hard to reach' and disengaged groups who are currently under-represented in science activities and areas (Frontier Economics, 2009).
- 8.13 Frontier Economics (2009) found that it was difficult to assess if science centres were value for money as there was not enough evidence on the long term outcomes of these resources and similar programmes. The report finds that there was not substantial evidence from evaluations and there was not sufficient reliable data on the long term impact of science centres. It highlights that data collection could be improved drawing on quantitative and qualitative data. The report suggests that it may be useful to add questions to existing longitudinal surveys while emphasising that longitudinal studies are resource intensive (Frontier Economics, 2009).
- 8.14 The House of Commons Select Committee into Science and Technology undertook an inquiry into science and discovery centres (Select Committee on Science and Technology, 2007). The Select Committee took evidence on a number of areas. This included the role of science and discovery centres, both in engaging the public and in encouraging young people to study science and undertake scientific careers. It also considered the funding of centres. The inquiry points out that there has been a substantial growth in the establishment of science centres during the last 20 years (House of Commons Select Committee into Science and Technology, 2007). Drawing on responses to the inquiry, the Committee's report states that these centres provide informal education across scientific and technological areas and cover diverse areas. What they have in common is the use of interactive exhibits and the promotion of active learning (House of Commons Select Committee into Science and Technology, 2007).

- 8.15 The Committee's report highlights that centres aim to inform and to engage the public on scientific issues. The report points out that there is limited research evidence of their impact in achieving these goals. In its recommendations, the Select Committee urges Government to commission independent research to assess the role of science centres. The inquiry report points out that the work of science centres is only one possible contributor to young people's educational and professional choices. To undertake a proper assessment of impact, the Committee suggests that multivariable longitudinal studies are required (Select Committee on Science and Technology, 2007).
- 8.16 Gammon (2009) considers whether the long term impact of science engagement can be assessed. He suggests that it is difficult to know what is being looked for or how to find information on long term impact. Gammon explores the challenges and the lack of clarity around what are the long term impacts that are being measured and how to measure them.
- 8.17 Rennie et al (2003) consider the possibilities of advancing research on science learning in out of school settings. They suggest that there are six strands which could be a focus for future research in the area of informal science. One of these strands is longitudinal research with an emphasis on exploring cumulative learning and impact. The authors suggest that longitudinal studies in informal science are difficult to undertake because participants are more difficult to track down or stay in touch with compared to participants in formal settings.
- 8.18 Rennie and McClafferty (1996) review the literature on interactive science centres and their role in contributing to learning about and understanding science. The review suggests using a model developed by Falk and Dierking (1992) which uses physical, social and personal contexts in order to understand the factors that have an impact on visitors' experiences. The review highlights the role of parents in facilitating children's visits and learning. The authors discuss the methodological challenges of measuring impact as each visitor's experience is unique. The paper identifies that it is difficult to measure unintended outcomes and that there are ethical and practical problems around collecting data (Rennie and McClafferty, 1996).
- 8.19 Johnson (2009) in a web article, *Science Centres as Learning Environments*, for the Association of Science-Technology Centres, identifies that it is difficult to measure long-term impact because there is a time gap between the actual experience and making sense of this experience (Johnson, 2009). This learning experience, Johnson points out, can be more 'random' than that of the classroom. In addition, the free-choice environment leads to more individualised learning, the benefits of which emerge over time. It supports teachers and parents in their roles and provides discursive ways of articulating ideas and providing learning opportunities.
- 8.20 Studies from the 1980s and 1990s highlight the role of science centres. Javlekar (1989) found that science centres were innovative in engaging in new approaches which were interactive. These participatory ways of presenting science resulted in an enhancement of scientific concepts.

Science centres were an important contributor to formal and informal learning in science (Javlekar, 1989). Wellington (1990) suggests that science centres can contribute to greater public awareness of science. Centres can have a significant role in promoting scientific literacy which, in turn, promotes enthusiasm, interest and involvement in science.

8.21 Studies and reports have highlighted the importance of exploring the long term impact of science engagement relating to science and discovery centres and museums. Those writing about informal science and visitor attractions suggest that there is a need for robust studies which can explore the long lasting impact of learning in childhood and its impact on adults. There is a need for reliable data which takes into account different variables which impact on interest in informal science.

