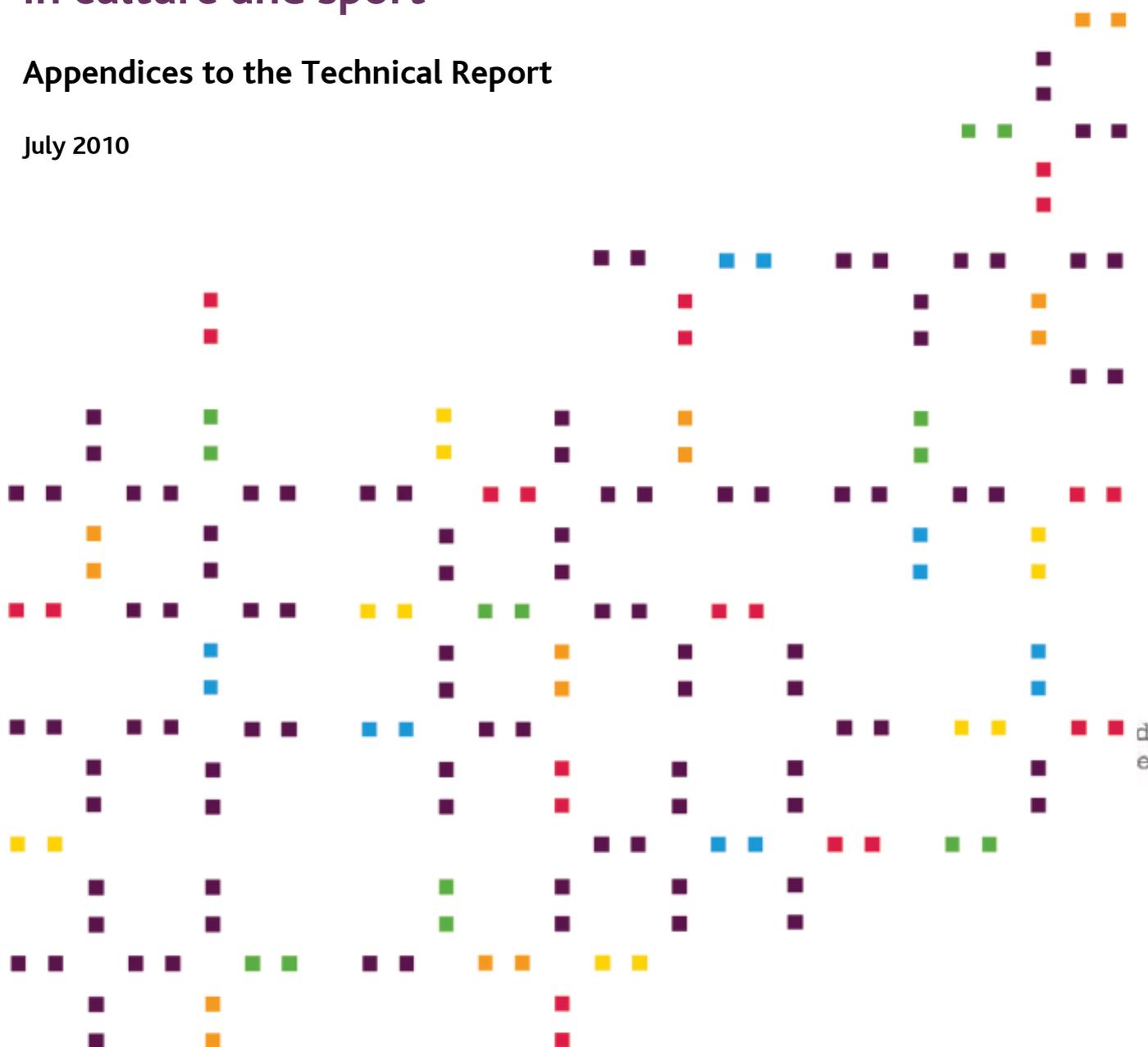


Understanding the drivers of engagement in culture and sport

Appendices to the Technical Report

July 2010



The work on this project was carried out by a consortium led by the EPPI centre with Matrix Knowledge Group

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This report can be downloaded from the DCMS website:

http://www.culture.gov.uk/what_we_do/research_and_statistics/5698.aspx

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1. Appendix 1: Regression – Literature review and conceptual framework development

This appendix summarises the rapid literature review undertaken to inform the development of the conceptual framework on which the regression analysis was based.

Research articles available on the English Heritage and Sport England websites and academic literature suggested by CASE members was collected and reviewed by the research team. **The purpose of this review was to inform the conceptualisation of the factors that impact engagement, not to systematically review the literature.** Consequently, while the review did not cover all the sectors or all the literature in the sector that it did cover, it was of sufficient scope for the intended purpose.

Both quantitative and qualitative studies were reviewed and factors affecting engagement were identified. An inclusive approach was used whereby any ambiguity as to whether the factor was important in driving engagement would lead to its inclusion. No differentiation was made between hypothesised and measured factors. The key theories presented in the articles reviewed were noted during this process, and factors identified as influencing engagement were collated into groups.

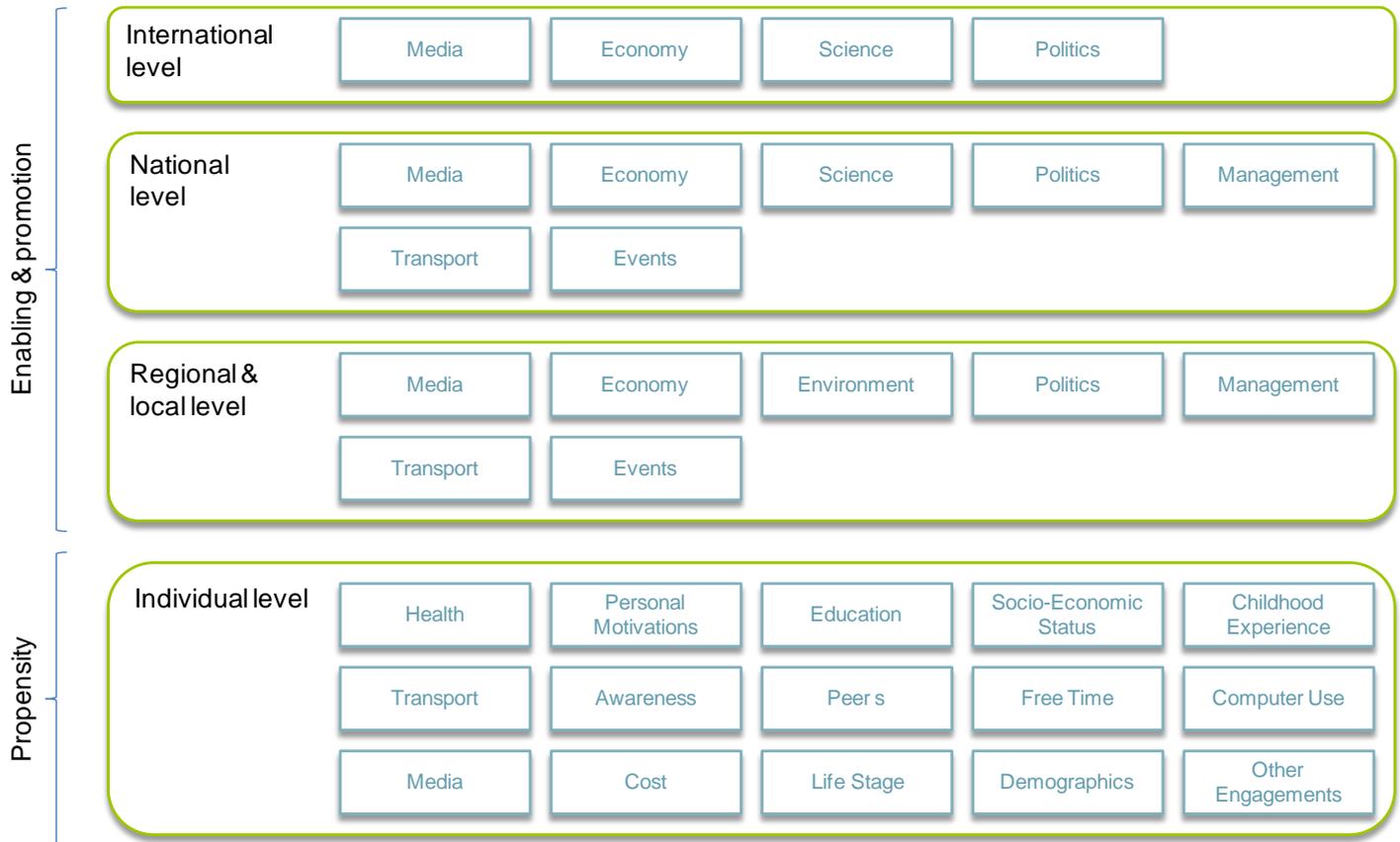
The project is concerned with a range of types of engagement in culture and sport, including: participation in sport, and attendance at museums, libraries, archives, art galleries, and heritage sites. This section, however, does not distinguish between these types of engagement. Instead, it summarises the factors that were identified in the literature as impacting on any of the engagement types.

The figure below shows the groups of factors identified in the review. The factor-groups are organised by:

1. The geographic level at which they impact on engagement.
2. Whether they enable/promote engagement or are related to the individual through a propensity to engage.

Within the factor-groups there are several possible operationalisations of the relationship of that factors and engagement. For example, there are many possible indicators of environmental factors that affect engagement, such as measures of green space for engagement in sports or proximity to opportunities to engage with art. The literature demonstrated that the exact instrument used to measure particular factors (and also coverage of the factor groups) varied, with many of the national and international level factors not being measurable.

Conceptual framework – drivers of engagement in culture and sport



Studies included in the review:

Arts Council England (2009) Encourage Children Today to build Audiences for Tomorrow: Evidence from the Taking Part survey on how Childhood Involvement in the Arts Affects Engagement in Adulthood, Arts Council: London

BMRB Social Research (2006) Taking Part: The National Survey of culture, Leisure and sport (2005-06): Final Technical Report, Department for culture, Media and Sport: London

Centre for Economics and Business Research (2007) Main Technical Report: Attending Heritage Sites: a Quantitative Analysis of Data from the Taking Part Survey, English Heritage: London

Centre for Economics and Business Research (2007) Summary Report: Attending Heritage Sites: a Quantitative Analysis of Data from the Taking Part Survey, English Heritage: London

Gayo-Cal, M., Savage, M., & Warde A. (2006) A Cultural Map of the United Kingdom 2003, *Cultural Trends*, 15: 2/3, 213–237

Heritage Link (2003) Volunteers and the Historic Environment, English Heritage: London

MEW Research (2005) Survey of Visits to Visitor Attractions 2004: Report for Heritage Counts, English Heritage: London

MORI (2003) Making Heritage Count? Research Study Conducted for English Heritage, Department for Culture, Media and Sport and the Heritage Lottery Fund,

[http://www.hlf.org.uk/NR/rdonlyres/15075044-B270-4B41-8467-](http://www.hlf.org.uk/NR/rdonlyres/15075044-B270-4B41-8467-AB5CBDDAAD97/0/Making_heritage_count.pdf)

[AB5CBDDAAD97/0/Making_heritage_count.pdf](http://www.hlf.org.uk/NR/rdonlyres/15075044-B270-4B41-8467-AB5CBDDAAD97/0/Making_heritage_count.pdf)

National Heritage Training Group (2008) Built Heritage Sector Professionals: Current Skills, Future Training, NHTG: London

National Heritage Training Group (2008) Traditional Building Craft Skills: Reassessing the Need, Addressing the Issue, NHTG: London

Piccini, A., Henson, D. & TRP Research (2006) Survey of Heritage Television Viewing 2005-06, English Heritage: London

Robson, K. & Feinstein, L. (2007) Leisure Contexts in Adolescence and their Associations with Adult Outcomes: a More Complete Picture, Department for Children, Schools and Families

Warde, A. & Tambubolon, G. (2002) Social capital, networks and leisure consumption, *Sociological review*, 50:2,155-180

DCMS and National Statistics (2008) Taking Part: the National Survey of Culture Leisure and Sport: Final Assessment of Progress on PSA3: Complete Estimates from Year Three 2007/08, DCMS: London

Rowe, N. (2009) The Active People Survey: A Catalyst for Transforming Evidence-Based Sport Policy in England, *International Journal of Sport Policy*, Vol 1, No 1, 89-98, Routledge.

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

Sport England (2000) Sports Participation and Ethnicity in England: National Survey 1999/2000 Headline Findings, *Sport England: London*

Sport England (2002) Adults with a Disability and Sport: National Survey 2000/2001 Headline Findings, *Sport England: London*

Sport England (2003) Sports Volunteering in England 2002, *Sport England: London*

Sport England (2003) Sports Volunteering in England in 2002: A Summary Report, *Sport England: London*

Sport England (2004) Driving Up Participation: the Challenge for Sport, *Sport England: London*

Sport England (2004) Understanding Participation in Sport: What determines Sports Participation Among 15-19 year-old Women, *Sport England: London*

Sport England (2005) Understanding Participation in Sport: A Systematic Review, *Sport England: London*

Sport England (2006) Active People Survey Headline Results, England, *Sport England: London*

Sport England (2006) The Value of Sport: Participation and Life-Long Participation, *Sport England: London*

Sport England (2006) Understanding Participation in Sport: What determines Sports Participation Among Lone Parents, *Sport England: London*

Sport England (2006) Understanding Participation in Sport: What determines Sports Participation Among Recently Retired People, *Sport England: London*

Sport England (2007) Active People Survey: Small Area Estimates, *Sport England: London*

Sport England (2008) Project 'Experience of Sport': Understanding the Lapsed Target Research Debrief, *Sport England: London*

Sport England (unknown) Technical Report: Sport England Market Segmentation, *Sport England: London*

Trust for the Study of Adolescence (2005) Determinants of Sports and Physical Activity Participation Amongst 15-19 year-old Young Women in England, *Sport England: London*

Discussion of the conceptual factors identified

The following section provides more detail on the factors impacting engagement identified in the literature review. It is divided into those factors common to all types of engagement, and those factors relevant to only certain types of engagement.

Common factors

Media

Levels of influence – international, national, regional, local, individual

'Media' includes all advertising, broadcasting and print. It is likely that Media has a different influence at higher levels compared to the individual level. At higher levels, Media creates and responds to fashions and trends, along with news and developments in some other factors relating to engagement. In this sense, Media interacts with other factors, leading to engagement. Media is likely to have a positive and a negative effect on engagement, depending on its ability to influence people via trends. At the individual level, media consumption may be a reflection of a person's social background and may enable engagement via the promotion of suitable options, or alternatively prevent engagement by taking up leisure time (such as with TV watching).

Useful variables for measuring the effect of Media could include:

1. Home geographic location as a proxy for higher levels of Media.
2. Work geographic location as a proxy for higher levels of Media.
3. Television and radio consumption.
4. Newspaper consumption.

Possible modelling issues could include:

- The inability to isolate Media effect when using geographic location as a proxy for higher levels of media influence.
- The causal direction of relationships between Media and the individual. Does Media influence the individual, the individual influence Media through consumption, or both?
- Availability of appropriate measures of individual media consumption.

Economy

Levels of influence – international, national, regional, local

'Economy' implies general performance of the economy, the economic cycle, growth and recession, etc. Economy is likely to act as a high level driver for many of the other factors that affect engagement, such as personal income, employment, tourism, facilities, deprivation, etc. Due to its high level, it is likely to have a vague relationship with individual engagement due to the time lag and complexity of relationships involved in economic effects filtering down to the individual level. It may have positive effects on some engagement types and negative effects on other engagement types. The majority of these effects will be more accurately measured at the local and individual level where the ultimate effects of changes in economy are realised, however, changes in tourism may be associated with interactions between national economies.

Useful variables for measuring the effect of Economy could include:

1. Home geographic location as a proxy for local economy.
2. National, regional and local indicators of economic performance.
3. National indicators of economic performance for countries related by tourism.

Possible modelling issues could include:

- The difficulty in measuring relevant changes to Economy considering the likely time lag involved between any change occurring and an impact on engagement.
- The complexity of isolating the effect of Economy on engagement when it is likely to interact and correlate with many other factors.
- The complexity of measuring interactions between economies as a factor affecting tourism.
- The use of a geographic proxy for multiple factors will prevent the causal factor from being identified.

Politics

Levels of influence – international, national, regional, local

'Politics' includes all political influences and policy developments, such as from government or policy developing organisations. Politics is a high level factor that is likely to impact at the international, national, regional and local levels. Similar to Economy, the effect of Politics is likely to be difficult to isolate from other related factors. There is also likely to be a time lag

between changes in Politics and the resulting effects on engagement. Politics includes any policy levers that might be used to encourage engagement in culture and sport, but various policies may have beneficial or detrimental effects on engagement. Particularly, educational policy may be a key driver of the factor relating to childhood experiences of culture and sport and employment policy may have a strong impact on volunteering. Also, through research such as the current work, Politics is ultimately affected itself by engagement, in a feedback loop.

Useful variables for measuring the effect of Politics could include:

1. Home geographic location as a proxy for local politics.
2. National, regional and local indicators of political change, such as educational or health policy changes.
3. Measures of national, regional and local culture and sport-related funding over time and the growth of national policy organisations.

Possible modelling issues could include:

- The difficulty in measuring relevant changes to Politics considering the likely time lag involved between any change occurring and an impact on engagement.
- The complexity of isolating the effect of Politics on engagement when it is likely to interact and correlate with many other factors.
- The use of a geographic proxy for multiple factors will prevent the causal effect from being identified.

Science

Levels of influence – international, national

'Science' includes the influence of new scientific knowledge, research and interpretation of scientific evidence on engagement in culture and sport. Particularly in the case of heritage and sport, this factor is likely to have an effect on engagement that is additional to that which occurs through Politics. However, as most scientific findings will be conveyed via the media, it is likely that it will not be possible to isolate the effect of this factor. Also, similar to Politics and Economy, the general effect of Science on engagement may be cumulative and slow acting. Any large changes in levels of engagement (for example, due to a new heritage discovery) are likely to be short-lived, with engagement levels gradually returning to normal. Long-term changes in engagement due to Science are likely to occur through Politics and Media.

Without extensive time series data relating the date of occurrence of scientific discoveries to engagement, and control data for similar time periods, it is unlikely that this factor will be measurable.

Possible modelling issues would include:

- The difficulty in measuring relevant changes to Science considering the likely time lag involved between any change occurring and an impact on engagement.
- The complexity of isolating the effect of Science on engagement when it is likely to interact and correlate with many other factors.

Environment

Levels of influence – regional, local

'Environment' includes the built environment and local landscape. In many engagement types, Environment has been found to be an important driving factor. Whether it is sport, where the availability of green spaces encourages participation, or proximity to artistic or MLA opportunities, Environment seems of crucial importance. Also, locality and Environment is a strong proxy for levels of localised multiple deprivation. Transport infrastructure is also included in this factor as it relates more to the locality than to the individual. It is expected that a positive relationship between Environment and engagement will be found, independent of personal income. It is possible that an interaction between Environment and Transport will exist, as public transport should be less important where an individual has adequate means of personal transportation.

Useful variables for measuring the effect of Environment could include:

1. Home geographic location as a proxy for local Environment.
2. Work geographic location as a proxy for local Environment.
3. Indices of multiple deprivation collated by the Office for National Statistics (ONS).
4. Other indicators of environmental quality and proximity of engagement opportunities.

Possible modelling issues could include:

- The availability of appropriate and sufficient measures that accurately estimate the quality of the environment in terms of opportunity to engage.
- The possible complexity of measuring environmental quality.
- The use of a geographic proxy for multiple factors will prevent the causal effect from being identified.

Cost

Levels of influence – individual

'Cost' refers to costs involved in participating in a particular cultural or sporting activity, including, for instance, the cost of transport, access, and equipment. Cost has been identified in the literature as being a key driver of engagement. See the background section of the technical report for further discussion of this literature.

Transport

Levels of influence – individual

'Transport' includes all personal forms of transport, such as vehicle ownership and the purchase of long distance travel, for example flights. Transport has been found to be important in many engagement types and so will be an essential variable to include in the majority of analyses. It is expected that an interaction between Transport and Environment will occur, as public transport will be more important to individuals who do not own a vehicle.

Useful variables for measuring the effect of Transport could include:

1. Vehicle ownership.
2. Use of public transport.

Health

Levels of influence – individual

'Health' includes all personal indicators of health, such as general fitness and illness. Disability is also included in this factor as, along with health, it is closely related to physical ability to engage. Personal health has been found to be an important driving factor in many engagement types. Not only does Health affect engagement in sport, it has also been found to be important in heritage engagement and disability discrimination policy evidences the impact of Health on employment. Interestingly, when controlling for general health in models of engagement in heritage, the influence of disability has been found to disappear. It will be important to include comprehensive measures of general health and disability in the factors used to model engagement.

Useful variables for measuring the effect of Health could include:

1. Multi-item well-being measures of physical and mental health.
2. Variables which identify disability.
3. Variables which identify chronic illness.

Possible modelling issues could include:

- The availability of appropriate and sufficient measures that accurately measure health and disability.

Education

Levels of influence – individual

'Education' represents an individual's level of education and training. Research has consistently found a relationship between engagement in culture and sport and Education, with higher educational achievement being associated with increased engagement. There is a possibility that parental level of education also has an effect on an individual's engagement but this might best be captured via measures of childhood experience. School-based experiences of engagement will also be captured in measures of childhood experience. 'Education' is not limited to mental abilities, as sports skills developed through training are also included in this factor.

Useful variables for measuring the effect of Education could include:

1. Profile of educational achievement.
2. Sports skill and knowledge.
3. Experience of ongoing education and training in adulthood.

Awareness

Levels of influence – individual

'Awareness' implies the awareness of an individual to the opportunities that are available to engage. This factor is the compliment to Media in the sense that Media enables Awareness, but it may also be closely related to peer environment ('Peers'). It is likely that engagement increases as awareness increases, although isolating this effect from that of Media, Education and Peers is likely to be difficult. Also, 'Awareness' is a type of engagement in itself, and so the direction of causality is not well defined. See section 2 for more information on response variables.

Useful variables for measuring the effect of Awareness could include:

1. Self-reported measures of knowledge of local opportunities to engage.
2. Self-reported measures of knowledge of regional and national events, etc.

Possible modelling issues could include:

- Awareness is likely to be closely related to many of the other factors found to drive engagement. It may, therefore, be difficult to isolate the individual effect of this factor.
- Measures of awareness are likely to be varied and imprecise, if they are available at all.

Childhood Experience

Levels of influence – individual

'Childhood Experience' includes all aspects of childhood engagement in culture and sport. The two main aspects of this are parental or family driven experience and school driven experience. Research on engagement in the arts found that Childhood Experience is a key driver in engagement as an adult. It is important to be cautious as to the causal processes involved in childhood experience of culture and sport with parents and the family, as it could be argued that parents actively increasing the engagement of their children may not necessarily lead to increased engagement in adulthood – the relationship may be driven instead by other associated factors, such as genetic, socio-economic or educationally driven interest in engaging, for the parent as well as the child.

At the higher levels, school trips, classes and sports activities are obviously a major driver of children's engagement in culture and sport. Whether this activity has an enduring effect on the child may not be so straightforward, however. There is a possibility that experience at school may interact with the experience at home – children who are sedentary at home may not actively engage in sport at school, for example, and so not continue to engage in adulthood. It would be interesting to investigate this possibility empirically.

Useful variables for measuring the effect of Childhood Experience could include:

1. Self-reported engagement with parents and family as a child.
2. Self-reported parental encouragement to engage as a child.
3. Self-reported enjoyment of culture and sport as a child.
4. Self-reported school experience of culture and sport (opportunities and enjoyment).