Impact of childhood exposure

- 8.22 There are a number of research studies which consider the place of informal science in life long learning and the impact of early experiences on later interests and choices relating to informal science
- 8.23 Bell et al (2009) in *Learning Science in Informal Environments in Informal Environments: People, Places and Pursuits* explore in detail the influences on people's engagement in informal science. The authors identify that the area of informal science is a developing and extensive area of study. They draw on ideas from educational research which emphasise the importance of viewing learning as a cultural process (Bell et al 2009).
- 8.24 Bell et al (2009) highlight the importance of life long learning across the life course. In addition, 'life-wide learning' which is defined as learning across diverse environments, and 'life-deep learning', which reflects 'beliefs, ideologies and values' (Bell et al, 2009: 28), are seen as associated learning concepts which contribute to life long learning experiences. Bell et al (2009) use these three inter-related concepts to explore science learning across settings and environments. Science learning, they suggest, is a 'cumulative process' where the initial experience is the 'product of events' which happen in advance of, and after, this experience (Bell et al, 2009: 312). The process of understanding the impact of childhood on adult engagement is highly complex and requires further exploration.
- 8.25 Bell et al (2009) highlight that people bring explanations from others to bear on their understanding of scientific knowledge from a young age. This suggests that learning in informal environments should enable participants to explore and scrutinise their own knowledge and ideas. At the same time, other elements can contribute to science learning which are outside the area of clearly defined formal or informal science. The importance of media and technologies such as television and the internet is emphasised in learning science. It is pointed out that digital resources are developing quickly and increasing in influence (Bell et al, 2009).

- 8.26 Anderson et al (2007) review the literature on long-term impact. Their review focuses on memories and learning rather than future visiting behaviour. Three factors are identified as influencing 'vivid' long term memories of visitor experiences. These are reflections on the memories of the experience, the emotional affect which is related to the experience and, finally, the extent to which an individual's personal interests were met by the visit (Anderson et al, 2007).
- 8.27 Medina-Jerez (2008) suggests that one of the aims of science education should be to provide a link between people's daily lives and science. He suggests that 'classroom science' reflects a Western world view and participation can be particularly difficult for those from black and minority ethnic backgrounds. Medina-Jerez (2008) points out that informal science learning is a way into science for groups who might not access science knowledge through formal science education.
- 8.28 Falk et al (2007) highlight that science education has traditionally focused on formal learning. They argue that most people develop an understanding of science during their lives and that this learning includes 'attitudinal and behavioural change, as well as changes in conceptual understanding' (Falk et al, 2007: 455). The authors draw attention to a body of evidence which confirms that people seek out these experiences in relation to work, personal interest and as adults taking children to science attractions and facilitating out of school learning. People choose to learn through their own life experiences (Falk et al, 2007).
- 8.29 Sladek (1998) reports on an evaluation of informal science education projects funded by the National Science Foundation (NSF) in the US between 1984 and 1994. Sladek compares NSF and non NSF funded programmes. These programmes include a range of informal science activities ranging from those taking place in museums, science centres, activities at libraries, community and youth centres to films and television programmes. Sladek (1998) identifies that participating in informal science education is chosen as a voluntary activity and is self-directed and lifelong. Understanding of science and technology cannot be attributed to a single factor. The report suggests that there are a number of benefits associated with participating in informal science education. These include increased understanding of different concepts, ideas and subjects which are associated with scientific disciplines. It also includes more awareness of professional and career opportunities (Sladek, 1998).
- 8.30 Sladek (1998) found that those working in science related areas identify that their first interests were associated with informal science opportunities such as visiting museums and science centres. The report draws on data from a survey of people in science careers undertaken by the COSMOS Corporation in 1996. It found that visiting a planetarium, aquarium or zoo had provided the most memorable childhood informal science activity (92.9%) followed closely by visiting a science or natural history museum (85%). Other activities which provided strong childhood memories included having a hobby or toys and choosing to read books or magazines. The report identifies that there is very little longitudinal data (Sladek, 1998).

- 8.31 Falk and Dierking (1990) asked 12 graduate students enrolled in a museum education class in the US about their recollections of childhood museum visits. The researchers interviewed participants about their memories of childhood museum visits. All had at least one memory that they could recall. Just over half of participants identified that they had been frequent museum visitors as children. In particular, they remembered family occasions such as birthdays and holidays and the impact of the visit. They remembered specific exhibits or objects but did not recall general concepts. Frequent and infrequent visitors remembered the visits in different ways. Falk and Dierking point out that experiences of museums in childhood are 'recalled within a larger social, physical and temporal context, are bound into an individual's memory in often idiosyncratic ways' (1990:100). Falk and Dierking (1990) suggest that more research in this area would be helpful, especially if it had a focus on the affective impact of museum visits.
- 8.32 Salmi's (2003) research with first and second year students in Finland indicates that there is a correlation between exposure to informal science learning opportunities and higher education choices. Spock (2000) asked 75 professionals who worked in museums about the formative experiences which contributed to their future professional interests. Spock found that childhood memories of museum experiences when young were 'vivid, relevant and lasting' (2000:28). These, and other narratives that were collected by Spock, suggest that exposure to museum can provide formative experiences that can profoundly affect people's lives. The author suggests that professionals' self knowledge about the formative experiences of childhood can provide an impetus to developing more effective experiences for children and young people in the here and now (Spock, 2000).
- 8.33 Trautmann and Lewenstein (2009) undertook a survey of US high-school students to look at whether science museums have changed students' attitudes to science. Their study considered how science centres impact on participants' attitudes in the long term. It was based on the premise that children and young people lose interest in visiting science centres at the age of 11 and 12 years. The researchers therefore surveyed 17 to 18 year olds in order to consider the long-term impact of earlier visits.
- 8.34 Their study found that there was some evidence that science centres impacted upon young people's attitudes and interests. This became more evident the more visits that young people made. However, the study is very careful to point out that this does not suggest causation. Students who are interested in science, for example, may visit science centres more. Trautmann and Lewenstein (2009) found that visits to science centres and museums have the potential to impact on attitudes to science as well as career choices in science.
- 8.35 Stevenson's (1991) research on the long-term impacts of interactive exhibits tracked visitors' visits to the London Science Museum. They were interviewed immediately after their visit and then six months later. In follow-up interviews, participants were able to recall what they did, how they thought and how they felt whilst visiting the museum. There was some evidence that participants had reflected on their experience, made connections between their visits and

other things in their lives and told other people about their visit. Stevenson (1991) states that visitors took away a set of experiences as memories, a set of 'effects', 'explanations' and 'applications' as well as more general understanding and a change in attitudes (Stevenson, 1991: 522).

8.36 A number of studies assert the importance of considering informal science learning in the context of life long learning. These texts also highlight the need for a wider interpretation of what is informal science learning. Although there is not an extensive body of research on the impact of childhood exposure on adult participation, there are some studies, particularly in the areas of education and professional choices which indicate a correlation between the experiences of childhood and the interests of adulthood.

9 SUMMARY: INFORMAL SCIENCE

- 9.1 Research in informal science settings has focused on visitor attractions such as science and discovery centres and museums. However, studies also point out that informal science experiences can take place in a number of settings and environments. The wide range of places where informal science learning occurs makes it difficult to identify the influence of particular factors on a person's interest in both childhood and adulthood.
- 9.2 There is evidence that childhood exposure has an impact on adult engagement (Ecsite-UK, 2007). Some of this research has explored adult recollections of childhood experiences in informal science settings. Memories associated with visits to informal science centres are seen to contribute to the long term impact of an experience. This includes the memory of the affect of the particular encounter, the acquisition of knowledge and behaviour change (Spock 2000; Anderson et al 2007; Stevenson 1991). Research has focused, in particular, on educational and professional choices in young adulthood.
- 9.3 The review found that there were few examples of longitudinal research which looked at the impact of childhood exposure on adult participation in the area of informal science. There did not appear to be any substantive studies undertaken in the UK with some research undertaken in the US and elsewhere. These were predominantly small scale studies.
- 9.4 An extensive body of research evaluates the impact of science and discovery centres. These studies are generally focused on the educational objectives of the organisations as well as being linked to formal learning, future studies and professional choices. There is a need to extend the scope of research to include the exploration of the longer term impact of informal science experiences.
- 9.5 The wide and diverse range of informal science environments and activities makes it difficult to measure the impact of informal science experiences on children, young people and adults and to isolate the influence of individual factors. There are challenges associated with measuring outcomes (Bell et al, 2009) and in identifying the impact of cause and affect (Trautmann and Lewenstein, 2009).
- 9.6 Although there is not an extensive body of research on the impact of childhood exposure on adult participation in informal science, there are studies which explore the relevance of this experience in some detail. There is, therefore, an opportunity to develop and extend the body of research in this area.