Possible modelling issues could include:

- It may be difficult to isolate the effect of Childhood Experience from that of Education, due to the possibility that opportunities to engage in the arts, heritage, MLA and sport are strongly associated with higher standards and quality of education.
- Sufficient measures of Childhood Experience may not be available, or available at all for certain engagement types.

Personal Motivations

Levels of influence – individual

'Personal Motivations' includes any individual reasons for engaging in a particular activity that are not generally covered by other factors. As a result, this is likely to be one of the factors that is most difficult to measure as it is likely to be dependent on engagement type and highly varied. For example, with sport, reasons could include self-esteem and personal sporting aims such as competing in a race; for volunteering it could include a need to make friends, interest or a sense of personal duty. It is an inherently vague factor that is broad in

scope and highly personal. The difficulty with which it is conceptualised indicates that it is likely to be difficult to measure without in-depth qualitative investigation.

Useful variables for measuring the effect of Personal Motivations could include:

1. Self-reported reasons for commencing engagement.

Possible modelling issues could include:

- The potential reasons for engaging are possibly infinite. Available survey datasets may not adequately collect a broad range of these reasons.

Peers

Levels of influence – individual

'Peers' is another vaguely defined important factor at the individual level. It includes all of the influences of a person's peer group on their engagement. People tend to engage in cultural and sporting activities with friends and family, and so their interests can have a great impact on the engagement of the individual. The causal process in this relationship is unclear however, as a person exerts influence on their peers in the same way. Investigating the way in which the engagement of individuals inter-relates via social networks would be a substantial piece of research in itself, and this extent of analysis will not be possible in the current research.

Useful variables for measuring the effect of Peers could include:

1. Number of friends with which the person engages in a particular cultural or sporting activity.
2. Whether the individual engages in the activity with their family.
3. All engagement types that the individual is engaged in along with the links to friends and family with whom they engage in these activities.

Possible modelling issues could include:

- If variables are included in survey datasets which measure this, they are likely to be imprecise.
- Modelling social networks and including their findings in models of engagement is likely to be a highly complex and challenging task.

Life Stage

Levels of influence – individual

'Life Stage' indicates a general status with regard to typical life stages such as being in education, being a young worker, having a young family, children having left home and retirement. This factor should cover aspects of life progress that are not covered by age alone. In particular, retirement and full-time education have been found to be related to engagement in volunteering, and having children has been shown to affect engagement in culture and sport.

Useful variables for measuring the effect of Life Stage could include:

1. Age.
2. Employment status.
3. Number of children in the household.

4. Ages of children.

Free Time

Levels of influence – individual

'Free Time' is the amount of time the individual has for leisure activities. This factor has been found to be important in previous research, however, there is some conflicting opinion as to the direction of its effect on engagement. Some research has found that as available leisure time decreases with increased working hours, engagement in culture and sport also decreases, whereas other research has found that people who work long hours may make more efficient use of their time and engage more as a result. It is likely that this confused picture is a result of the effect of other factors such as income, socio-economics and social status. The current research may be able to determine more clearly what the empirical relationships involved are.

Useful variables for measuring the effect of Free Time could include:

1. Self-reported working hours per week.
2. Self-reported hours spent doing other necessary non-leisure tasks per week.
3. Self-reported hours of leisure time available per week.

Possible modelling issues could include:

- Inaccuracy of self-report information.

Socio-Economic Status (SES)

Levels of influence – individual

'Socio-Economic Status (SES)' is a factor that has varying definitions. It is partly related to income and assets, and partly related to social status and class. Most surveys include elements which can together comprise a measure of SES. In general, research has found that the higher an individual's SES, the higher their engagement in culture and sport, however, some research (Chan & Goldthorpe) has found that the relationship between engagement and SES is more complex than a simple, single measure of SES would be able to account for. They investigated the role of social class and social status as separate measures in models of engagement in art, and found that income and social status but not social class accounted for some variation in engagement.

Useful variables for measuring the effect of Socio-Economic Status could include:

1. Income.
2. Asset ownership, such as property and vehicles.
3. Social class categorisation.
4. Social status categorisation.

Possible modelling issues could include:

- Lack of appropriate measures for social class and status.
- Lack of a precise measure of income.
- Lack of any measure of asset ownership, such as property and vehicles.

Demographics

Levels of influence – individual

'Demographics' include standard personal information relating to age, gender, ethnicity, race, religion, etc. Past research has found gender and age to be important in engagement preferences and level of engagement. Personal heritage, as typically measured by variables such as ethnicity, race and religion, has been found to be particularly important in engagement with English heritage and may be important for other engagement types.

Useful variables for measuring the effect of Demographics could include:

1. Age.
2. Gender.
3. Race.
4. Ethnicity or personal heritage.
5. Religion.

Possible modelling issues could include:

- Race and ethnicity variables may not adequately measure personal heritage.

Computer Use

Levels of influence – individual

'Computer Use' is a factor that includes screen time not associated with television media. As computer games have developed over time, gaming has become a common competitor to other uses of leisure time. Also, the internet is now a central source of information and communication in the home and at work. It is possible that as internet and computer game use increases, certain engagement types decrease. This possible impact of 'Computer Use' on engagement will be tested.

Useful variables for measuring the effect of Computer Use could include:

1. Computer ownership.
2. Hours spent playing computer games per week.
3. Hours spent on the internet per week.

Possible modelling issues could include:

- Availability of data on computer use.

Engagement specific factors

Volunteer Management

Levels – local

'Volunteer Management' includes all management and bureaucracy related to volunteers being employed by organisations. Research on volunteering has found that the way in which volunteers are managed can have a great impact on the quality of the experience for the volunteers. It is expected that light-touch and efficient management of volunteers to give them flexible and rewarding experiences is likely to be associated with higher levels of volunteer engagement.

Useful variables for measuring the effect of Volunteer Management could include:

1. Self-reported satisfaction with volunteer management.

Possible modelling issues could include:

- Although this factor should probably be measured at the organisational or local level, measures are likely to only be available at the individual level as a personal satisfaction proxy.

Volunteering Expenses

Levels – individual

Research on volunteering has consistently shown that if volunteers have to cover the costs they incur to volunteer, they are less likely to continue to engage for long periods of time. It is likely that this cost interacts with the income of the individual, as those with higher incomes will not be as greatly affected by costs.

Useful variables for measuring the effect of Volunteering Expenses could include:

1. Self-reported reasons for ceasing voluntary activity.
2. Self-reported costs of voluntary activity.
3. Self-reported criticisms of volunteering.

Possible modelling issues could include:

- Measures of the costs involved in volunteering at an individual level may not be available.

Non-Voluntary Engagement

Levels – individual

Research has found that participation, particularly in sporting activities, is associated with volunteering. It therefore seems likely that this could be consistent with other forms of engagement. As with 'Awareness', this introduces the problem of causal directionality – does 'Non-Voluntary Engagement' cause voluntary engagement or is the relationship the other way around? The relationship could even involve a feedback loop, or both types of engagement could be associated with other common factors.

Useful variables for measuring the effect of 'Non-Voluntary Engagement' could include:

1. Other self-reported measures of engagement.

Possible modelling issues could include:

- Being a type of engagement itself, the causal direction of association with voluntary engagement may not be clear.
- There may be modelling challenges from the inherent limitations of using a single response variable in linear regression models.

Sporting Events

Levels of influence – international, national, regional, local

'Sporting Events' includes all organised sporting contests and challenges. These could be club or international football matches, organised running events, triathlons, etc. They are differentiated from sports club activities by being ticketed, publicly accessible, generally large scale and professionally organised. This factor is of central importance in engagement through attendance at a sporting event, though may also have an association with other types of engagement, such as awareness. It is also possible that 'Sporting Events' interacts

with 'Transport' in its effect on attendance at events, and may be mediated by 'Media'. This factor is a key driver of engagement through tourism.

Useful variables for measuring the effect of 'Sporting Events' could include:

1. Frequency of international, national, regional and local sporting events.
2. Locations of sporting events.
3. Ease of travel to sporting events.

Possible modelling issues could include:

- Difficulty in finding appropriate measures of frequency of sporting events.
- Problems in determining the interaction of sporting events and ease of travel to them.
- Causal issues relating to supply and demand of sporting events.

Heritage Management

Levels – national, regional, local

'Heritage Management' includes all management of heritage assets. Research on heritage visits has found that the way in which assets are managed can have a great impact on the quality of the experience for the visitors. Managers have a great influence on the facilities provided at heritage sites, their marketing, maintenance and staffing.

Useful variables for measuring the effect of Volunteer Management could include:

1. Self-reported satisfaction with volunteer management.

Possible modelling issues could include:

- Although this factor should probably be measured at the organisational or local level, measures are likely to only be available at the individual level as a personal satisfaction proxy.

Heritage Assets

Levels – international, national, regional, local

'Heritage Assets' is a factor representing the supply side of the heritage economy. In the same way as 'Sporting Events' supplies the demand for attending sporting events, so 'Heritage Assets' supply the demand for attendance at heritage sites. Unlike 'Sporting Events', however, 'Heritage Assets' do not respond to demand (though the management of them does). It should, therefore, be more straightforward to determine the effect of presence of assets on attendance. There is also likely to be an interaction with 'Transport', and it may be mediated by 'Media'. This factor is a key driver of engagement through tourism.

Useful variables for measuring the effect of 'Heritage Assets' could include:

1. Numbers of local heritage assets.
2. Locations of heritage assets.
3. Measures of ease of access to heritage assets.

Possible modelling issues could include:

- Difficulty of measuring accessibility of multiple assets with respect to multiple locations.

Cultural Events

Levels of influence – international, national, regional, local

'Cultural Events' includes all organised festivals, concerts, parades, etc. They are publicly accessible, generally large scale and professionally organised. This factor is of central importance in engagement through attendance at a cultural event, though may also have an association with other types of engagement, such as awareness. It is also possible that 'Cultural Events' interacts with 'Transport' in its effect on attendance at events, and may be mediated by 'Media'. This factor is a key driver of engagement through tourism.

Useful variables for measuring the effect of 'Cultural Events' could include:

1. Frequency of international, national, regional and local cultural events.
2. Locations of cultural events.
3. Ease of travel to cultural events.

Possible modelling issues could include:

- Difficulty in finding appropriate measures of frequency of cultural events.
- Problems in determining the interaction of cultural events and ease of travel to them.
- Causal issues relating to supply and demand of cultural events.

Career Appeal [prospects/image/salary/interest] (all levels)

Levels of influence – international, national, regional, local

'Career Appeal' includes employment characteristics, such as salary and benefits, cultural aspects such as the social desirability of a particular career, and market aspects such as career prospects and demand. The effect of 'Career appeal' at an individual level is likely to be accounted for by 'Personal Motivations'. Each of these aspects of 'Career appeal' is not unique to employment in culture and sport, and so should be covered by pre-existing research. It would be sensible to review what research on employment is available before embarking on a new modelling exercise.

2. Appendix 2: Regression – Review of data and options for modelling

This section considers the data available to measure the relationship between factors and engagement. The purpose of this review was to identify:

- The best source to be used as the main dataset in the statistical modelling.
- Additional datasets that might efficiently be used to supplement the main source.

A search was performed for datasets that could be useful for building statistical models of engagement. Datasets used in the literature reviewed (see Appendix 1) were included and the national data archive and question bank were also searched. CASE members provided additional suggestions which were added.

The review comprised the following three steps:

1. A high level assessment of datasets.
2. A detailed coding of selected datasets.
3. The selection of datasets for inclusion in the analysis.

The result of the first stage of the review is summarised in the table below. The objective of this stage of the project was to identify datasets to include in a more detailed review. The table indicates whether the dataset was reviewed in more detail and a summary of the assessment of the dataset.

Complete list of datasets reviewed

Dataset	Summary	Included in review?
Active People Survey	Very large representative sample and very well-defined engagement variables for sport, which since 2007/08 includes culture engagement variables. Records defined down to postcode sector allowing geographic matching. Available for 2005/06, 2007/08 and 2008/09, and now run annually. Cross-sectional design.	Yes
Expenditure and Food Survey	Highly complex financial survey not containing many of factors related to engagement. Medium sized representative sample. Run annually from 2001. No engagement variables. Likely to be very resource intensive to analyse.	No
Place Survey	Postal survey undertaken by local authorities. Variable response rate. Records defined down to local authority. Undertaken in 2008/09. New version being created to link into development of National Indicators. Contains information on satisfaction with local area, council and public transport. [UPDATE: the new version, which has a revised and standardised methodology, became available after this data review. Many estimates from it are included in the National Indicators data, see below. Data from the new version was included in the final selection of supplementary data sourced from the National Indicators]	No

Dataset	Summary	Included in review?
Taking Part	Very large representative sample and well-defined engagement variables covering many engagement types. Records defined down to postcode sector allowing geographic matching. Available from 2005/06 and run annually. Cross-sectional design. Good coverage of factors.	Yes
Best Value Performance Indicators / National Indicators	A variety of data sources compiled and used to provide indicators of local council performance. Defined to local council level. Sources of data would need to be individually assessed. Covers a wide range of area characteristics. Available from 1999/00 to 2007/08. Changed to National Indicators after 2007/08 – this new dataset includes a revised Places Survey. [UPDATE – the National Indicator data became available for use publicly after this data review took place]	Yes
British Household Panel Survey	Large representative sample. Highly complex survey with varying modules over different waves. Records defined down to postcode sector level. Basic engagement variables available in particular waves. Available from 1991 to 2008 annually. Longitudinal design. Resource intensive to analyse.	No
Families and Children Study	Medium sized representative sample. Records defined down to postcode sector level. No engagement variables for adults, some for children. Contains some area level variables on deprivation, transport and housing. Available from 1999 to 2005. Longitudinal design.	No
Health Survey for England	Large representative sample. Defined to postcode sector level. Very many health related variables with some sports engagement variables but modules vary over time. Very few factors covered. Available from 1990 to 2007. Cross-sectional design.	No
Indices of Multiple Deprivation (IMD)	Indices constructed from various sources of data weighted. Not designed to be used as continuous measures of deprivation. Can be used as ranks. Possibly useful for area level but will need to be assessed in more detail, may be difficult to incorporate. Available for 2001, 2004, 2007.	No
Youth Cohort Study	Large sample with large non-response. Defined to postcode sector level. No engagement variables. Available from 1985 to 2007 in panels of 3 years (respondents 16 to 19 years old). Longitudinal design.	No
Asset datasets	Various sources of data providing counts of facilities, sites, organisations etc. in local areas. Available from Sport England, English Heritage, Arts Council, Experian.	Yes
National Travel Survey	Large representative sample. Defined to postcode sector level. Contains a large amount of variables related to private transport and public transport availability and use. Available from 1988 to 2007. Cross-sectional design. Resource intensive to analyse. Possibly useful only as supplementary information.	No

Dataset	Summary	Included in review?
Sport England's 'Sport Satisfaction Survey'	Focuses on satisfaction with sporting experience of people who participate in sport.	No
Time Use Survey (2000)	Medium sized representative sample. Very complex dataset which logs time use of respondents for 1 week day and 1 weekend day in 10 minute intervals. Possibly very interesting engagement information but only available for 2000. Defined down to postcode sector level. Does not contain many factors.	No
British Cohort Study	Large representative sample of birth cohort. Very complex dataset. Defined down to postcode sector level. Available waves: 1970,1975,1980,1986,1996, 2000, 2004 and 2008. Limited use because of cohort nature. Poor engagement and factor variables available only in certain waves. Longitudinal design.	No
General Household Survey	Large representative sample. Defined down to postcode sector level. Engagement variables only available in certain years. Engagement questions not particularly good. Available from 1971 to 2008. Cross-sectional design.	No
Health and Lifestyle Survey	Very old dataset similar to Health Survey for England, measuring health risk factors and monitoring deaths. Only two waves in 1984/85 and 1991/92.	No
Longitudinal Study of Young People in England	Large representative sample. Longitudinal study following up children from 13 years old to 24 years old. Currently only first three waves have been executed.	No
Millennium Cohort Study	Large representative sample of millennium cohort spread across entire year. Respondents are currently young children. May be useful in the future.	No
MLA Hub Exit Survey	Small samples of visitors carried out in 45 hub museums and galleries across England. Few details of sampling methodology in report. Unlikely to be suitable for models or representative of national engagement.	No
National Adult Learning Survey	Small sample designed to be representative. Records defined to postcode sector level. Available in 1997 and from 2000 to 2002 annually. Very comprehensive study variables, but subject codes would need to be checked to determine applicability. No other engagement types.	No
National Survey of Voluntary Activity	Very small sample (N≈1,500) and old data set from 1997. Better datasets are available for volunteering (National Survey of Volunteering and Charitable Giving).	No
National Survey of Volunteering and Charitable Giving	Relatively small sample made up of re-contacts from the Citizenship Survey, and so may be biased. Only available for 2006. Records defined down to postcode sector level. Very good volunteering engagement questions. Can be linked to Citizenship Survey.	No

Dataset	Summary	Included in review?
ONS Omnibus Survey	Sample large and representative. Records defined down to postcode sector level. Survey waves occur monthly from 1990 onward, but relevant modules are rare. Only arts participation module particularly useful, but is only undertaken for ethnic minorities.	No
British Social Attitudes Survey	Larger representative sample. Records defined down to postcode sector level. Contains information on attitudes and opinions but no engagement variables. Attitudes concerning many factors covered. Available from 1987 to 2007.	No
Census	Large representative sample available from Census. Defined down to postcode sector level. No engagement variables but could be useful for reweighting to represent the population more closely. Available from 1991, 2001.	No
CIPFA data at Local Authority	CIPFA data available as a subscription service. Some difficulty was encountered in retrieving technical information on the data available, the sources of that data and the estimation methods used to create financial estimates. The data seems to be collected without probability sampling and so may not be statistically robust. Due to time constraints, this possibility was not pursued further.	No
Citizenship Survey	Large representative sample. Records defined down to postcode sector level. Available for 2001, 2003, 2005, 2007. Contains some very good free/work time and media consumption variables but no engagement variables except for volunteering. Most factors covered to some extent. Would need to consider if the useful variables could be included in a model somehow.	No
International Passenger Survey	Travellers sampled at travel hubs throughout country. Rich dataset of reasons for travel, but few factors of interest. Only useful in estimating volume of tourism and travel to distant engagement opportunities. Available for 1997 to 2007 annually.	No
MLA Cultural Workforce	No technical information was found online and information was requested through CASE but was not forthcoming within the time limits of the review	No
MLA Renaissance Participation	No technical information was found online and information was requested through CASE but was not forthcoming within the time limits of the review	No
Survey of Live Music	Survey of venues putting on live music events. Narrow in scope. Small sample. Only possible use is for creating estimates of area availability of live music events.	No
English Longitudinal Study of Ageing	Only includes people over 50 years of age.	No
British Crime Survey	Only useful for area level crime estimates, fear of crime, etc. No variables related to present concepts.	No

Dataset	Summary	Included in review?
Continuous Household Survey (Northern Ireland)	Northern Ireland survey not relevant to England.	No
Culture Map London	Asset database only relevant to London.	No
England Leisure Visits Study	Small samples in first two waves, third wave has large representative sample. Records defined down to postcode sector level. Available for 1998, 2002 and 2005. Samples leisure trips of respondents made in last seven days. Some very good engagement variables, including whether activities are done with friends. Does not have all the required factors and may focus too much on national parks.	No
National Child Development Study	Cohort study of people born in 1958. Relevant variables and waves are rare. Not particularly useful because of cohort.	No
Scottish Schools Adolescent Lifestyle and Substance Use Survey	Scottish survey of young people not relevant to England or the majority of age groups.	No
Survey of Activity and Health	Survey describing sport and health of small localised samples with follow-up small representative sample. A one-off survey, which took place in 1990. Good variables on reasons for doing / not doing sport.	No
Young People's Social Attitudes Survey	Very small sample survey investigating young people's social attitudes and opinions. Available from 1994, 1998 and 2003.	No
Young Persons' Behaviour and Attitudes Survey (NI)	School-based survey of 11 to 16 year olds only undertaken in Northern Ireland. Data available from 2000, 2003 and 2007.	No
AVON Longitudinal Study	Study of cohort born in the Avon area in the early 1990s. Mainly a survey of parents and carers. Children are still young. May possibly be useful in investigating the link between parental influences and child preferences.	No
English Heritage Visitor Survey	No technical information was found online and information was requested through CASE but was not forthcoming within the time limits of the review	No
Euro-barometer	Small representative samples in European countries. N=1300 in the UK. Conducted every two years. Few questions relating to engagement in occasional modules.	No
European Social Survey	Small sample size European survey with large non-response. Only one module in one year contained any engagement questions.	No

Dataset	Summary	Included in review?
Living in Wales Survey	Welsh survey not representative of England.	No
Northern Ireland Life and Times Survey	Northern Ireland survey not representative of England.	No
Poverty and Social Exclusion Survey of Britain	Sub-sample of the General Household Survey focusing on people in low socio-economic groups. Defined down to postcode sector level. Single wave of survey conducted in 1999.	No
Youth Lifestyles Survey	Main focus of survey is crime. Only young people sampled. Available for 1992/93 and 1998/99.	No

Those datasets included in the review where coded in more detail according to the following criteria:

- The availability of engagement variables.
- The sampling methodology used.
- The time points for which data is available.
- The availability of explanatory factors.

The tables below summarise the results of the more detailed review. Not all the candidate datasets are in each of the tables as they were not all found to have relevant variables.

Summary of engagement variables found in the datasets

Note:
Green markers indicate detailed engagement variables, red markers indicate poor engagement variables, yellow markers indicate intermediate engagement variables.

		Participation (Attendance)	TV viewing of culture and sport	Awareness of culture and sport	Studying culture and sport	Employment in culture and sport	Culture and sport volunteering	Culture and sport club membership	Attend sporting or live music event
Active People Survey	Sport	●			●		●	●	●
	Art	●							
	Heritage	●							
	MLA	●							
Taking Part	Sport	●	●		●		●	●	
	Art	●	●				●		
	Heritage	●	●				●		
	MLA	●	●				●		
BVPs	Sport								
	Art								
	Heritage								
	MLA	●							
BHPS	Sport	●					●		
	Art	●					●		
	Heritage						●		
	MLA						●		
Families and Child Survey	Sport	●							
	Art								
	Heritage								
	MLA								
Health Survey for England	Sport	●							
	Art								
	Heritage								
	MLA								
Time Use Survey 2000	Sport	●					●		
	Art	●					●		
	Heritage						●		
	MLA	●					●		
British Cohort Study	Sport	●	●				●	●	
	Art		●		●		●	●	
	Heritage		●				●	●	
	MLA	●	●				●	●	
General Household Survey	Sport	●						●	●
	Art	●						●	●
	Heritage	●						●	
	MLA	●						●	
National Adult Learning Survey	Sport				●	●			●
	Art				●	●			●
	Heritage				●	●			
	MLA				●	●			
National Survey of Volunteering and Charitable Giving	Sport						●		
	Art						●		
	Heritage						●		
	MLA						●		
ONS Omnibus Survey	Sport	●							
	Art								
	Heritage								
	MLA								
Citizenship Survey	Sport			●			●	●	
	Art			●			●	●	
	Heritage			●			●	●	
	MLA			●			●	●	
England Leisure Visits Study	Sport	●							●
	Art	●							
	Heritage	●							
	MLA	●							

The datasets were then also reviewed to determine the time points at which data is available. The table below shows years from 1990 onwards for which data is available. Those with annual waves and recent data which are continuing in future years are preferable for model building.