10 CONCLUSIONS

- 10.1 This review has considered two areas; arts and culture, and informal science. It has reviewed research that has examined the extent of childhood exposure to, and experience of, arts and culture and informal science, and subsequent adult participation.
- 10.2 The areas of arts and culture and informal science have different dominant aims and objectives. The aims of informal science are primarily about learning and future study and career options while those most commonly identified in arts and culture tend to be about enjoyment, social capital, community and inclusion. The evidence identified in this review highlights that there are benefits in sharing learning from research across the areas of arts and culture and informal science in order to better understand the impact of childhood exposure on adult participation.
- 10.3 The research that is available on the impact of childhood exposure in both areas finds that experiences in childhood *do* have an impact on adult participation. This is influenced by a range of factors including family support and interest, socio economic circumstances and frequency of engagement. This is not an exhaustive list. There are many variables which influence participation and engagement in both childhood and adulthood.
- 10.4 There is little longitudinal research in both areas. There are few studies based on data relating to Scotland and the UK. There is a particular lack of longitudinal research in informal science although there appears to be growing interest in this area. Existing surveys such as the recent insertion of a Culture and Sport module in the Scottish Household Survey and the Taking Part survey in England offer opportunities to develop a greater body of research evidence over time.
- 10.5 Many of the other studies across the two areas are small scale research activities. There not many large scale research studies which examine childhood exposure and adulthood participation and take account of the influence of multiple factors on participation.
- 10.6 Researchers in both the culture and informal science areas suggest that there is a need to develop a greater body of research on long term impact on people's engagement. There are a number of challenges associated with undertaking this research. These include identifying the individual factors which impact on people's long term engagement, challenges associated with tracking participants over time and covering the range of cultural and science activities in which people participate.
- 10.7 The increasing importance of digital media and technologies, as well as the relevant output of more traditional media such as television and films, highlights the need for researchers in culture and informal science to take these influences into account in their research activities.

10.8 Although there is not a substantial body of research on the impact of childhood exposure in both areas, there is ongoing interest in the relationship between childhood experiences and adult engagement reflected. There is a developing body of research which offers the opportunity to explore the relationship between childhood and adult participation in both areas more widely.

11 REFERENCES

Arts and culture

Centre for Economics and Business Research (2007). *Summary report: Attending Heritage Sites Quantitative analysis of data from Taking Part: The National Survey of Culture, Leisure and Sport*, Centre for Economics and Business Research.

Creative New Zealand (2009). *New Zealanders and the arts: Attitudes, attendance and participation in 2008*, Wellington, Creative New Zealand.

<http://www.creativenz.govt.nz/Portals/0/publications/NZers-and-the-arts-2008.pdf>

Bamossy, G. (1982). "Socialising experiences as predictors of performing arts patronage behaviour." *Journal of Cultural Economics* 6(2).

Bergonzi, L. and Smith, J (1996) *Effects of Arts Education on Participation in the Arts*, California: National Endowment for the Arts.

Bromley, C (2009) *Growing up in Scotland: The impact of children's early activities on cognitive development*, Edinburgh: The Scottish Government.

<http://www.scotland.gov.uk/Publications/2009/03/16101519/0>

DiMaggio, P. and Useem, M (1978). "Social class and arts consumption: The origins and consequences of class differences in exposure to the arts in America." *Theory and Society* 5(2), pp 141-161.

EKOS (2009) *Evaluation of the Cultural Pathfinder Programme in Scotland*, Edinburgh: Scottish Government.

Fresh Minds (2007). *Culture on Demand: Ways to engage a broader audience* London: Department for Culture, Media and Sport.

Galloway, S (2008) *The evidence base for arts and culture policy: A brief review of selected recent literature*, Edinburgh: Scottish Arts Council.

Galloway, S., Bell, D., Hamilton, C and Scullion, A (2005) *Well-being and quality of life: measuring the benefits of culture and sport*, Edinburgh: Scottish Executive.

Georg, W. (2004). "Cultural Capital and Social Inequality in the Life Course." *European Sociological Review* 20(4), pp 333-344.

Gray, C. M. (1998). "Hope for the Future? Early Exposure to the Arts and Adult Visits to Art Museums." *Journal of Cultural Economics*, Vol 22, Numbers 2-3, pp 87-98.

Kracman, K. (1996). "The effect of school-based arts instruction on attendance at museums and the performing arts." *Poetics*, Vol, 24, pp 203-218.

Matarasso, F. (1997). *Use or Ornament? The social impact of participation in the arts*. Stroud: Comedia.

McCarthy, K., Ondaatje, E.H. and Zakaras, L. (2001). *Guide to the Literature on Participation in the Arts*, Santa Monica, California; RAND Corporation.

Morrison, W. and West, E (1986). "Child exposure to the performing arts: The implications for adult demand." *Journal of Cultural Economics* 10(1), pp 17-24.

Nagel, I. and Ganzeboom, H (2002). "Participation in Legitimate Culture: Family and school effects from adolescence to adulthood." *The Netherlands' Journal of Social Sciences* 38(2), pp 102-120.

Orend, R. (1988). *Socialization in the Arts. Research Division Report 21*, Washington, DC: National Endowment for the Arts.

Orend, R. and Keegan, C (1996). *Education and Arts Participation: A Study of Arts Socialisation and Current Arts-Related Activities Using 1982 and 1992 SPPA Data*. Washington, D.C., National Endowment for the Arts.

Oskala, A., Keaney, E, Chan, T.W. and Bunting, C (2009) *Encourage children today to build audience for tomorrow: Evidence from the Taking Part survey on how childhood involvement in the arts affects arts engagement in adulthood*. London: Arts Council England.

PLB Consulting Ltd (2001). *Developing New Audiences for the Heritage: Research Study for Heritage Lottery Fund*.

Robson, K. (2003). *Teenage Time Use as Investment in Cultural Capital. Working Papers of the Institute for Social and Economic Research*. Colchester: University of Essex.

Ruiz, J. (2004). *A Literature Review of the Evidence Base for Culture, The Arts and Sport Policy*, Edinburgh: Scottish Executive.

Scottish Arts Council (2008) *Taking Part in Scotland 2008: Full Report*. Edinburgh: Scottish Arts Council.

Scottish Government (2008) *People and Culture in Scotland: Results from the Scottish Household Survey and Sport Culture 2007/2008*, Edinburgh, National Statistics for Scotland.

<http://www.scotland.gov.uk/Publications/2009/11/24085939/0>

Walker, C., Scott-Melnyk, S and Sherwood, K (2002). *Reggae to Rachmaninoff: How and why people participate in arts and culture. Building Arts Participation: New findings from the field*, Washington, D.C., The Urban Institute.

Zakaras, L. and Lowell, J (2008). *Cultivating demand for the arts: arts learning, arts engagement, and state arts policy*, RAND.

Informal Science

Anderson, D., Storcksdieck, M., and Spock, M. (2007). The long-term impacts of museum experiences. In J. Falk, L. Dierking, and S. Foutz (Eds.), *In principle, in practice: New perspectives on museums as learning institutions* East Lansing, Michigan State University Press.

Barriault, C (1998) The Science Centre Learning Experience: A Visitor-Based Framework, *The Informal Learning Review*.

<http://www.informallearning.com/archive/1999-0304-c.htm>

Bell, P. B., Lewenstein, V., Shouse, A. and Feder, M (Eds) (2009). *Learning Science in Informal Environments: People, Places, and Pursuits*, Washington, DC., National Academies Press.

CRG Research Ltd (2006) *Millennium Science Centres Impact Assessment Report: Executive Summary*, The Wellcome Trust.

Ecsite UK (2008) *Inspiration, Engagement and Learning: The Value of Science and Discovery Centres in the UK Working towards a Benchmarking Framework*, Ecsite-UK.

<http://sciencecentres.org.uk/reports/value-of-science-discovery-centres-in-the-uk.html>

Ecsite-UK (2007) *The Impact of Science and Discovery Centres.: A review of worldwide studies*.