Summary of time points for which survey data is available

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Active People Survey																			
Place Survey																			
Taking Part																			
BVPs / National Indicators																			
BHPS																			
Families and Children Study																			
Health Survey for England																			
Indices of Multiple Deprivation																			
Youth Cohort Study																			
National Travel Survey																			
Time Use Survey 2000																			
British Cohort Study																			
General Household Survey																			
National Adult Learning Survey																			
National Survey of Volunteering and Charitable Giving																			
ONS Omnibus Survey																			
British Social Attitudes Survey																			
Census																			
Citizenship Survey																			
International passenger survey																			
England Leisure Visits Study																			
European Social Survey																			

The quality of sampling methodology was also assessed. The table below, shows an assessment of the sampling for each of the datasets listed. 'Good' sampling indicates that the sample was designed to be nationally representative and was large enough to allow sophisticated modelling to be undertaken. 'Poor' sampling indicates that the survey method used was weak (such as with postal surveys) or that there was non-response that would be likely to create a bias. 'Small' samples were not large enough for sophisticated modelling approaches. The BVPIs contain many different data sources and so are listed as 'Varied'.

Summary of sample quality and geographic identifiers in the survey data

Survey name	Geographic identifiers	Sample quality
Active People Survey	Postcode	Good
Place Survey	Local Council	Poor
Taking Part	Postcode	Good
BVPIs	Councils	Varied
BHPS	Postcode	Good
Families and Children Study	Postcode	OK
Health Survey for England	Postcode	Good
Indices of Multiple Deprivation	LSOA	Good
Youth Cohort Study	Postcode	Poor
National Travel Survey	Postcode	Good
Time Use Survey 2000	Postcode	Good
British Cohort Study	Postcode	Good
General Household Survey	Postcode	Good
National Adult Learning Survey	Postcode	Small
National Survey of Volunteering and Charitable Giving	Postcode	Good
ONS Omnibus Survey	Postcode	Good
British Social Attitudes Survey	Postcode	Good
Census	Postcode	Good
Citizenship Survey	Postcode	Good
International passenger survey	Travel hubs	Good
England Leisure Visits Study	Postcode	Good
European Social Survey	Postcode	Small

Finally, the availability of explanatory factors was assessed in order to determine how well the datasets covered the factors contained in the conceptual model framework. The table below shows the respondent level factors available in the datasets reviewed. '1' indicates the presence of good quality measures of the factor, '2' indicates poorer quality measures of the factor. The table shows that coverage was best for the Taking Part survey, the National Adult Learning Survey, the British Household Panel Survey, the National Survey of Volunteering and Charitable Giving and the Citizenship Survey.

Summary of explanatory factors available in the survey data

	Media	Environment	Transport	Health	Education	Awareness	Genetics	Childhood Experience	Personal Motivations	Peers	Life Stage	Free Time	Socio-Economic Status	Demographics	Computer Use	Volunteering Expenses	Career Appeal
Active People Survey		1	1	1	1						1		1	1			
Place Survey		1	1														
Taking Part	1	1	1	1	1			1	1	1	1	2	1	1			
Best Value Performance Indicators		1	1	1	1								1				
British Household Panel Survey	1	1	1	1	1			1		1	1		1	1	1		
Families and Children Study		1	1	1	1								1	1			
Health Survey for England				1					1				1	1			
Indices of Multiple Deprivation		1		1	1								1				
Youth Cohort Study			1	1									1	1			
National Travel Survey		1	1	1									1	1			
Time Use Survey 2000		2	1	1	1					1	1	1	1	1			
British Cohort Study				1	1			1	1		1		1	1			
General Household Survey		1	1	1	1					1	1		1	1			
National Adult Learning Survey	1			1	1	2			1	2	1	2	1	1	1		1
National Survey of Volunteering and Charitable Giving	1			1	1	1			1	1	1	2	1	1		1	
ONS Omnibus Survey			1	1	1						1		1	1			
British Social Attitudes Survey	1		1	1	1				1		1		1	1	1		
Census			1	1	1						1	1	1	1			
Citizenship Survey	1		1	1		2			1	1	1	1	1	1		1	
England Leisure Visits Study	1	1	1	1						1	1		1	1			

Determination of which datasets should be used in the modelling

Following the coding summarised in the above tables, the datasets regarded as most useful for statistical model building were determined from the review process as follows:

1. Those with the best engagement variables were deemed vital to gain an accurate measure of engagement.
2. If the data were not recent they were likely to be less relevant to the population today.
3. If the data were collected only rarely they were likely to have less continuing value for identifying changes in engagement in the future.
4. If the sample quality was poor there may be a risk of bias in the results.
5. If the samples were small they may not support sophisticated statistical modelling techniques.
6. Good coverage of the factors impacting on engagement (section 3) was preferred over poor coverage, but if the previous criteria were met, the possibility of using other datasets to cover missing factors was kept in consideration.

Ideally, a dataset would be available that covered all engagement types and factors along with having a high quality sample. As can be seen in the summary tables, this was not the case. The alternative was to combine data from various sources; an approach that adds complexity to the task and has its own associated issues and risks¹. This was therefore only attempted where absolutely necessary.

Measuring engagement: the Taking Part Survey, Active People Survey and England Leisure Visits Study had the most developed participation variables.

Factors impacting engagement: the datasets containing the most conceptual factors were:

- Taking Part (12 factors).
- National Adult Learning Survey (12 factors).
- British Household Panel Survey (11 factors).
- Citizenship Survey (11 factors).
- National Survey of Volunteering and Charitable Giving (11 factors).

It was therefore proposed that the central dataset used in the modelling should be the Taking Part Survey. Other datasets that may have been useful in providing estimates of missing factors included:

- National Travel Survey – for area level public transport estimates.
- Time Use Survey – for working/leisure time estimates.
- Citizenship Survey – for working/leisure time and media consumption estimates.
- Best Value Performance Indicators (BVPs) – for local environment characteristics (this was updated to the National Indicators dataset during the modelling process).
- Asset datasets – for geographic location data of opportunities to engage.
- Census – for reweighting.

¹ Rodgers, Willard L, 1984. "An Evaluation of Statistical Matching," Journal of Business & Economic Statistics, American Statistical Association, vol. 2(1), pages 91-102, January.

Although the conceptual model framework includes factors at the international and national level, these were not measurable with the data available. In order to measure international influences, a vast amount of multi-national data over a long time span would be required and even then this would be a highly complex and challenging undertaking. Likewise with national factors, national survey data would need to be related to national indicators over time. It is highly likely that the time lags and the complexity of the relationships involved would prevent modelling robust estimates of influence.

After the conceptual framework had been populated with the data available in the Taking Part Survey, gaps in the framework were filled using other data sources. Specifically:

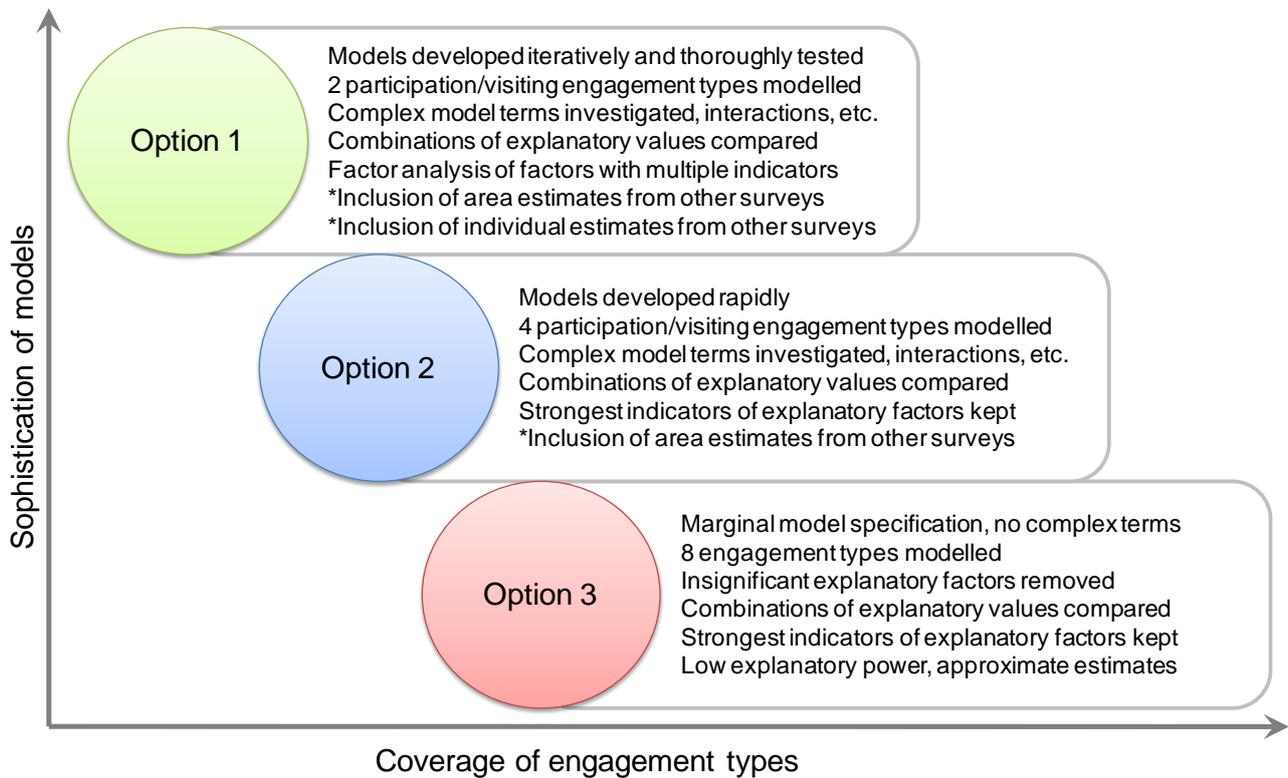
- Media consumption was adequately measured by Taking Part, and working/leisure time was measured by proxy using a combination of family structure and working status variables in Taking Part.
- The National Indicators dataset was used to measure area level access to services via public transport; community cohesion, quality of local parks museums and galleries, libraries and sports facilities (data originally sourced from the new Place Survey).
- Assets data were collated from various sources, including:
 - English Heritage
 - Sport England
 - Arts Council
 - Experian business data

It was found that a reweighting variable was already available in the survey data, thus Census data was not required. Further information on the data used in the models can be found in Appendix 3.

The modelling approach adopted

Modelling approaches vary in their level of sophistication. The more sophisticated a modelling approach, the more resources it requires. Given the scope of the regression part of the research, Figure 2 outlines the three options that were available on a sliding scale of number of models that could be run within the existing budget balanced against sophistication of modelling approach.

Figure 1: Statistical modelling options arranged by sophistication of statistical models and number of models



The modelling option adopted determined the number of engagement types that could be modelled. It was proposed that the most appropriate option was the one that maximised the sophistication of the methods adopted whilst ensuring that the statistical modelling provided an analysis of engagement that met the requirements of the system dynamics modelling element of the project. In discussion with CASE, it was determined that the following four engagement types should be included in the model:

1. Participation in sport.
2. Visiting museums, libraries, and archives.
3. Visiting art galleries.
4. Visiting heritage sites.

Given that the minimum number of models required to inform the system dynamics element of the project was four, it was proposed that Option 2 be adopted.

3. Appendix 3: Regression – Final dataset description

Variable name	Description	Level	Source
access	Accessibility to services index from National Indicator set (percent) – percentage of people who can reach selected core services and facilities within 15 minutes by public transport and/or walking (National Indicator 175)	Area	National Indicator set
age	Age in years	Individual	Taking Part 2007/08
alcohol	Days alcohol drunk per week (categorical from 0=none to 4=every day)	Individual	Taking Part 2007/08
art	Attended arts event in last 12 months (1=yes, 0=no)	Individual	Taking Part 2007/08
art_internet	Visited art website in last 12 months (1=yes, 0=no)	Individual	Taking Part 2007/08
art_tv	Watches art television programmes (1=yes, 0=no)	Individual	Taking Part 2007/08
BMEgroup	Member of ethnic minority group (1=yes, 0=no)	Individual	Taking Part 2007/08
child_encouraged_creative	Encouraged to draw, paint or write when growing up (categorical from 0=not to 2=a lot)	Individual	Taking Part 2007/08
child_encouraged_perform	Encouraged to perform music, dance, act growing up (categorical from 0=not to 2=a lot)	Individual	Taking Part 2007/08
child_encouraged_read	How much encouraged to do read when growing up (categorical from 0=not to 2=a lot)	Individual	Taking Part 2007/08
child_encouraged_sport	How much encouraged to do sport when growing up (categorical from 0=not to 2=a lot)	Individual	Taking Part 2007/08
child_gallery_visit	Average times per year taken to museums or art galleries when growing up	Individual	Taking Part 2007/08
child_heritage_visit	Average times per year taken to heritage sites when growing up	Individual	Taking Part 2007/08
child_library_visit	Average times per year taken to libraries when growing up	Individual	Taking Part 2007/08
child_museum_visit	Average times per year taken to museums or art galleries when growing up	Individual	Taking Part 2007/08

Variable name	Description	Level	Source
child_theatre_visit	Average times per year taken to theatre, dance event or classical music when growing up	Individual	Taking Part 2007/08
children	Children living in household (1=yes, 0=no)	Individual	Taking Part 2007/08
community_cohesion	% of people who feel that they belong to their neighbourhood	Area	National Indicator set
coupled	Living as part of a couple (1=yes, 0=no)	Individual	Taking Part 2007/08
cultural_influence	Has influence over local cultural facilities (categorical from 0=no to 2=a lot)	Individual	Taking Part 2007/08
cycles	Cycles to get from place to place (1=yes, 0=no)	Individual	Taking Part 2007/08
education	Highest educational qualification held (categorical from 1=degree to 8=no qualifications)	Individual	Taking Part 2007/08
heritage	Visited heritage site in last 12 months (1=yes, 0=no)	Individual	Taking Part 2007/08
heritage_internet	Visited heritage website in last 12 months (1=yes, 0=no)	Individual	Taking Part 2007/08
highSES	Member of high socio-economic group NS-SEC 1-4 (1=yes, 0=no)	Individual	Taking Part 2007/08
history_tv	Watches historical television programmes (1=yes, 0=no)	Individual	Taking Part 2007/08
income	Highest income in household (interval from 0=£0 to 12=£50,000 or more)	Individual	Taking Part 2007/08
internet	Has access to internet (1=yes, 0=no)	Individual	Taking Part 2007/08
library	Visited library in last 12 months (1=yes, 0=no)	Individual	Taking Part 2007/08
library_internet	Visited library website in last 12 months (1=yes, 0=no)	Individual	Taking Part 2007/08
limiting_illness	Has illness or disability which limits activities (1=yes, 0=no)	Individual	Taking Part 2007/08
live_sport_tv	Watches live sport coverage television programmes (1=yes, 0=no)	Individual	Taking Part 2007/08
local_art_awards	Population weighted count of Artsmark 'Regularly Funded Organisations' awards in area	Area	Arts Council

Variable name	Description	Level	Source
local_art_funding	Population weighted sum of Artsmark 'Regularly Funded Organisations' funding in area	Area	Arts Council
local_gallery_satisfaction	% of people who are very or fairly satisfied with museums/galleries	Area	National Indicator set
local_heritage_sites	Population weighted count of heritage sites in area (including scheduled monuments and grade I and II* listed buildings)	Area	English Heritage
local_libraries	Population weighted count of libraries in area – categorised by SIC(92) classification code 9251 (Library And Archive Activities)	Area	Experian
local_library_satisfaction	% of people who are very or fairly satisfied with libraries	Area	National Indicator set
local_museum_satisfaction	% of people who are very or fairly satisfied with museums/galleries	Area	National Indicator set
local_museums	Population weighted count of museums in area – categorised by SIC(92) classification code 9252 (Museum Activities And Preservation Of Historical Sites And Buildings)	Area	Experian
local_parks_satisfaction	% of people who are very or fairly satisfied with parks and open spaces	Area	National Indicator set
local_sports_facilities	Population weighted count of sport assets in area – including the following categories: Grass Pitch, Sports Hall, Swimming Pool, Golf, Synthetic Turf Pitch, Health and Fitness Suite, Athletics Tracks, Indoor Tennis Centre, Indoor Bowls, Ice Rinks, Ski Slopes	Area	Sport England
local_sports_satisfaction	% of people who are very or fairly satisfied with sport/leisure facilities	Area	National Indicator set
motor_vehicle	Has access to a motor vehicle (1=yes, 0=no)	Individual	Taking Part 2007/08
museum	Visited museum in last 12 months (1=yes, 0=no)	Individual	Taking Part 2007/08
museum_internet	Visited museum website in last 12 months (1=yes, 0=no)	Individual	Taking Part 2007/08
newspaper	Reads daily newspaper at least three times per week (1=yes, 0=no)	Individual	Taking Part 2007/08
other_sport_tv	Watches other sport television programmes (1=yes, 0=no)	Individual	Taking Part 2007/08
radio	Radio available in household (1=yes, 0=no)	Individual	Taking Part 2007/08

Variable name	Description	Level	Source
religious	Religiosity (0=not religious, 1=non-practising, 2=practising)	Individual	Taking Part 2007/08
science_tv	Watches science television programmes (1=yes, 0=no)	Individual	Taking Part 2007/08
sex	Sex of respondent (1=male, 0=female)	Individual	Taking Part 2007/08
social_housing	Is a social housing tenant (1=yes, 0=no)	Individual	Taking Part 2007/08
sport	3x30 minutes moderate intensity sport per week in last month ('1 million sport' indicator)	Individual	Taking Part 2007/08
sport_facility_nearby	Can get to a sports facility within 20 minutes (1=yes, 0=no)	Individual	Taking Part 2007/08
sport_internet	Visited sport website in last 12 months (1=yes, 0=no)	Individual	Taking Part 2007/08
sports_influence	Has influence over local sporting facilities (categorical from 0=no to 2=a lot)	Individual	Taking Part 2007/08
tv_hours	Hours of television watched per day on average	Individual	Taking Part 2007/08
work_status	Work status (0=not working, 1=part-time, 2=full-time)	Individual	Taking Part 2007/08

4. Appendix 4: Regression – Univariate analysis

Summary of variables

The table below shows a summary of the variables included in the analyses. The number of observations vary due to missing data in different variables, such as “don’t know” answers or refusals to answer survey questions. In particular, the **income** variable suffered from a noticeably high amount of refusals. Categorical or binary variables are highlighted with an asterisk against the variable name. For these variables, care must be taken in interpreting the meaning of the mean and standard deviation, though these values are still useful in understanding the data.

Variable	Observations	Mean	Std. Dev.	Min	Max
access	12678	95.29612	6.060047	66	100
age	12632	49.18904	18.74864	16	99
alcohol*	12646	1.586589	1.211735	0	4
art*	12678	0.5855024	0.4926545	0	1
art_internet*	12678	0.3170847	0.4653591	0	1
art_tv*	12424	0.1296684	0.3359518	0	1
BMEgroup*	12660	0.1097946	0.3126459	0	1
child_encouraged_creative*	12612	1.01118	0.8436314	0	2
child_encouraged_perform*	12647	0.830869	0.8632235	0	2
child_encouraged_read*	12596	1.326056	0.8037175	0	2
child_encouraged_sport*	12637	1.146791	0.8405058	0	2
child_gallery_visit	12637	1.42154	2.625746	0	12
child_heritage_visit	12637	1.811743	2.881348	0	12
child_library_visit	12596	4.649929	5.462591	0	12
child_theatre_visit	12654	1.141536	2.361747	0	12
children*	12669	0.2925251	0.4549401	0	1
community_cohesion	12678	58.12987	6.231322	42.8	75.1
coupled*	12548	0.5380937	0.4985666	0	1
cultural_influence*	12516	0.1287152	0.365036	0	2
cycles*	12678	0.0269759	0.1620192	0	1
education*	12655	4.389332	2.685871	1	8
heritage*	12678	0.7011358	0.4577782	0	1
heritage_internet*	12678	0.2037388	0.4027928	0	1

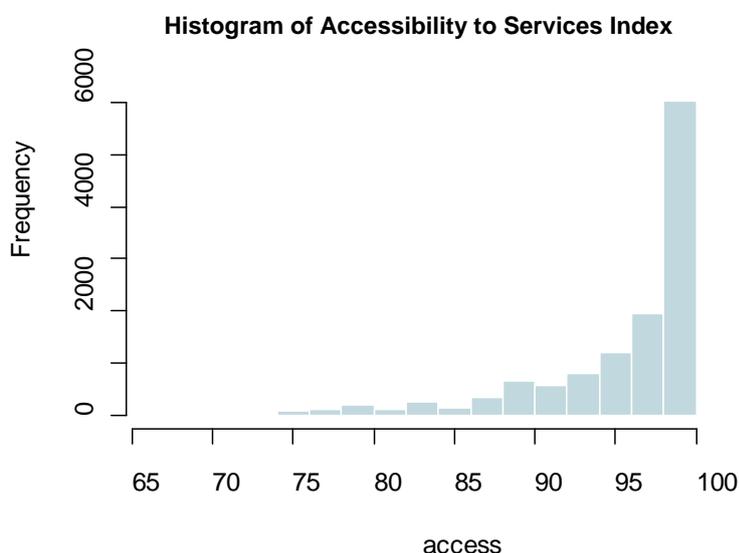
Variable	Observations	Mean	Std. Dev.	Min	Max
highSES*	12678	0.5333649	0.4989052	0	1
history_tv*	12424	0.4047811	0.4908694	0	1
income*	10441	5.364524	3.231499	0	12
internet*	12672	0.6538037	0.4757755	0	1
library*	12670	0.4642463	0.4987397	0	1
library_internet*	12678	0.1008045	0.3010816	0	1
limiting_illness*	12669	0.2377457	0.4257194	0	1
live_sport_tv*	12424	0.5288152	0.4991891	0	1
local_art_awards	12678	0.017711	0.0280157	0	0.5
local_art_funding	12678	6500.893	23098.37	0	358738
local_gallery_satisfaction	12678	40.72476	11.78437	9.712664	87.15099
local_heritage_sites	12678	1.045776	1.808738	0.03	27.125
local_libraries	12678	0.0635286	0.0252719	0.0171	0.75
local_library_satisfaction	12678	68.30182	4.826819	50.3913	84.73732
local_museums	12678	0.0342454	0.0449023	0	0.5077
local_parks_satisfaction	12678	67.88618	7.723299	47.1555	92.51251
local_sport_facilities	12678	1.207116	0.4012959	0.281	6.125
local_sports_satisfaction	12678	45.60406	6.76629	20.43493	69.14835
local_theatre_satisfaction	12678	42.65174	13.63666	13.98575	85.13792
motor_vehicle*	12676	0.7582834	0.4281404	0	1
museum*	12662	0.4334228	0.4955672	0	1
museum_internet*	12678	0.1736867	0.3788548	0	1
newspaper*	12672	0.5849905	0.4927431	0	1
other_sport_tv*	12424	0.3002254	0.4583743	0	1
pweight1	12678	1.006326	0.6570881	0.0932354	4.870317
pweight2	12678	1.006326	0.3039908	0.394103	3.397024
radio*	12678	0.9395015	0.2384175	0	1
religious*	12667	1.060946	0.7452651	0	2
science_tv*	12424	0.2777688	0.4479168	0	1
sex*	12678	0.4358732	0.4958903	0	1
social_housing*	12678	0.1845717	0.387965	0	1
sport*	12678	0.1384288	0.3453631	0	1
sport_facility_nearby*	12272	0.9326108	0.250705	0	1
sport_internet*	12678	0.2593469	0.4382936	0	1

Variable	Observations	Mean	Std. Dev.	Min	Max
sports_influence*	12486	0.1299055	0.3741008	0	2
tv_hours*	12662	2.750197	1.443192	0	5
work_status*	12652	0.9548688	0.9225493	0	2

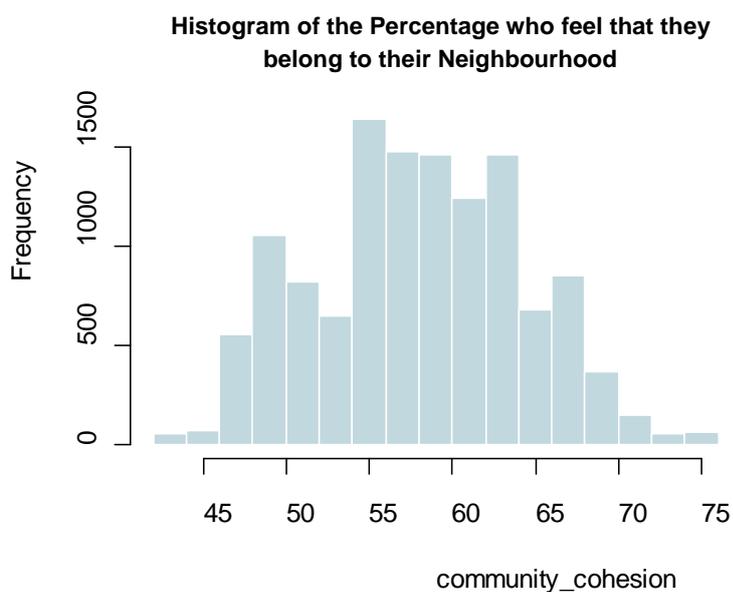
*Note: asterisk indicates categorical or binary variable

Univariate histograms of area level variables

The variables below are those which are applicable to the area level (as opposed to the level of individual survey respondents). Many of the variables demonstrate a high degree of skew. Where this was the case, an attempt to reduce skew was made by using log transformations of the variables.



Accessibility to services was very skewed, though this was related to the nature of the variable – a percentage. Accessibility was highest for very urban areas, and lower for more predominantly rural areas.

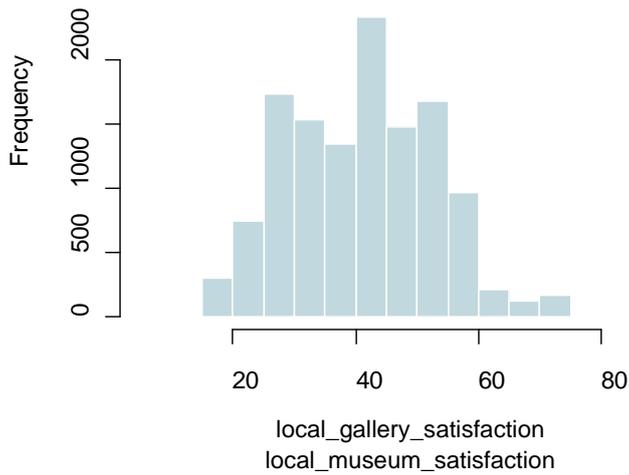


ohesi

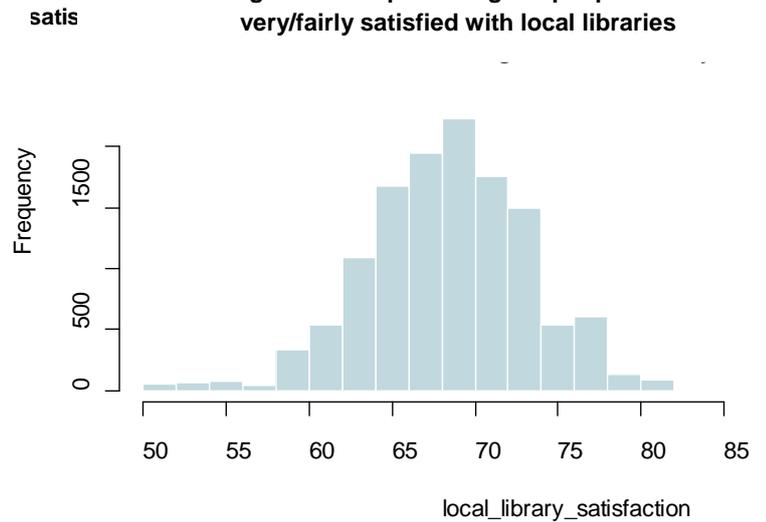
The percentage of people responding to the new Place Survey in local authorities who feel that they belong to their neighbourhood was used as a measure of community cohesion. This variable was reasonably normally distributed.

Satisfaction with local museums/galleries, libraries and sports facilities were also variables from the new Place Survey, collated as part of the National Indicator dataset. These variables were used as measures of quality at the local authority level. Histograms of these variables are shown below. They were all reasonably normally distributed.

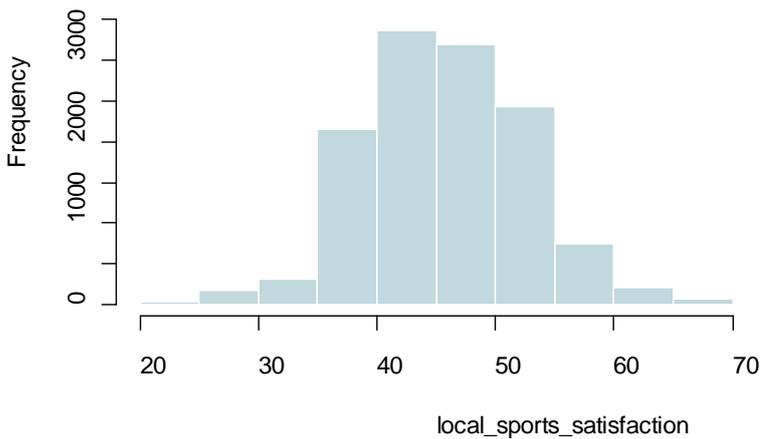
Histogram of the percentage of people who are very/fairly satisfied with local galleries/museums



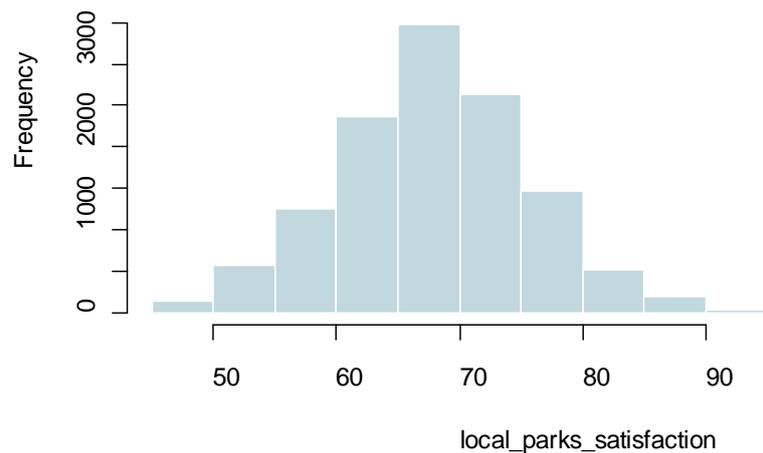
Histogram of the percentage of people who are very/fairly satisfied with local libraries



Histogram of the percentage of people who are very/fairly satisfied with local sport/leisure facilities

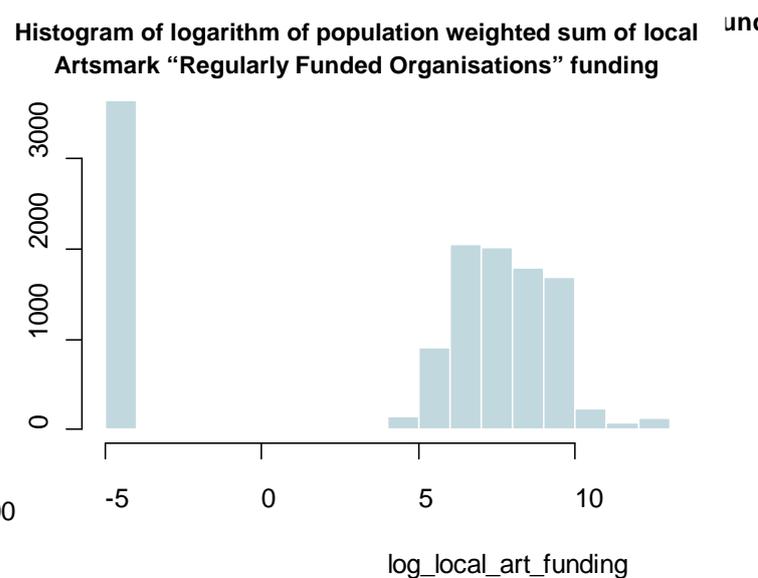
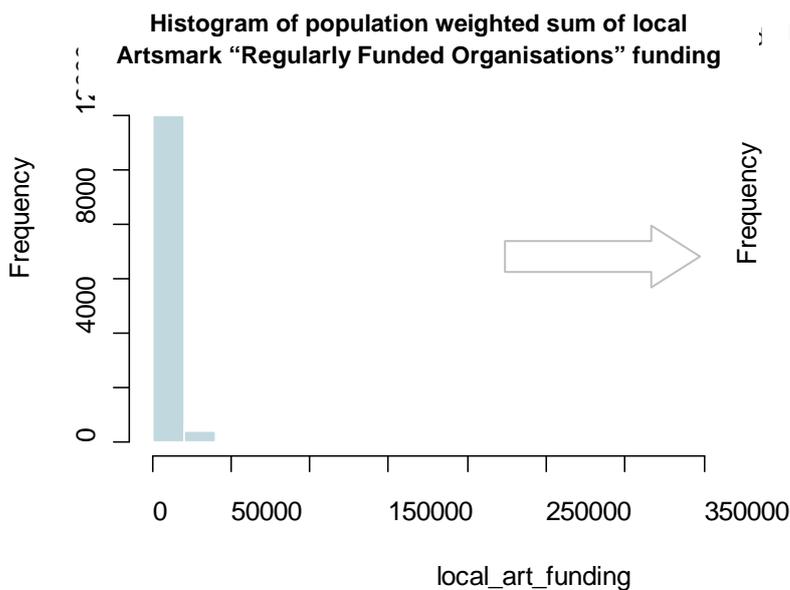
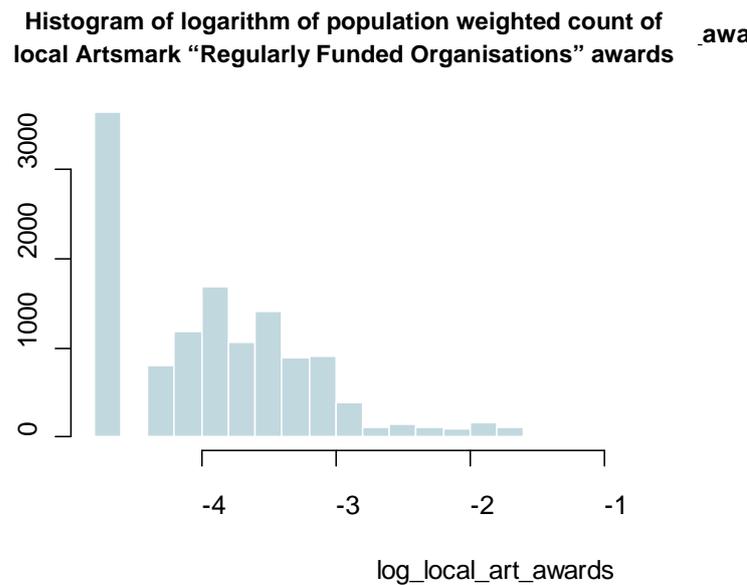
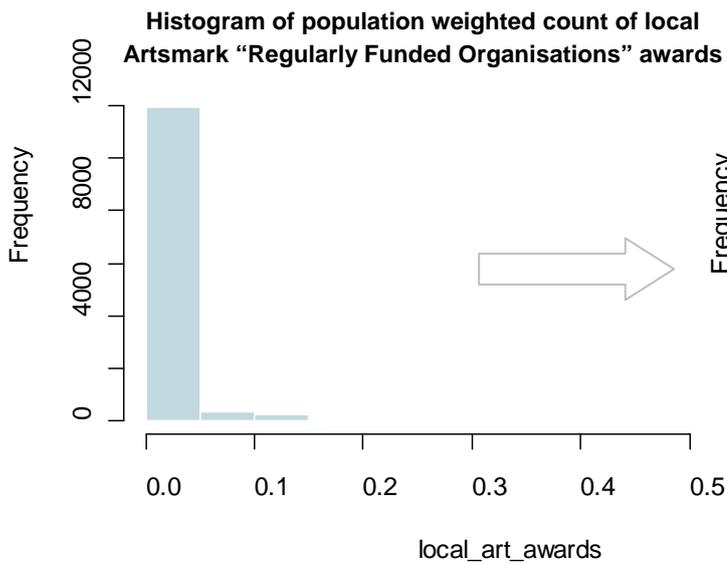


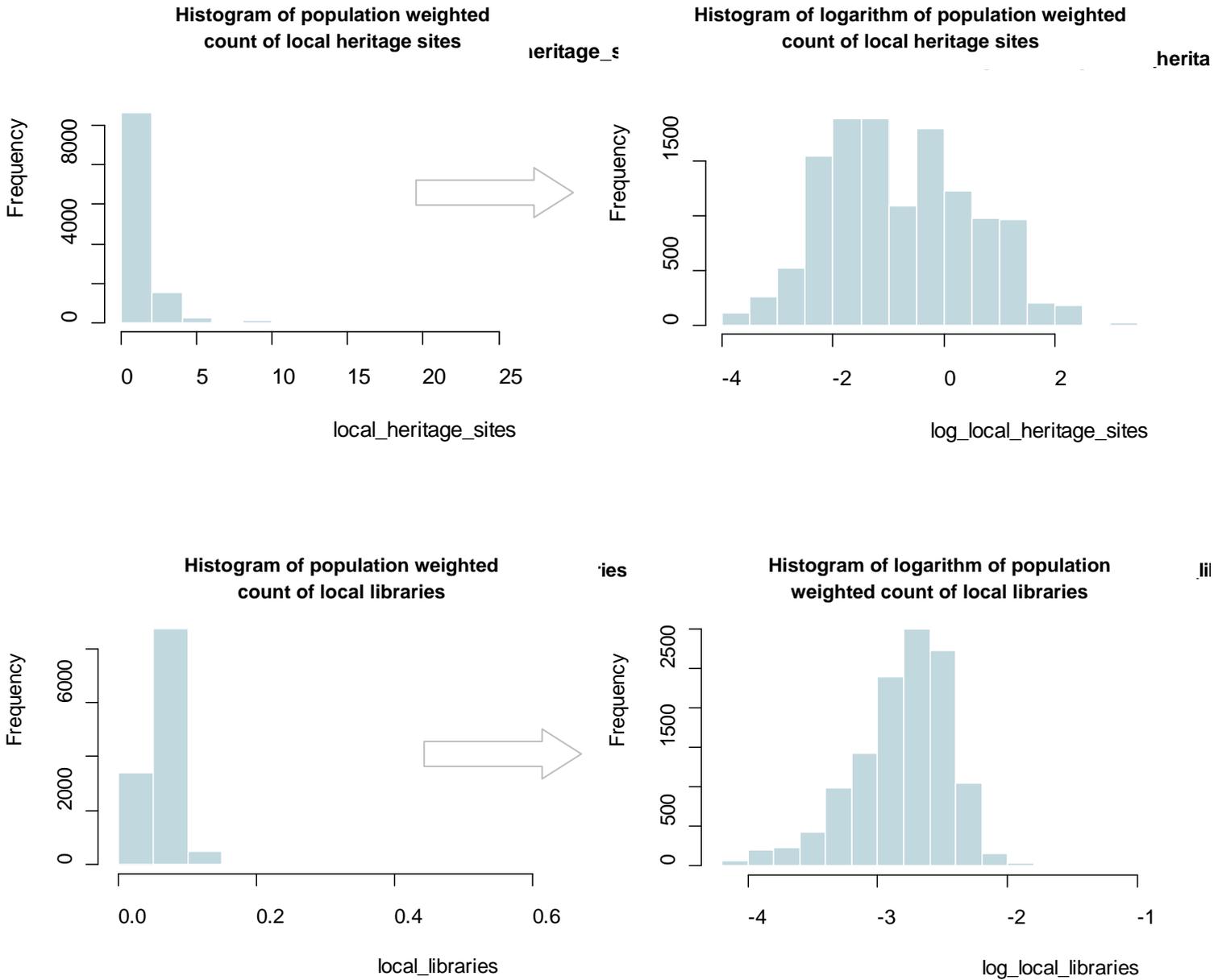
Histogram of the percentage of people who are very/fairly satisfied with local parks and open spaces



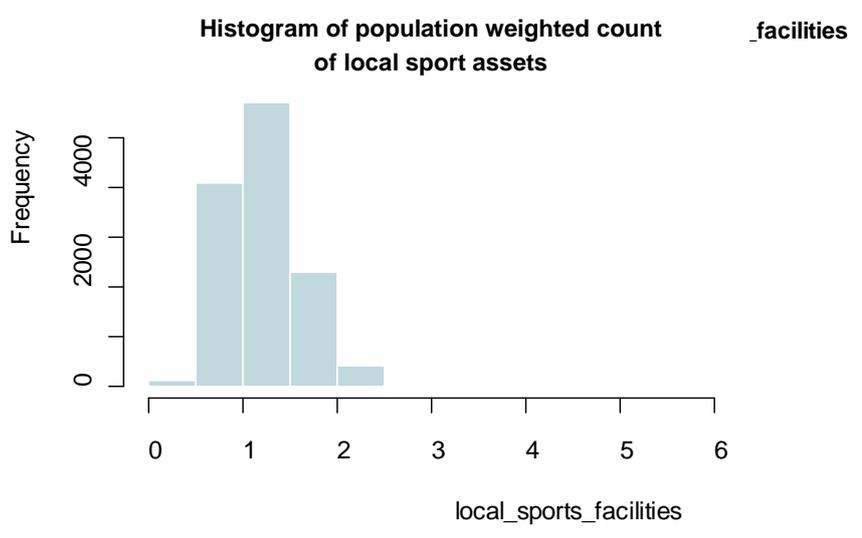
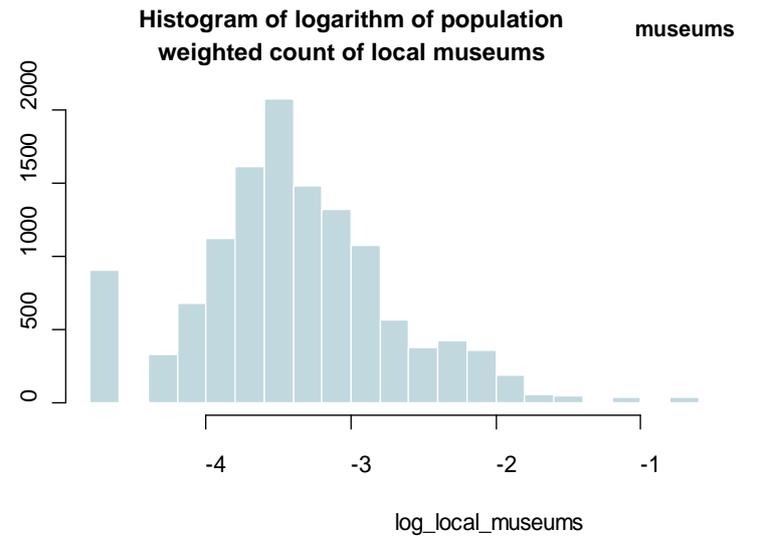
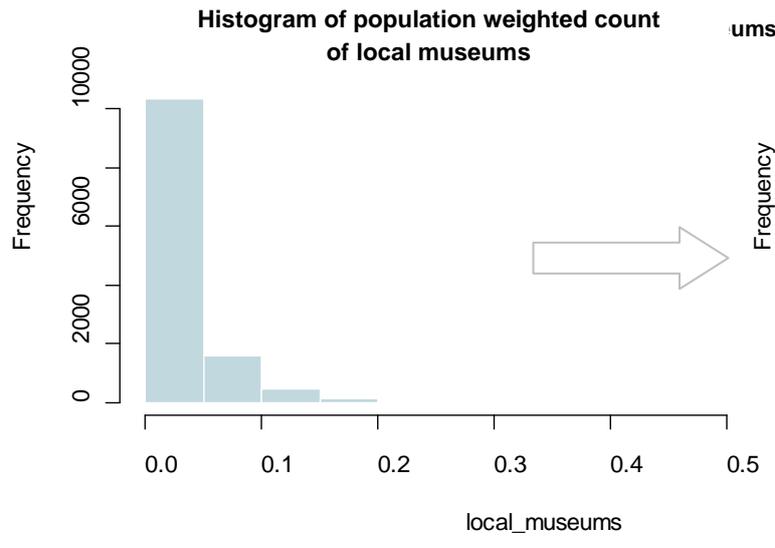
The asset data were generally highly skewed and so log transformations of the variables were attempted. In many cases, there were also a high number of zero counts for local authorities. In this case, a small constant was added to the data before log transformation. The results are shown below.

In the case of the Artsmark “Regularly Funded Organisations”, the number of awards and the funding were highly correlated ($R=0.81$). Due to concerns over multi-collinearity, only one of these variables was included in the art model at any one time.





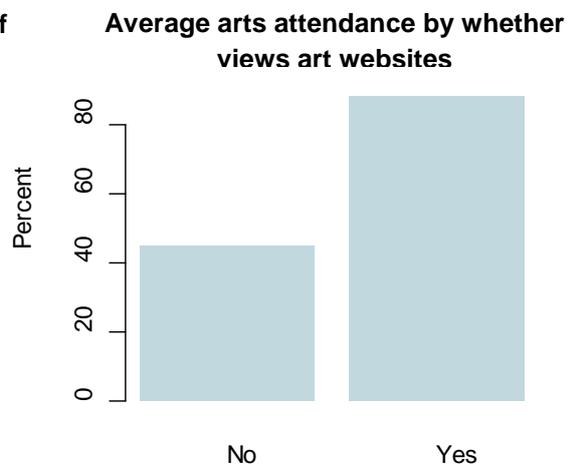
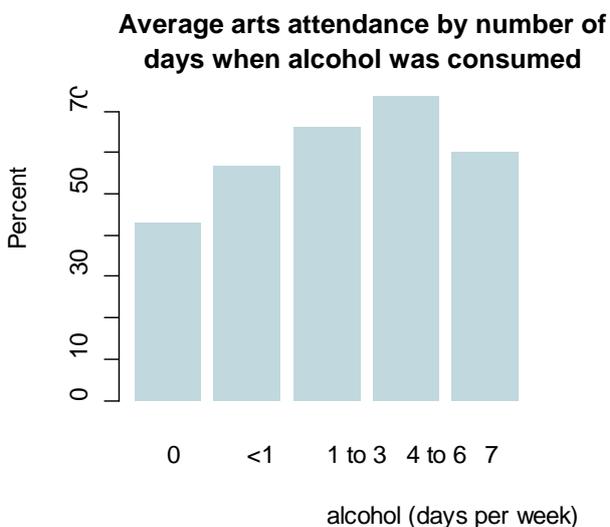
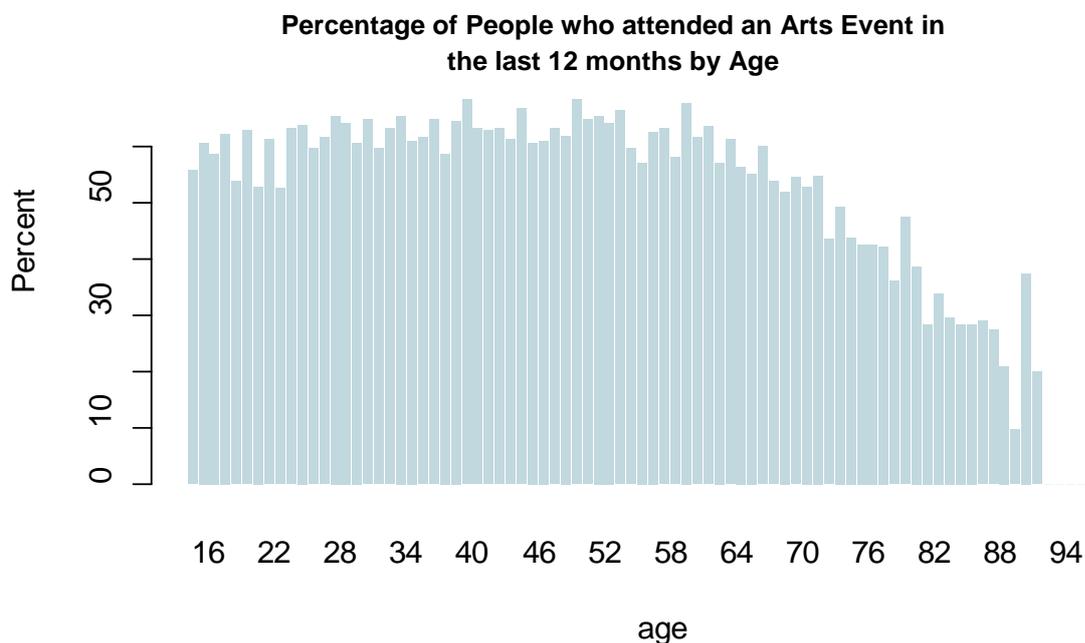
Of the asset variables available, the heritage and libraries data (above) and museums data (below) responded the best to log transformation, leading to distributions that were very near to normal. The arts data were the least responsive, and it was decided that the sport assets data did not require log transformation, as it was not as highly skewed as the other asset variables.