<http://www.sciencecentres.org.uk/reports/impact-of-science-discovery-centres.ht>

Falk, J. H. and Dierking, L.D (1992). *The Museum Experience*. Washington, D.C., USA, Whalesback Books.

Falk, J. H. & Dierking, L. D. (1990). "The effect of visitation frequency on long-term recollection." In S. Bitgood (Ed.), *Visitor studies: Proceedings of the 3rd annual Visitor Studies Conference* (pp. 94 - 104). Jacksonville, AL: Center for Social Design.

Falk, J., Storcksdieck, M and Dierking, L.D. (2007). "Investigating public science interest and understanding: evidence for the importance of free-choice learning." *Public Understanding of Science* 16, Vol 4, pp 455-469.

Frontier Economics (2009). *Assessing the impact of science centres in England London, Frontier Economics*.

http://www.sciencecentres.org.uk/govreport/docs/impact_of_science_centres.pdf

Gammon, B. (2009). "Assessing long-term impact of science engagement: Can it be done yet?" In Bultitude, K., Featherstone, H. and K, Wilkinson, C (Eds) *Evolving Science Communication: learn, adapt, collaborate*, University of West of England (UWE).

<http://scu.uwe.ac.uk/index.php?q=node/182>

Garnett, R (2002) *The Impact of Science Centers/Museums on their surrounding Communities: Summary Report*, International Science Centre Steering Group.

HM Inspectorate of Education (2007) *Review of the Contribution of the Scottish Science Centres Network to Formal and Informal Education*, Livingston, HMIE.

Javlekar, V. (1989). "Learning Scientific Concepts in Science Centers." In Bitgood, S *Proceedings of the 1989 Visitor Studies Conference*, Vol 2. Jacksonville, AL, Centre for Social Design.

Johnson, C (2009). "Science Centers as Learning Environments." Association of Science-Technology Centres
http://www.astc.org/resource/education/johnson_scicenters.htm

McCallie, E., Bell, L., Lohwater, T., Falk, J. H., Lehr, J. L., Lewenstein, B. V., Needham, C., and Wiehe, B. (2009) *Many Experts, Many Audiences: Public Engagement with Science and Informal Science Education. A CAISE Inquiry Group Report*. Washington, D.C., Center for Advancement of Informal Science Education (CAISE).
http://caise.insci.org/uploads/docs/public_engagement_with_science.pdf

Medina-Jerez, W. (2008). "Between Local Culture and School Science: The Case of Provincial and Urban Students from Eastern Columbia." *Research in Science Education* 38.

Persson, P-E. (2000). "Science Centres are thriving and going strong!" *Public Understanding of Science* 9, pp 449-460.

Rennie, L., Feher, E. Dierking, L.D. and Falk, J.H (2003). "Towards an Agenda for Advanced Research on Science Learning in Out-of-School Settings." *Journal of Research in Science Teaching*, Vol 50. 2: pp112-120.

Rennie, L. J. and T. P. McClafferty (1996). "Science Centres and Science Learning". *Studies in Science Education*. 27, pp 53-93.

Salmo, H (2003) "Science centres as learning laboratories: experiences of Heureka, the Finnish Science Centre". *International Journal of Technology Management*, Vol. 25, No. 5. pp 460-476.

Sladek, M. (1998). *A Report on the Evaluation of the National Science Foundation's Informal Science Education Programme*, The National Science Foundation.
<http://www.nsf.gov/pubs/1998/nsf9865/nsf9865.htm>

Spock, M. (2000). "When I grow up I'd like to work in a place like this". *Curator: The Museum Journal* 43(1), pp 19-32.

House of Commons Select Committee on Science and Technology (2007) *11th Report, Inquiry into science and discovery centres*
<http://www.publications.parliament.uk/pa/cm200607/cmselect/cmsctech/903/90302.htm>

Stevenson, J. (1991). "The long-term impact of interactive exhibits." *International Journal of Science Education* 13(5), pp 521-531.

Trautmann, C. and Lewenstein, B (2009). "Long-term Impact of Museums." *The Informal Learning Review* 95, pp 1-5.

Wellington, J. (1990). "Formal and informal learning in science: the role of the interactive science centres." *Physics Education* 25, pp 247-252

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