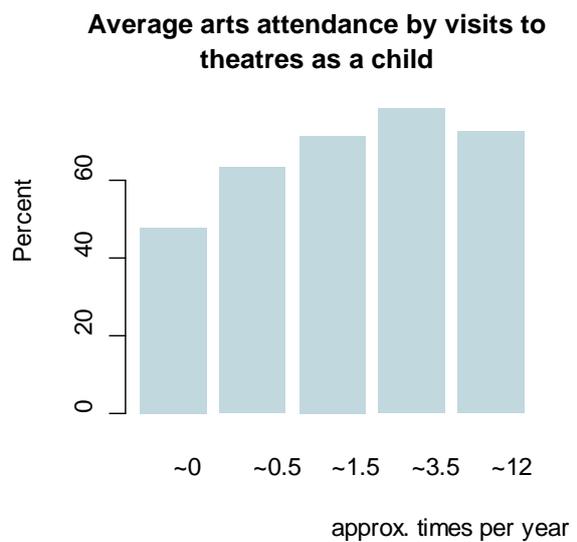
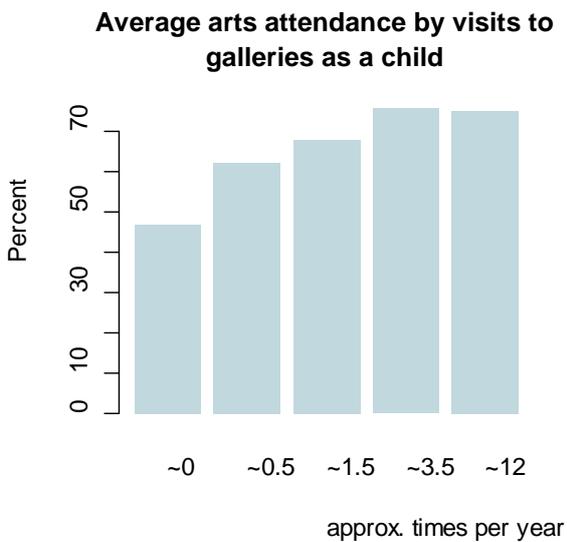
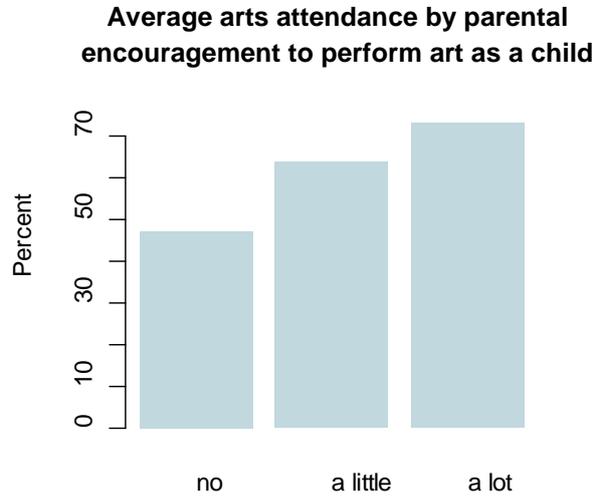
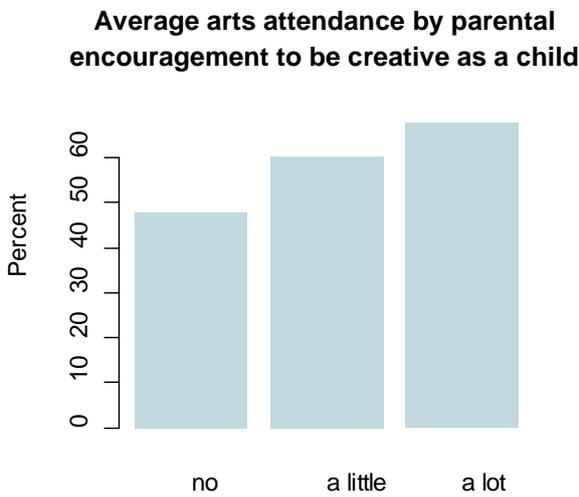
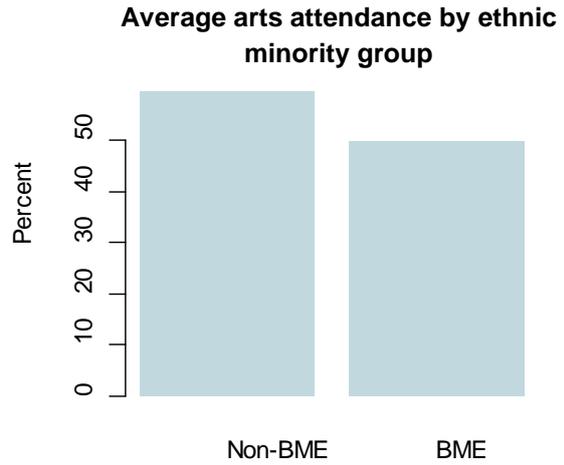
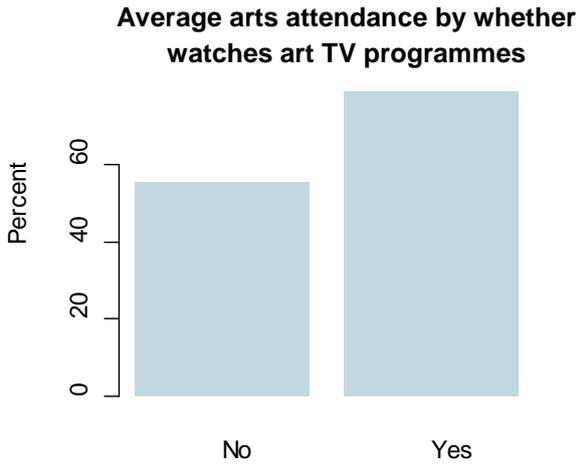


5. Appendix 5: Regression modelling – bivariate analysis

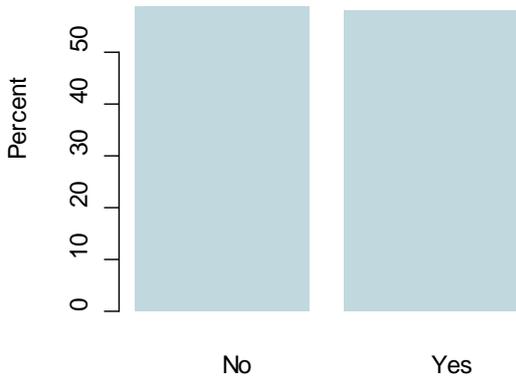
Art bivariate plots

The plots below show the percentage of people who attended an arts event in the last 12 months in the Taking Part data broken down by a variety of explanatory variables. Interesting associations were in evidence for variables related to television and internet use, childhood experiences of art and variables related to socio-economic status, such as education, being a social housing tenant or a member of a high socio-economic group, and income. There also appeared to be an association with alcohol consumption.

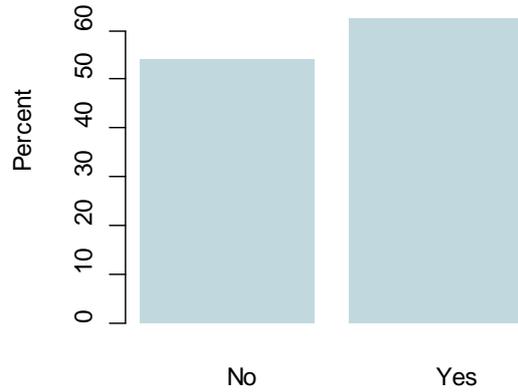




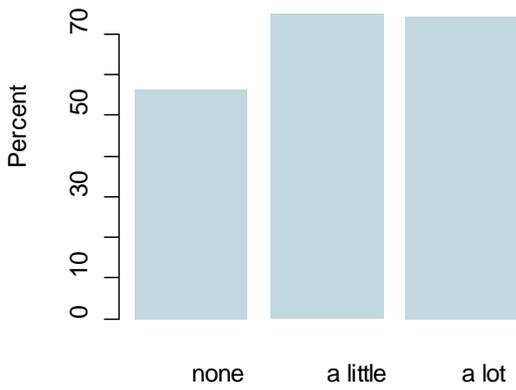
Average arts attendance by whether children are living in household



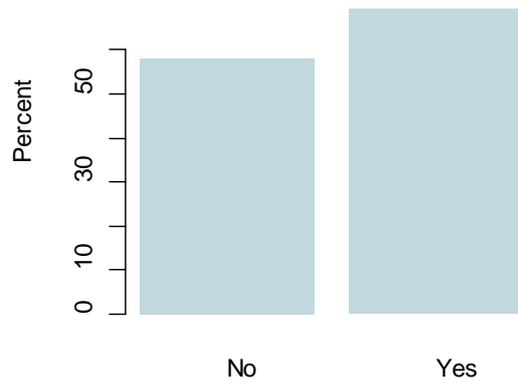
Average arts attendance by whether attendee is living with a partner



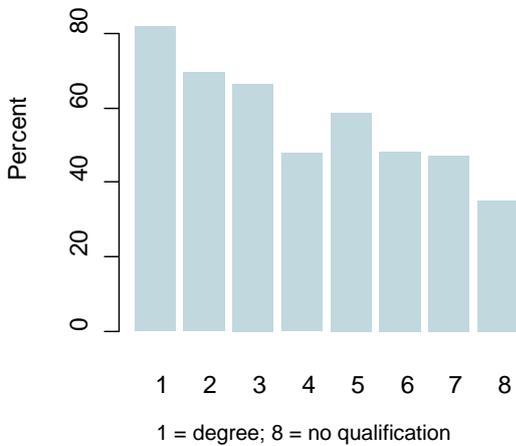
Average arts attendance by whether attendee has influence over local cultural facilities



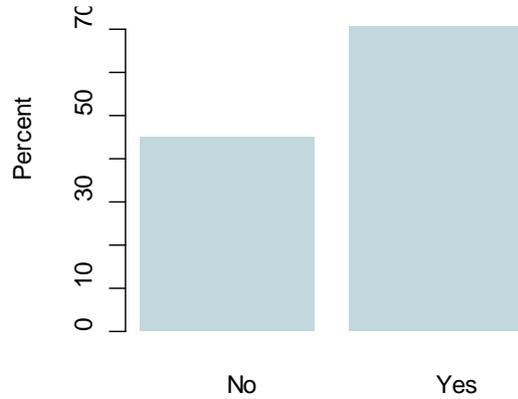
Average arts attendance by whether attendee cycles



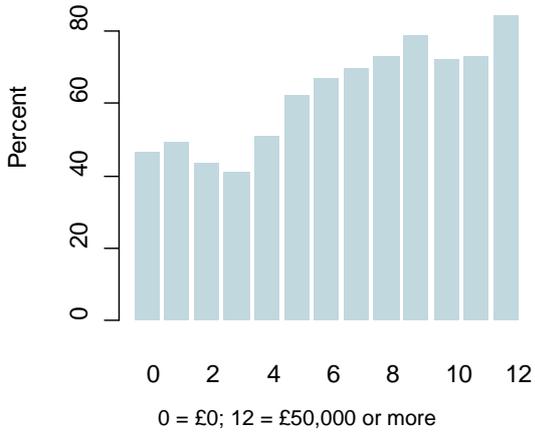
Average arts attendance by highest educational qualification



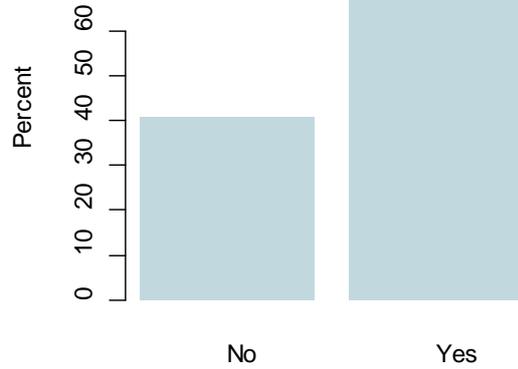
Average arts attendance by whether in a high socio-economic group



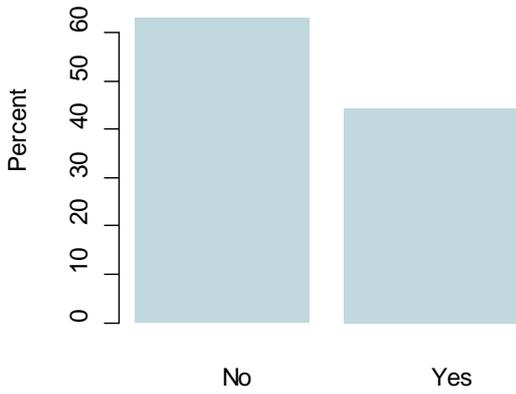
Average arts attendance by income



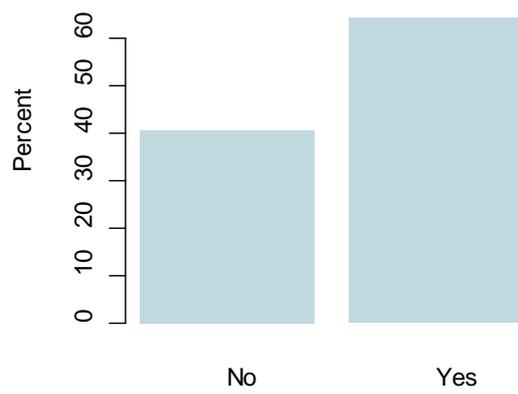
Average arts attendance by internet access



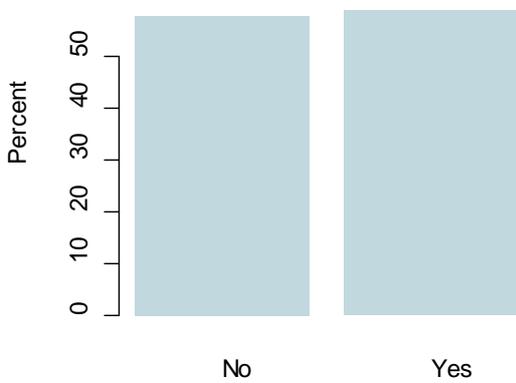
Average arts attendance by illness or disability which limits activities



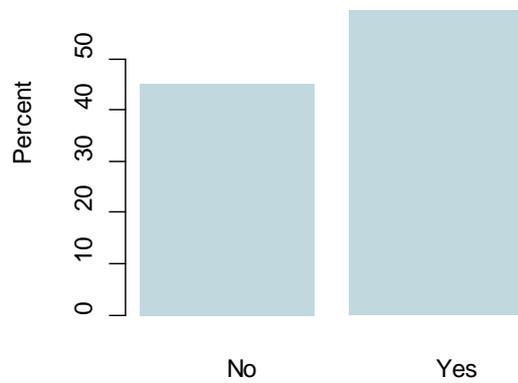
Average arts attendance by access to motor vehicle



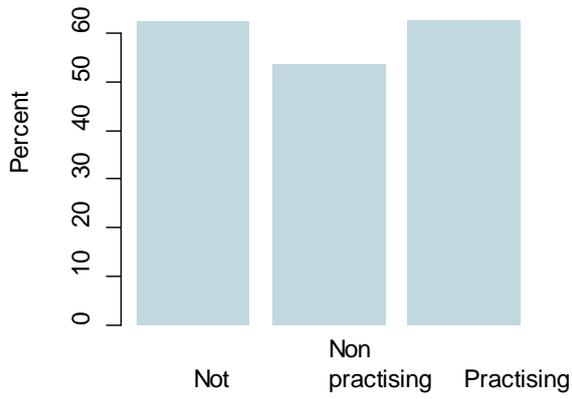
Average arts attendance by reading newspaper at least 3 times per week



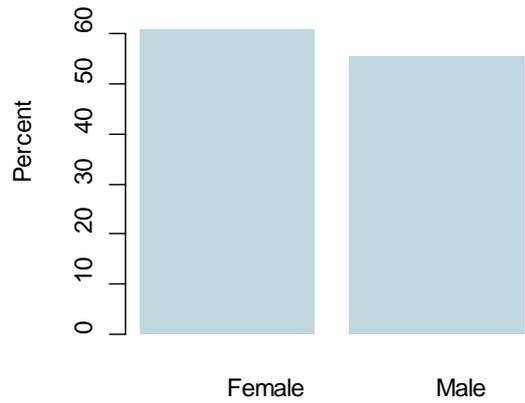
Average arts attendance by radio available in household



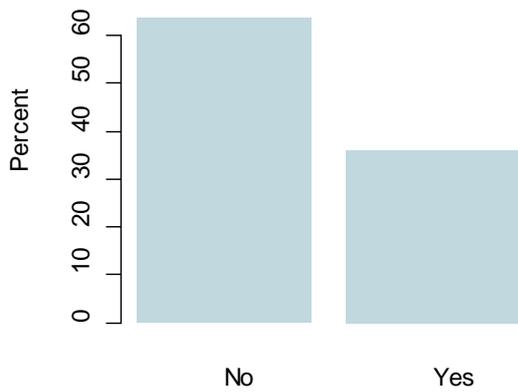
Average arts attendance by religiosity



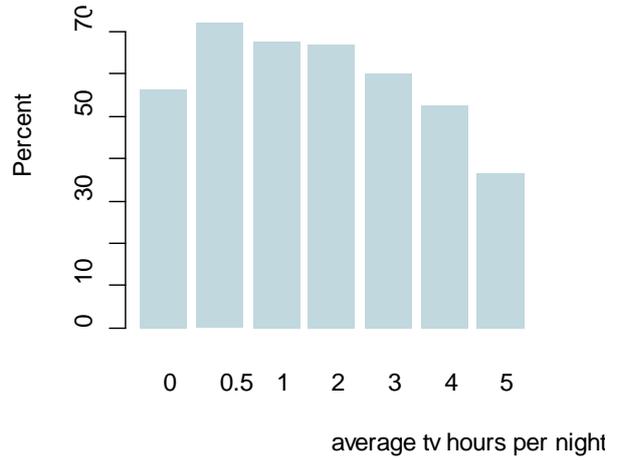
Average arts attendance by gender



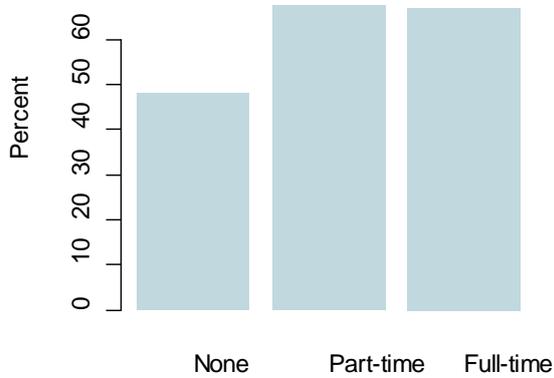
Average arts attendance by whether a social housing tenant



Average arts attendance by hours of TV watched on average per night

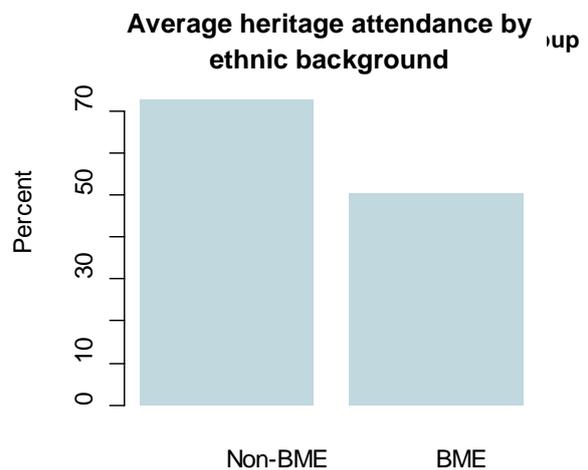
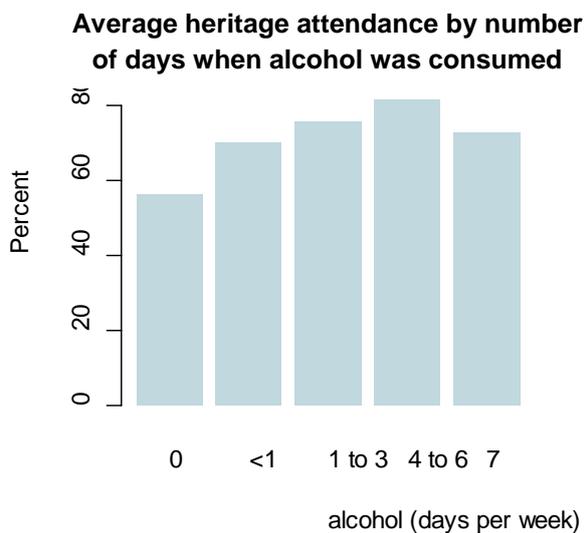
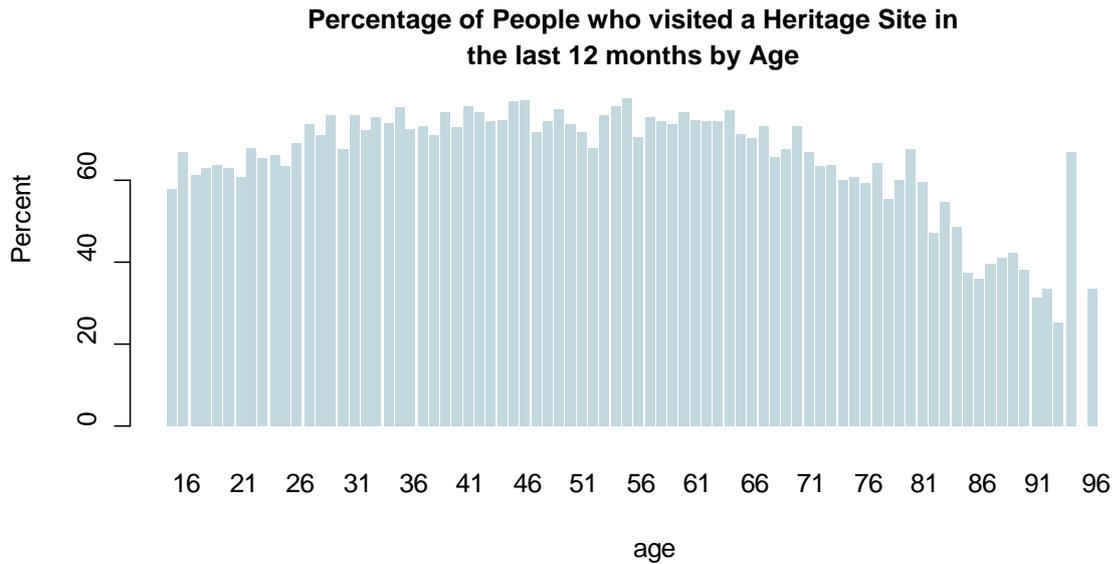


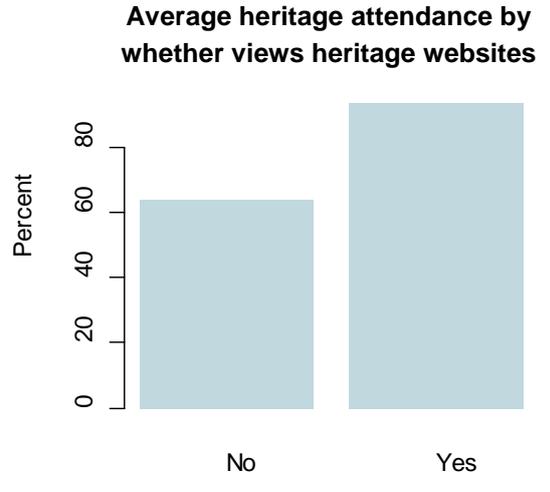
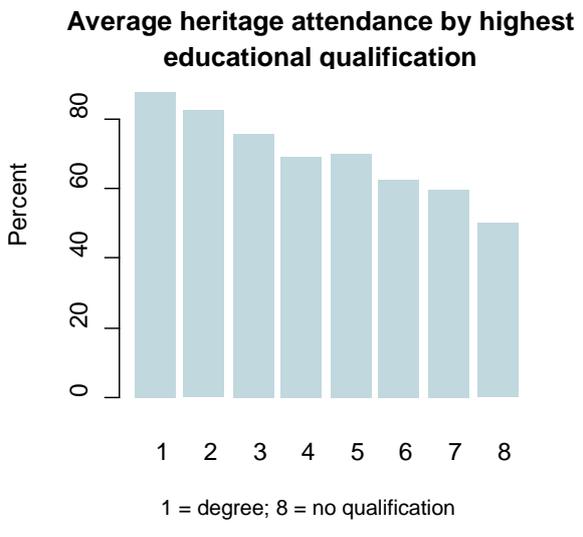
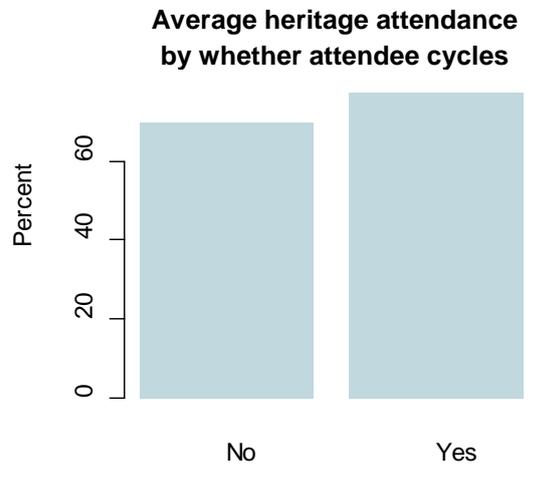
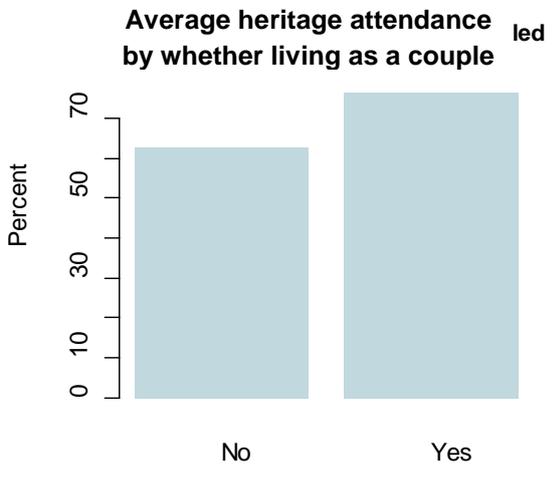
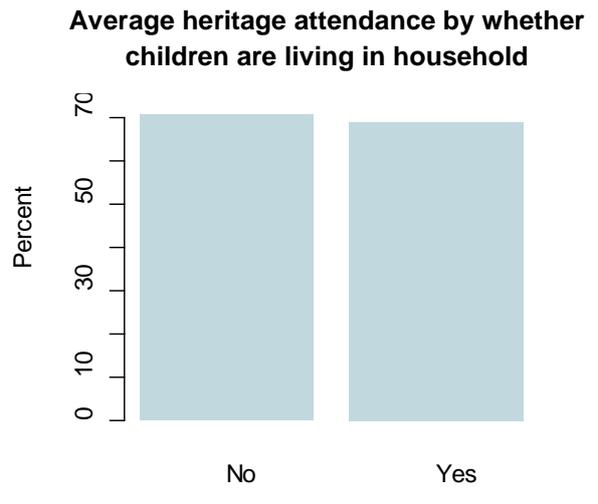
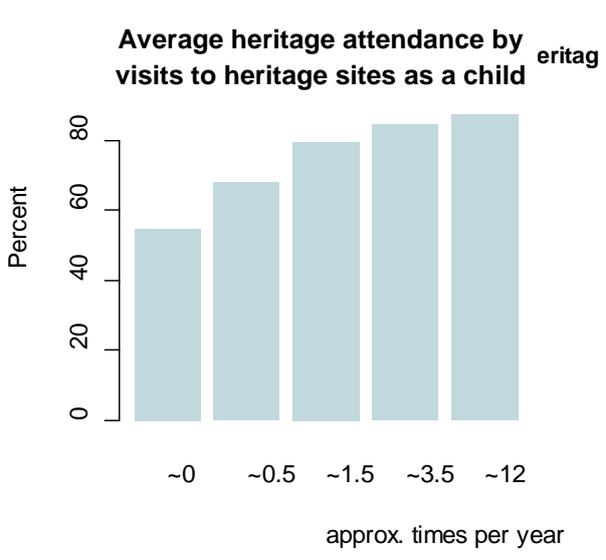
Average arts attendance by Work Status



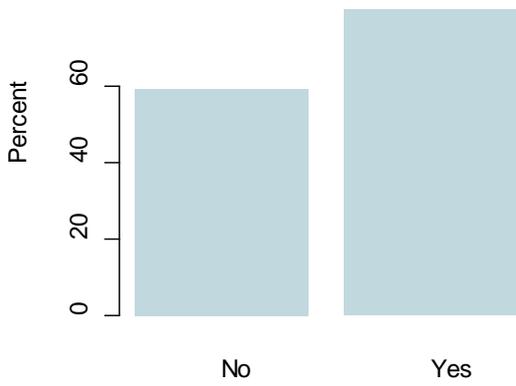
Heritage bivariate plots

The plots below show the percentage of people who attended a heritage site in the last 12 months in the Taking Part data broken down by a variety of explanatory variables. Interesting associations were in evidence for variables related to ethnicity, television and internet use, childhood experiences of heritage and variables related to socio-economic status, such as education, being a social housing tenant or a member of a high socio-economic group, and income.

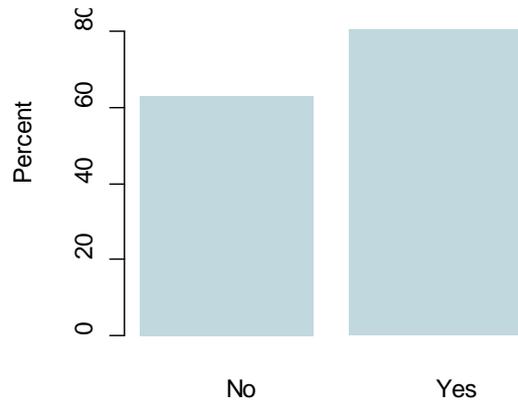




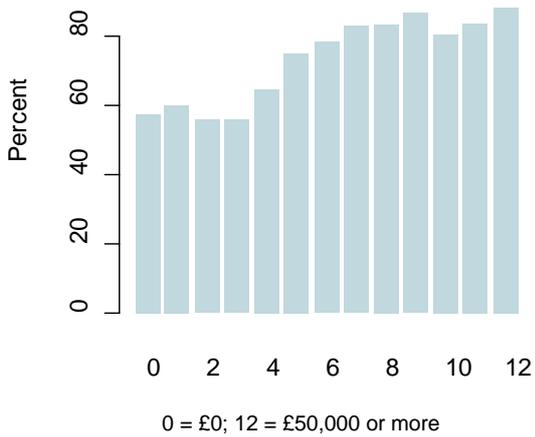
Average heritage attendance by whether in a high socio-economic group



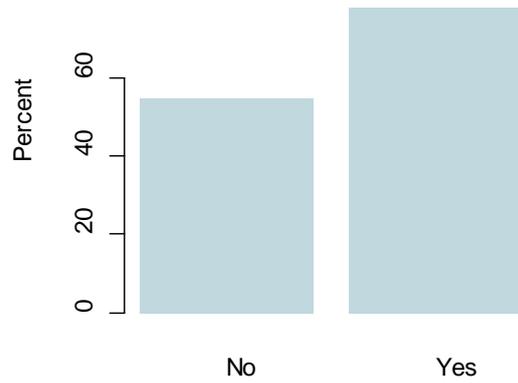
Average heritage attendance by whether watches heritage TV programmes



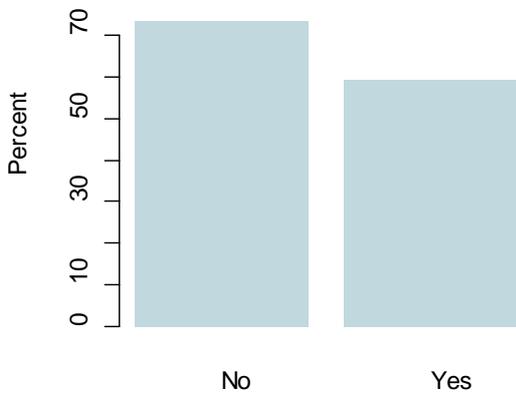
Average heritage attendance by income



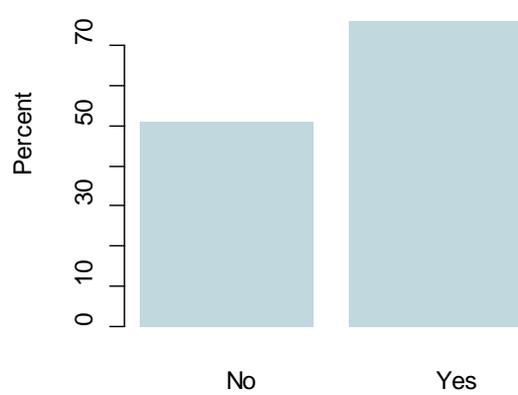
Average heritage attendance by internet access



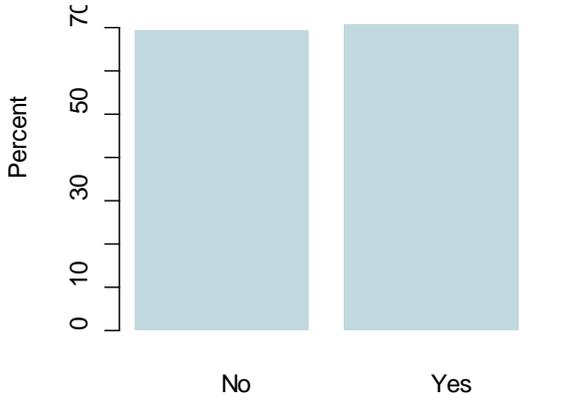
Average heritage attendance by illness or disability which limits activities



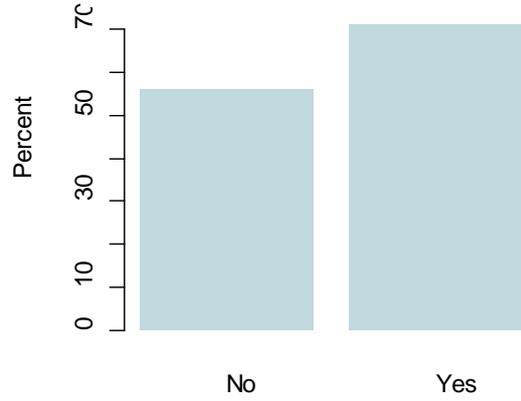
Average heritage attendance by access to motor vehicle



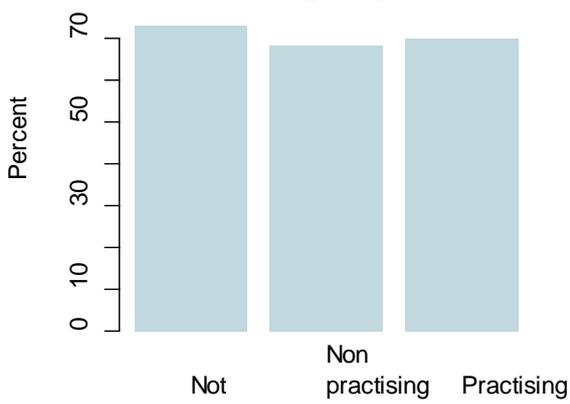
Average heritage attendance by reading newspaper at least 3 times per week



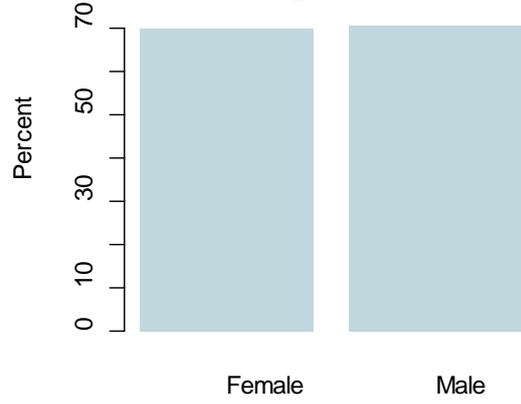
Average heritage attendance by radio available in household



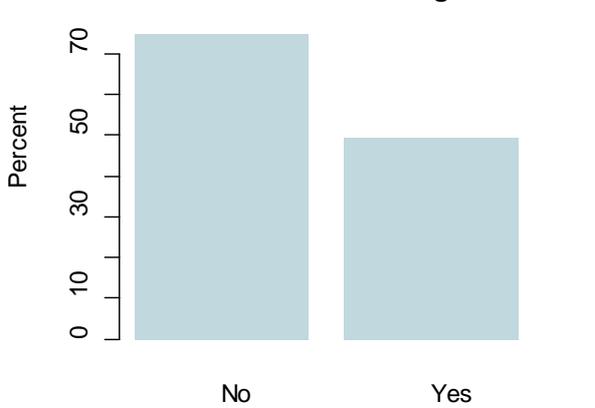
Average heritage attendance by religiosity



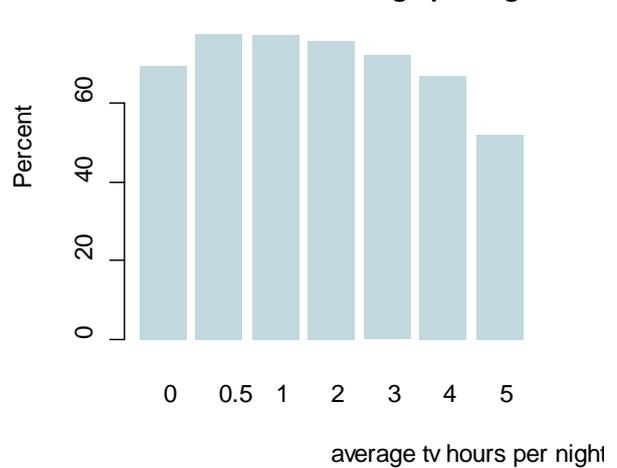
Average heritage attendance by gender



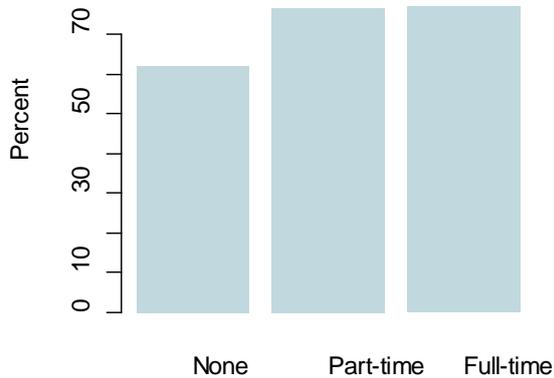
Average heritage attendance by whether a social housing tenant



Average heritage attendance by hours of TV watched on average per night



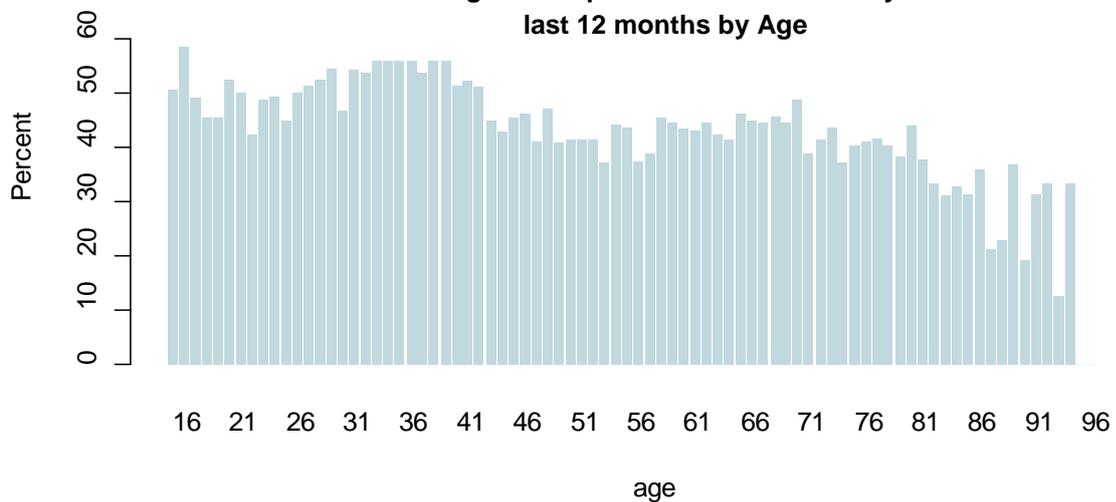
Average heritage attendance by Work

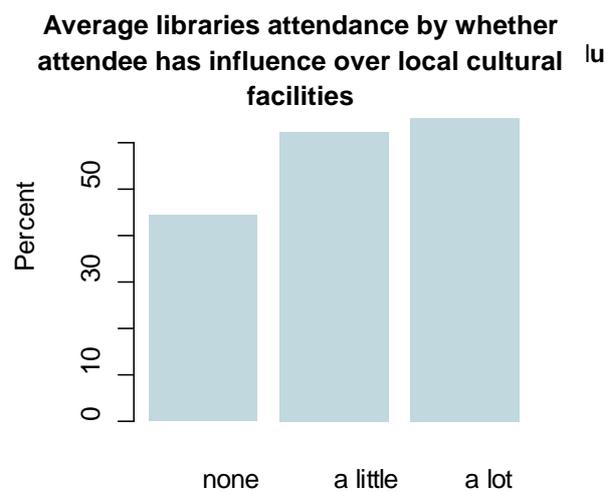
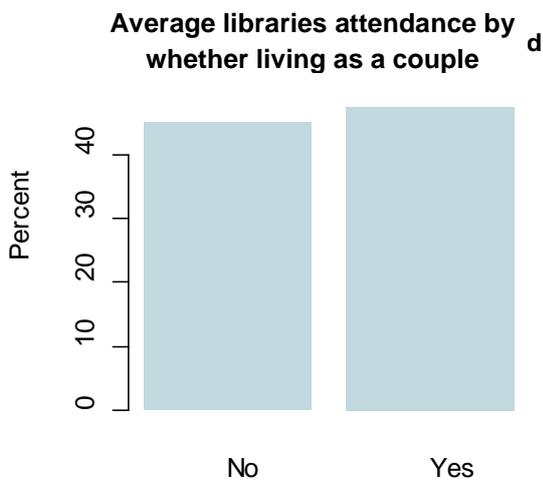
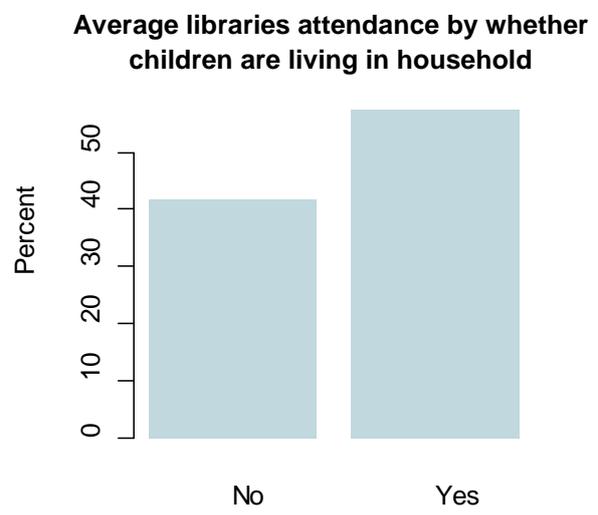
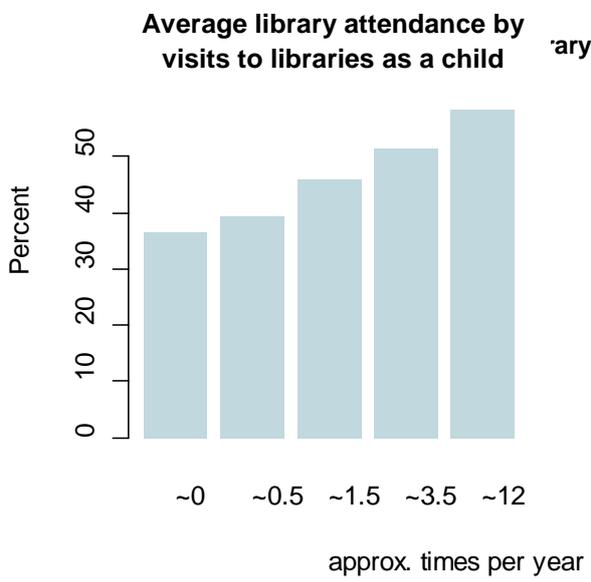
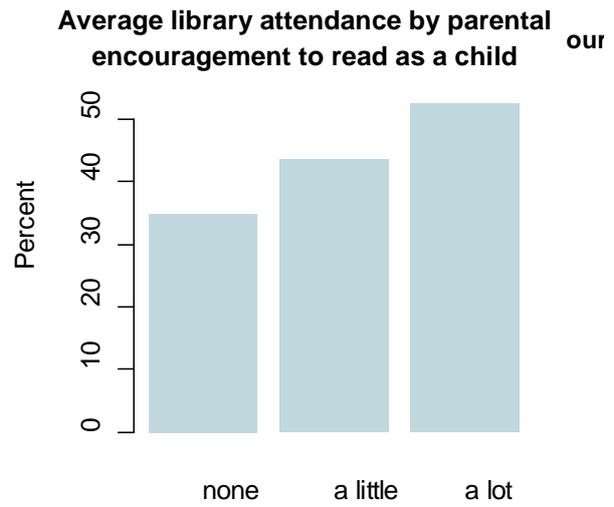
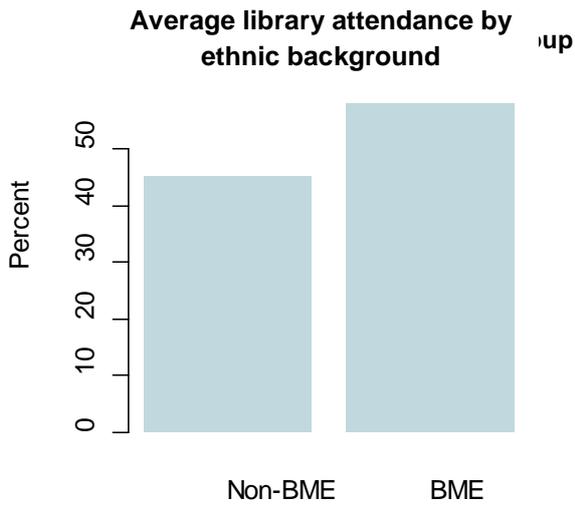


Library bivariate plots

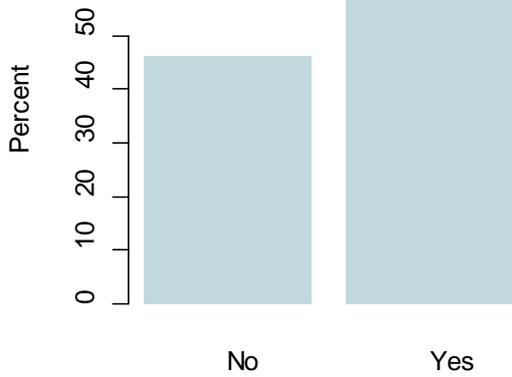
The plots below show the percentage of people who attended a library in the last 12 months in the Taking Part data broken down by a variety of explanatory variables. Interesting associations were in evidence for variables related to ethnicity, childhood experiences of library visits and reading, whether children were living in the household, internet use and whether the respondent cycles to get from place to place. Particularly striking was the lack of association with income.

Percentage of People who visited a Library in the last 12 months by Age

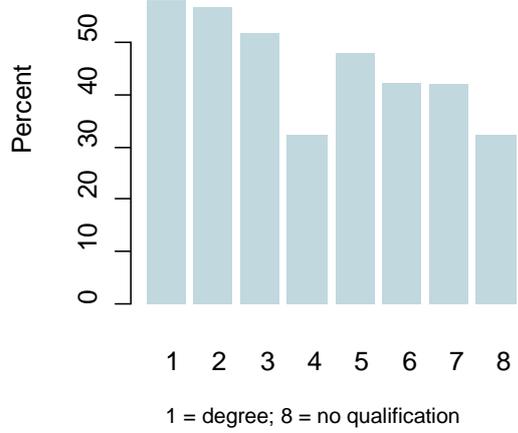




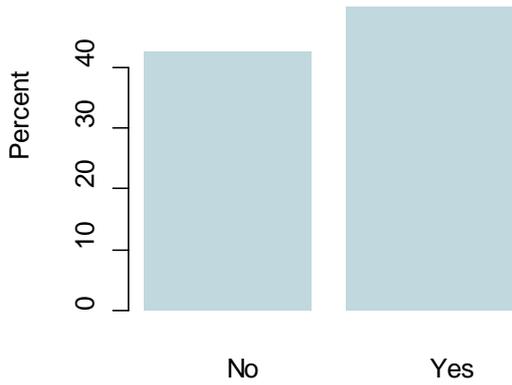
Average libraries attendance by whether attendee cycles



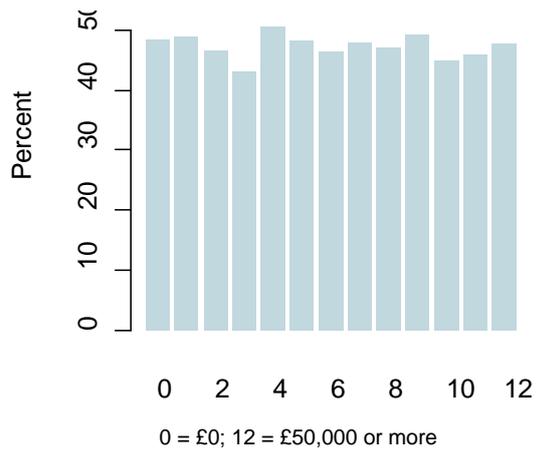
Average libraries attendance by highest educational qualification



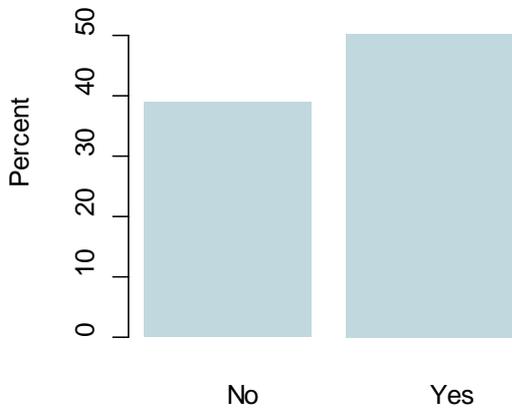
Average libraries attendance by whether in a high socio-economic group



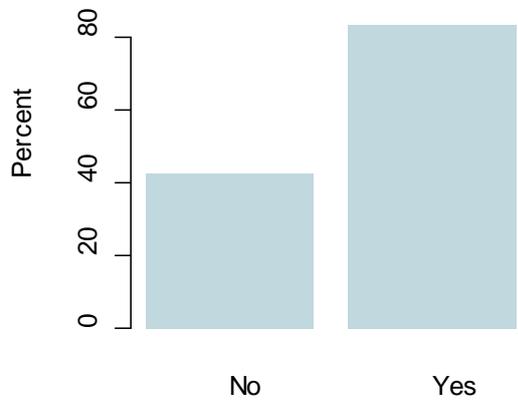
Average libraries attendance by income



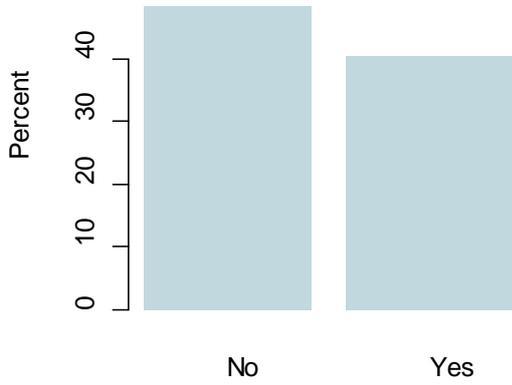
Average libraries attendance by internet access



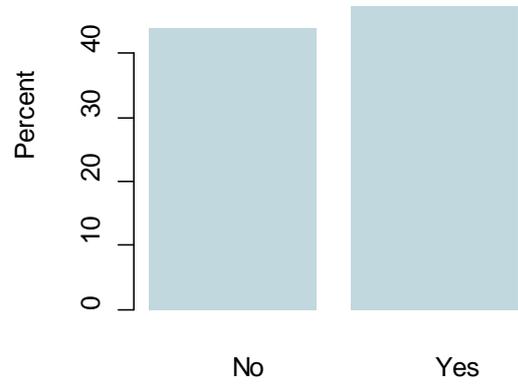
Average libraries attendance by whether views libraries websites



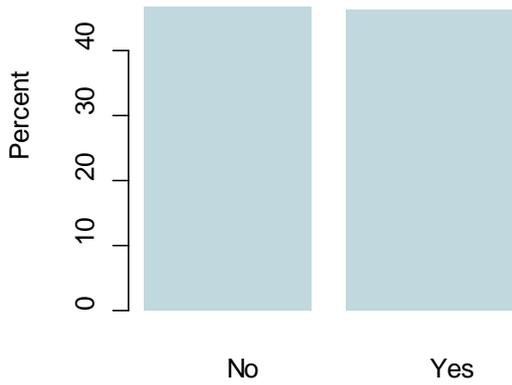
Average libraries attendance by illness or disability which limits activities



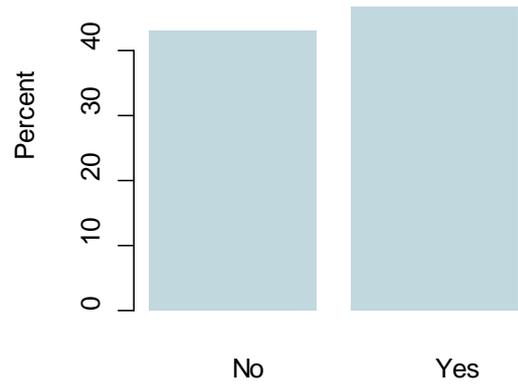
Average libraries attendance by access to motor vehicle



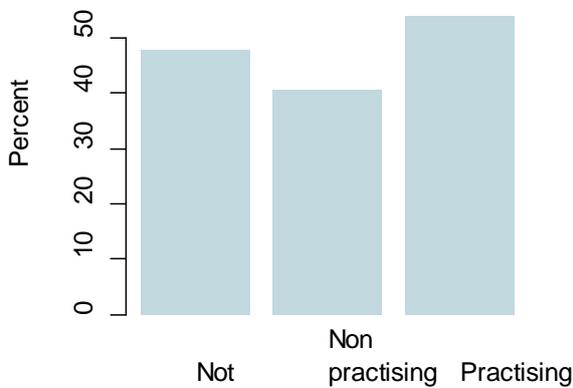
Average libraries attendance by reading newspaper at least 3 times per week



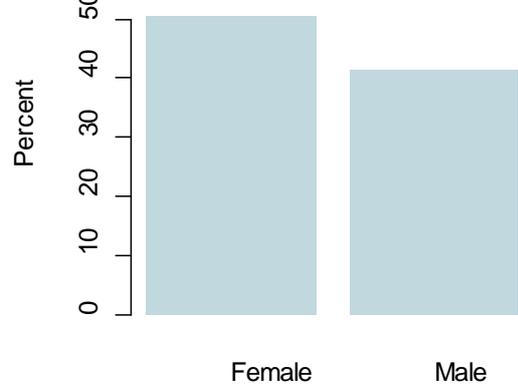
Average libraries attendance by radio available in household

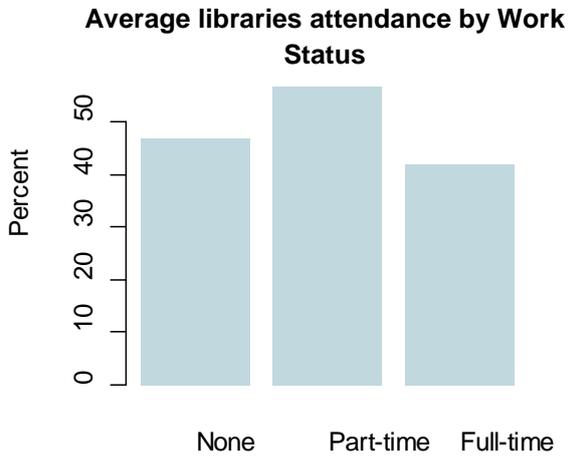
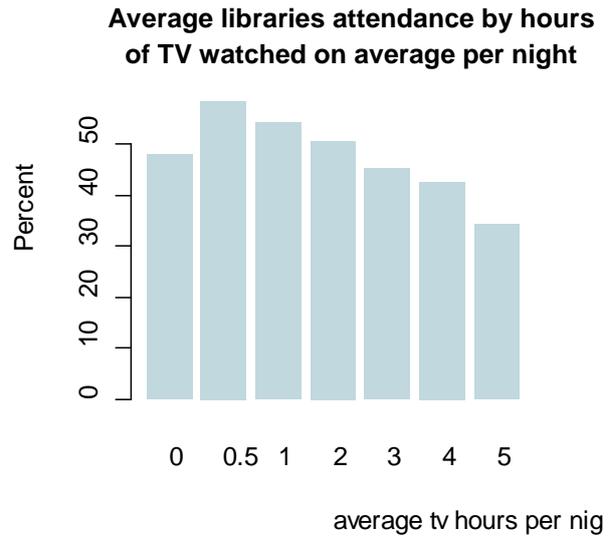
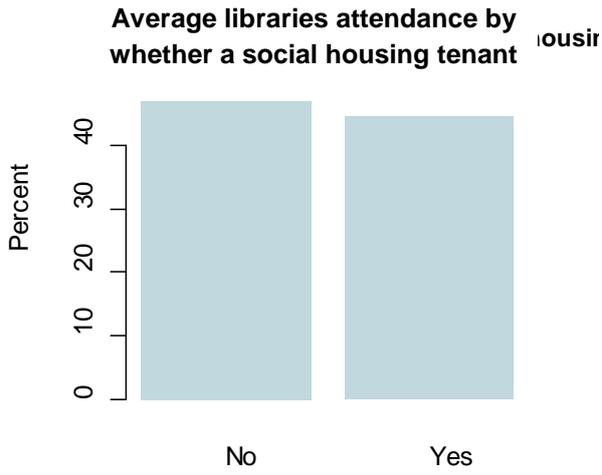


Average libraries attendance by religiosity



Average libraries attendance by gender

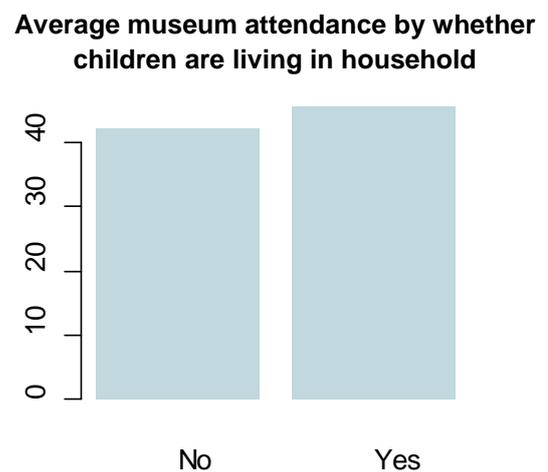
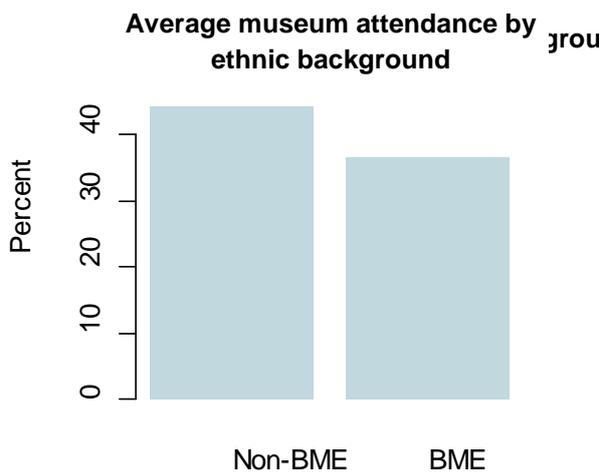
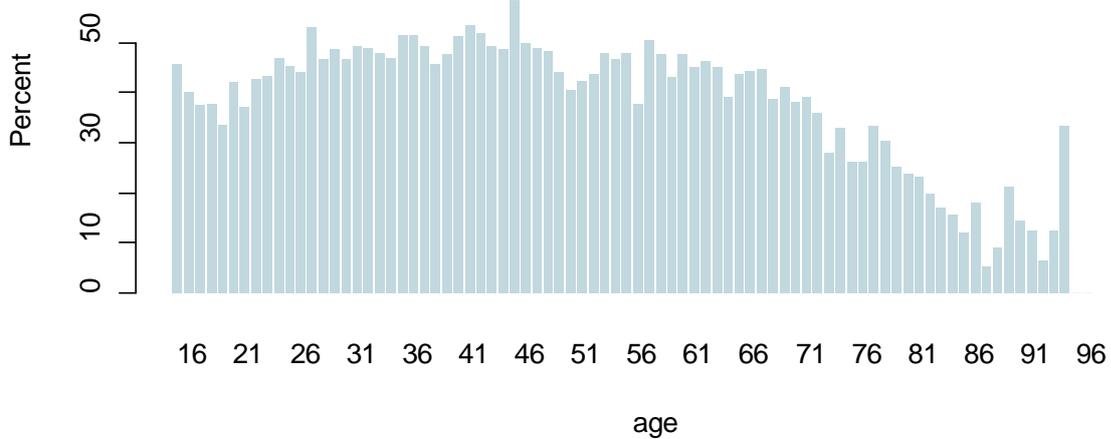




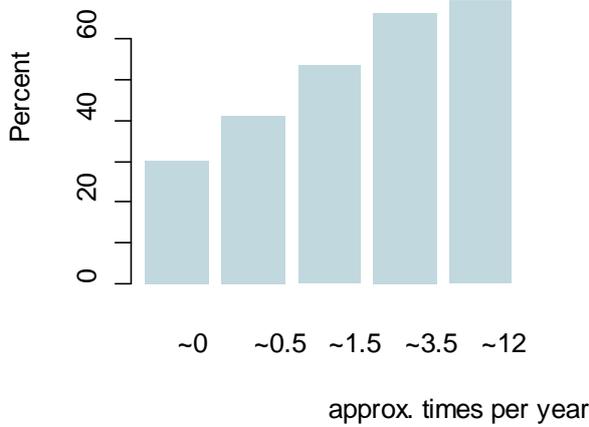
Museum bivariate plots

The plots below show the percentage of people who attended a museum in the last 12 months in the Taking Part data broken down by a variety of explanatory variables. Interesting associations were in evidence for variables related to ethnicity, childhood experiences of museums and heritage, whether the respondent cycles to get from place to place and use of TV and internet. Socio-economic variables such as income, education and whether the respondent is a social housing tenant or a member of a high socio-economic group also demonstrated strong associations.

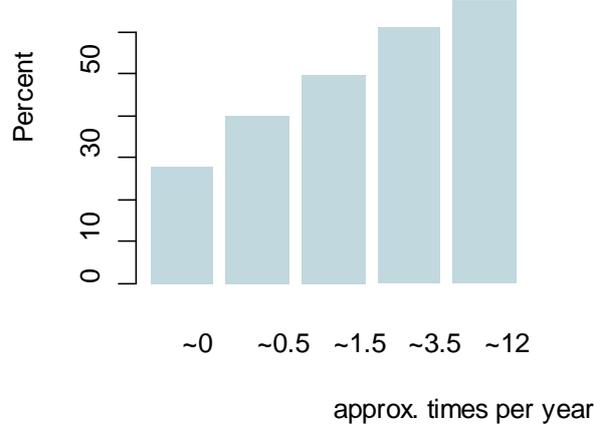
Percentage of People who visited a Museum in the last 12 months by Age



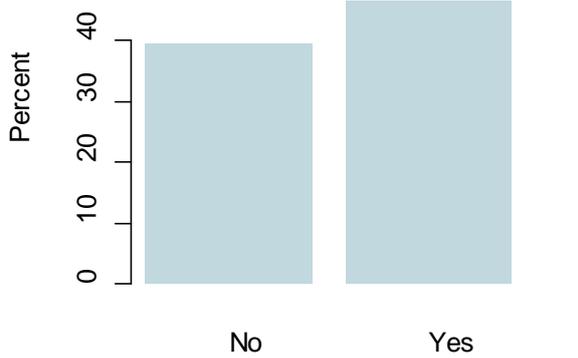
Average museum attendance by visits to museum as a child



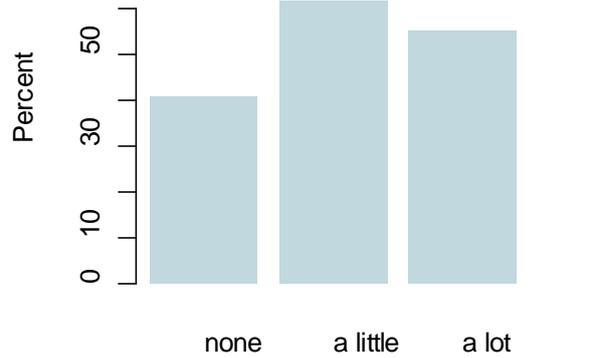
Average museum attendance by visits to heritage as a child



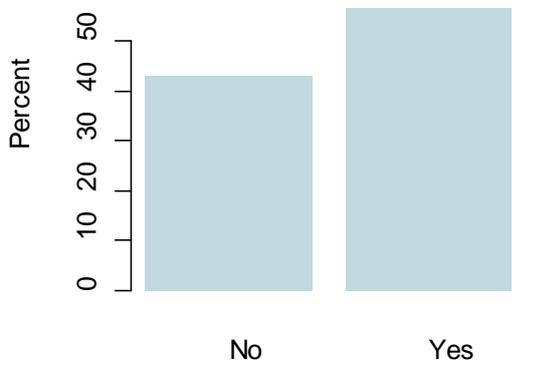
Average museum attendance by whether living as a couple



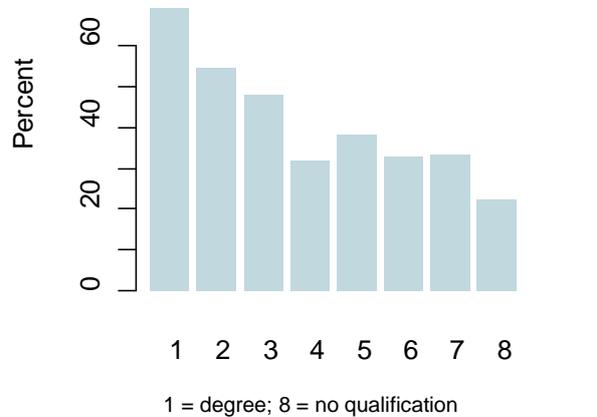
Average museum attendance by whether attendee has influence over local cultural facilities



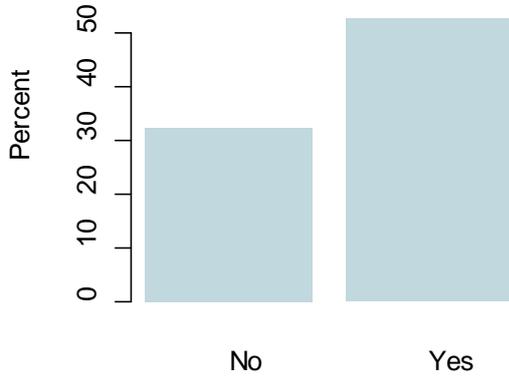
Average museum attendance by whether attendee cycles



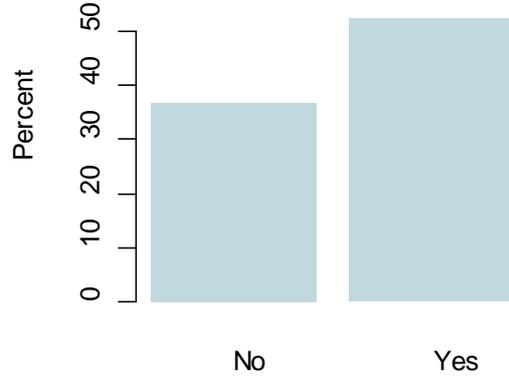
Average museum attendance by highest educational qualification



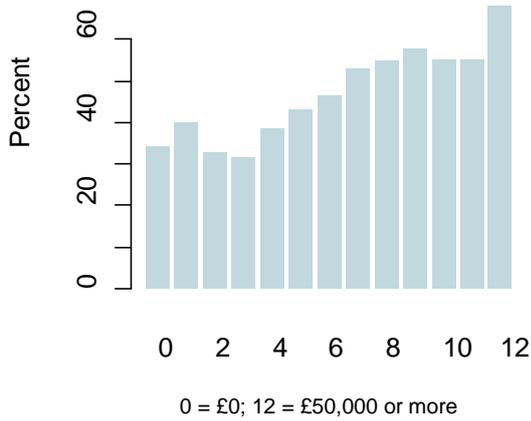
Average museum attendance by whether in a high socio-economic group



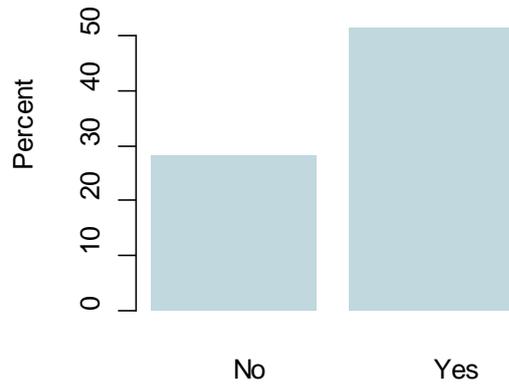
Average museum attendance by whether watches historical TV



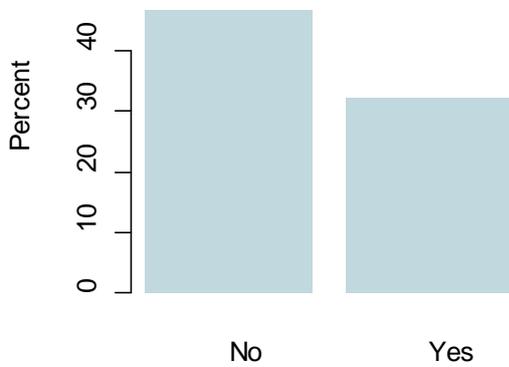
Average museum attendance by income



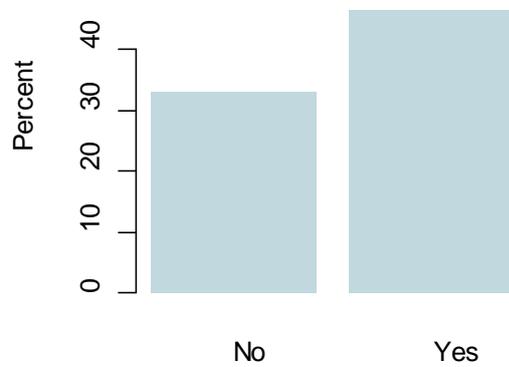
Average museum attendance by internet access



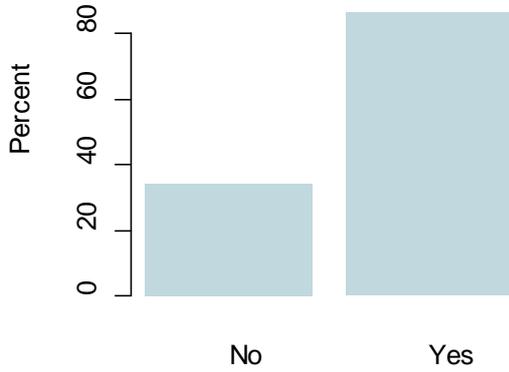
Average museum attendance by illness or disability which limits activities



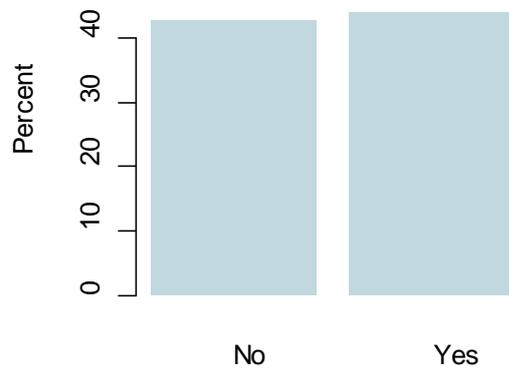
Average museum attendance by access to motor vehicle



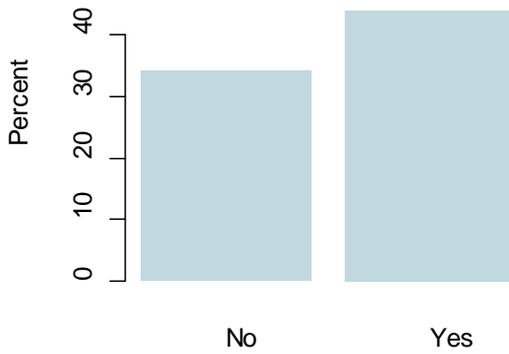
Average museum attendance by whether views museum websites



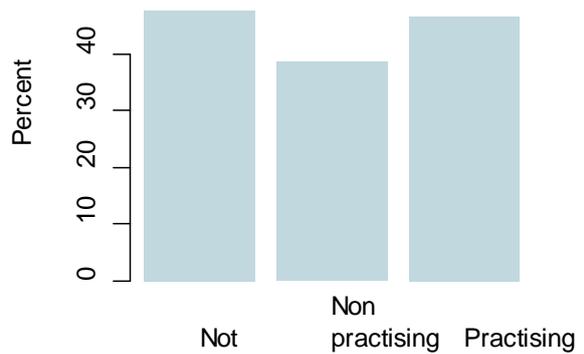
Average museum attendance by reading newspaper at least 3 times per week



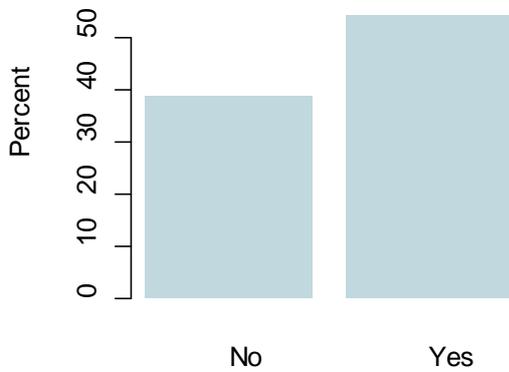
Average museum attendance by radio available in household



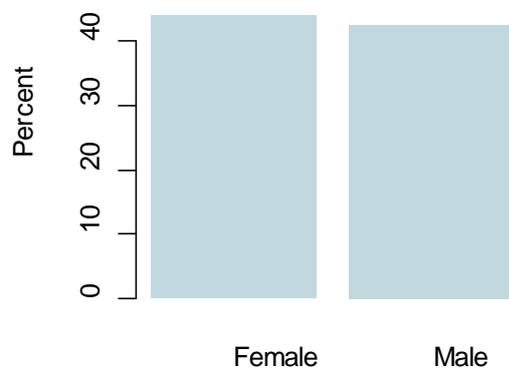
Average museum attendance by religiosity



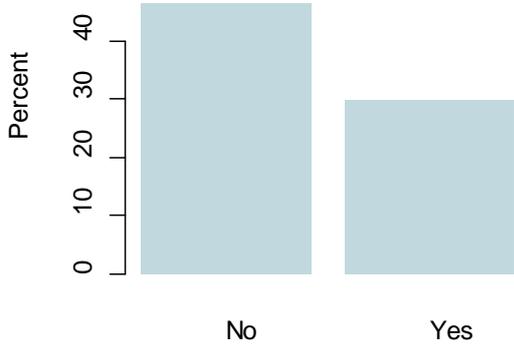
Average museum attendance by whether watches science TV



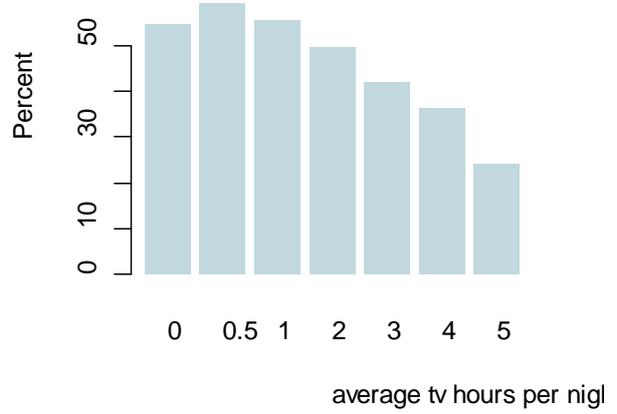
Average museum attendance by gender



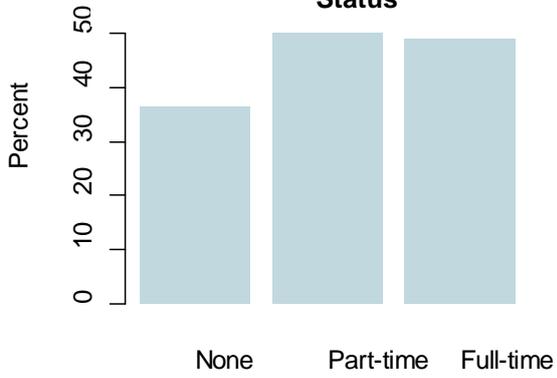
Average museum attendance by whether a social housing tenant



Average museum attendance by hours of TV watched on average per night



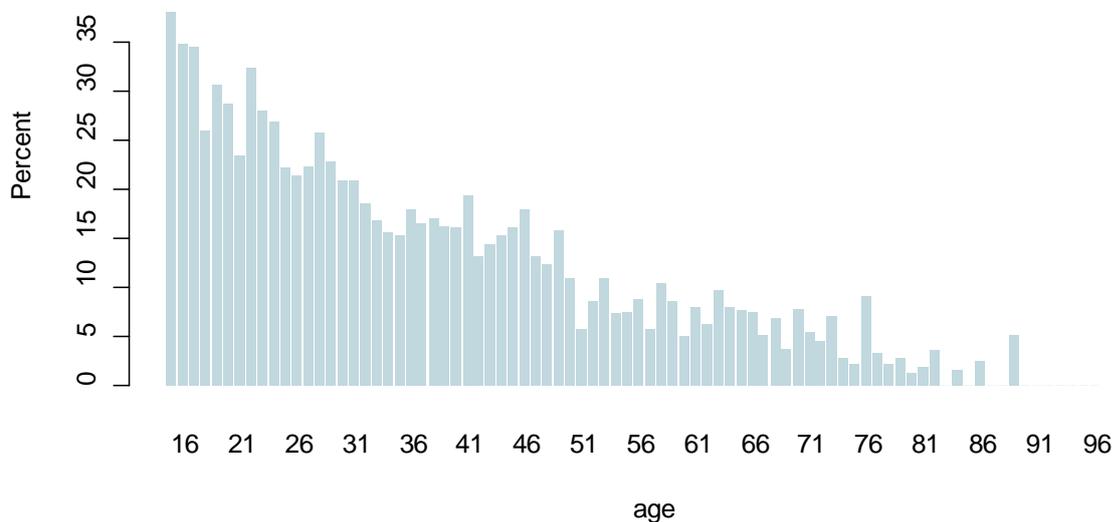
Average museum attendance by Work Status



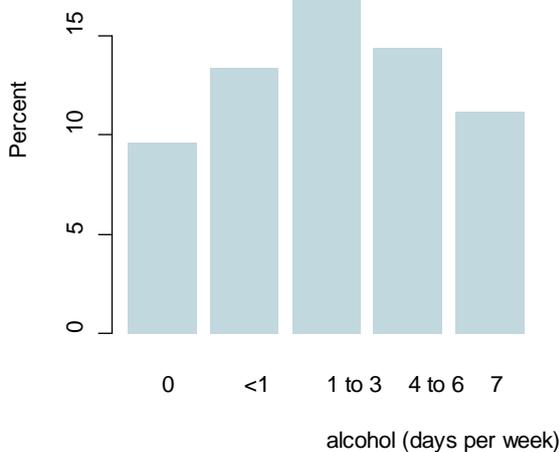
Sport bivariate plots

The plots below show the percentage of people who participated in sport (based on the definition of Sport England’s “1 million sport” indicator: three times 30 minutes per week of moderate intensity sport in the past month, excluding any walking and low-frequency cycling) in the last month in the Taking Part data broken down by a variety of explanatory variables. The association of sport participation with age was notable for the sharp drop off in participation rates as age increases. Because of this relationship, overall participation rates across the sample were very low, with the average being approximately 14%. Also, the gender difference was very noticeable, with men more There were many interesting associations: alcohol consumption, cycling to get from place to place, childhood experience of sport, socio-economic variables, limiting illness or disability, TV and internet use, and the proximity of and influence on local sports facilities all exhibited moderate or strong associations.

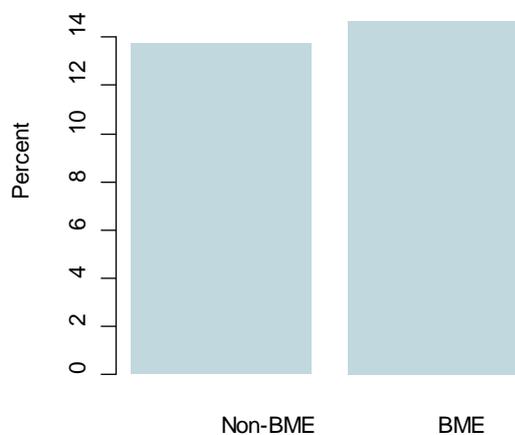
Average sports participation by Age



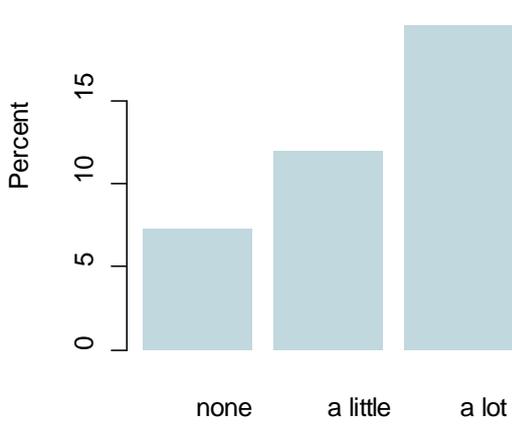
Average sports participation attendance by number of days when alcohol was consumed



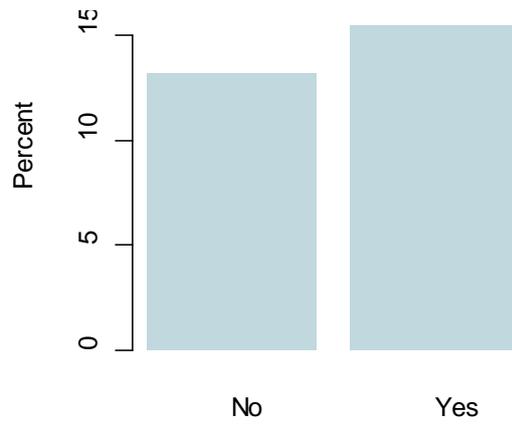
Average sports participation attendance by ethnic background



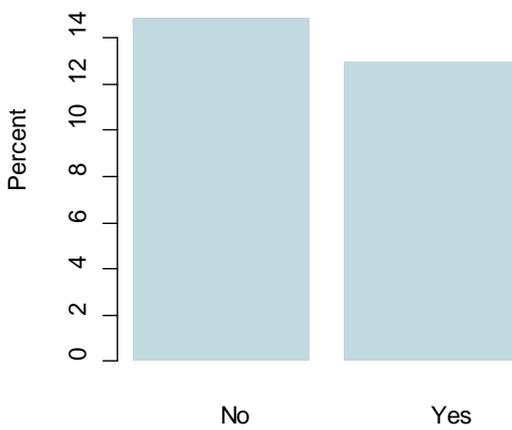
Average sports participation by parental encouragement to do sport as a child



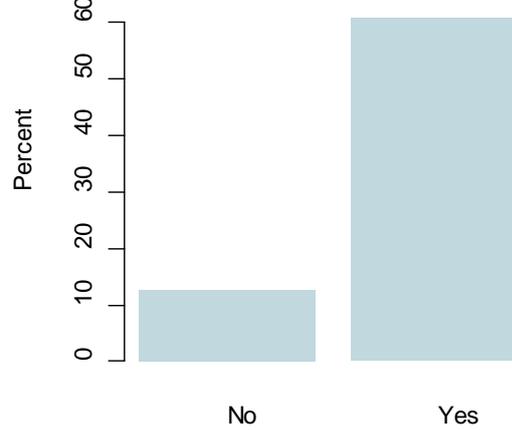
Average sports participation by whether children are living in household



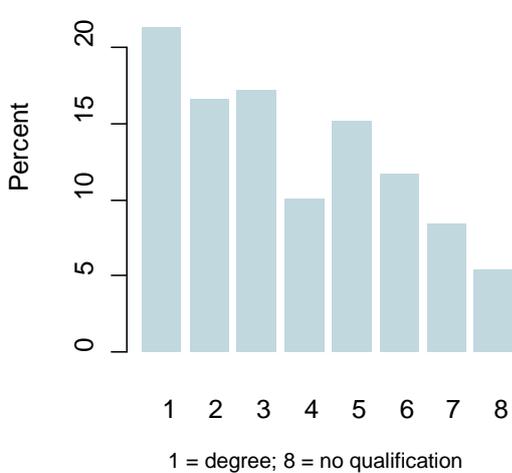
Average sports participation by whether living as a couple



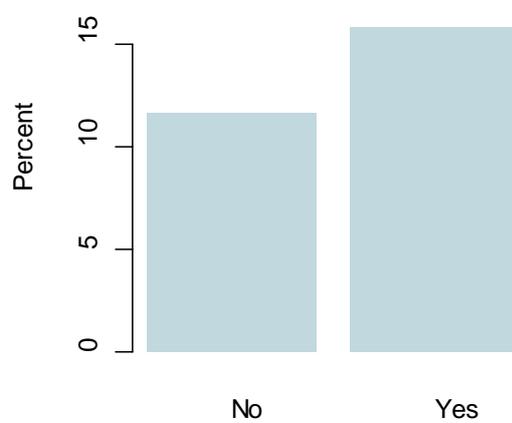
Average sports participation by whether attendee cycles



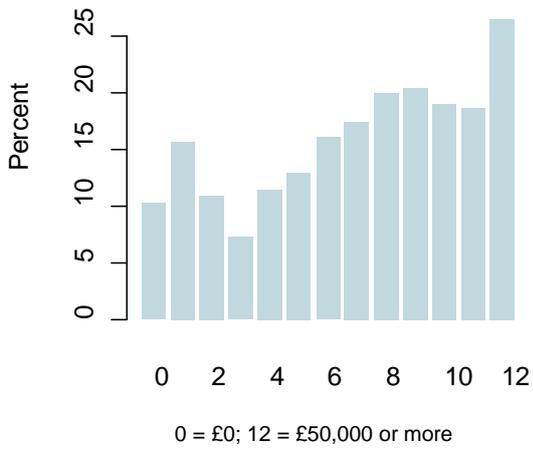
Average sports participation by highest educational qualification



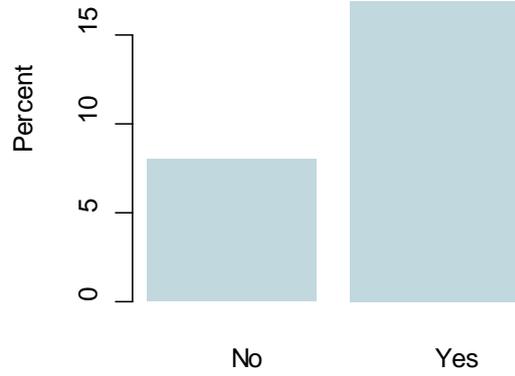
Average sports participation by whether in a high socio-economic group



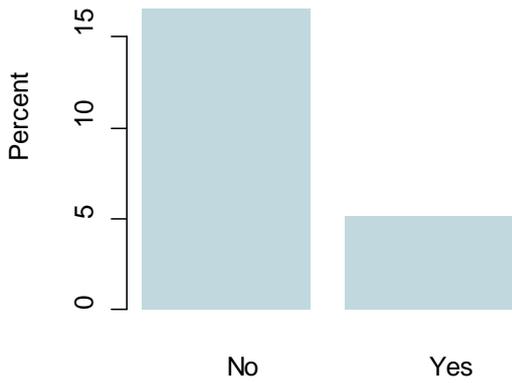
Average sports participation by income



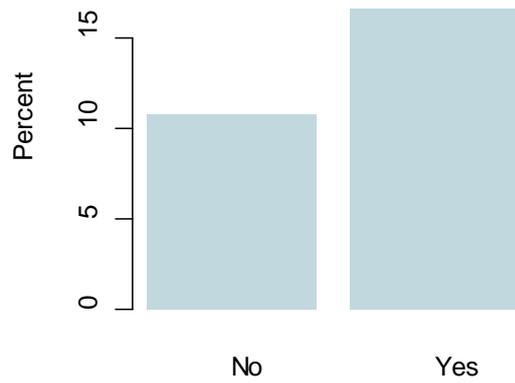
Average sports participation by internet access



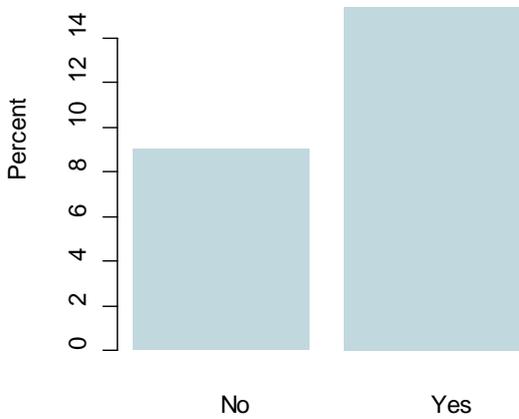
Average sports participation by illness or disability which limits activities



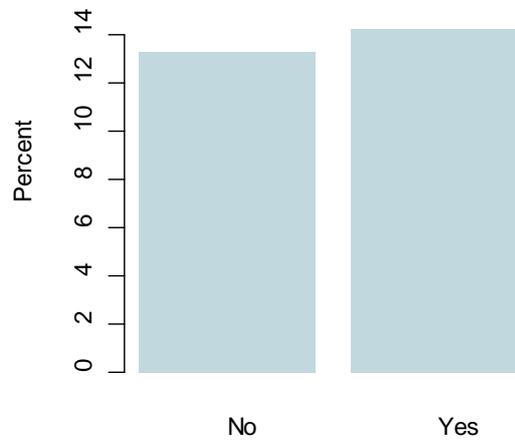
Average sports participation by whether watches live sport on TV



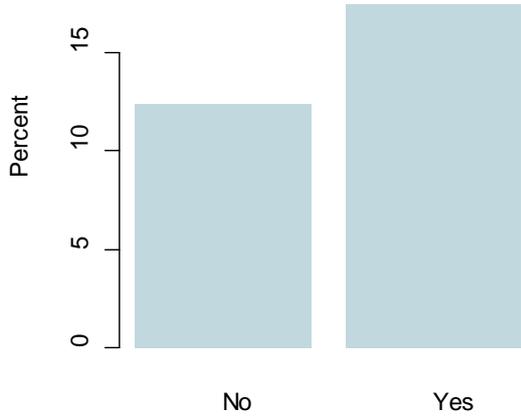
Average sports participation by access to motor vehicle



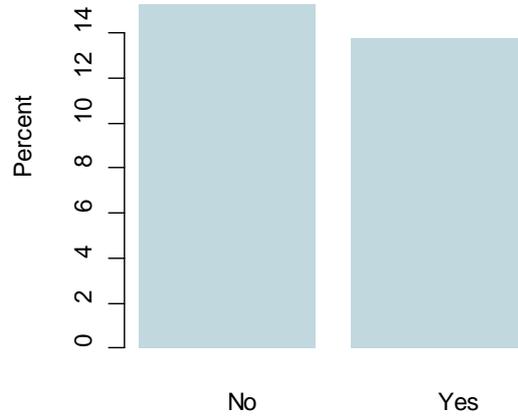
Average sports participation by reading newspaper at least 3 times per week



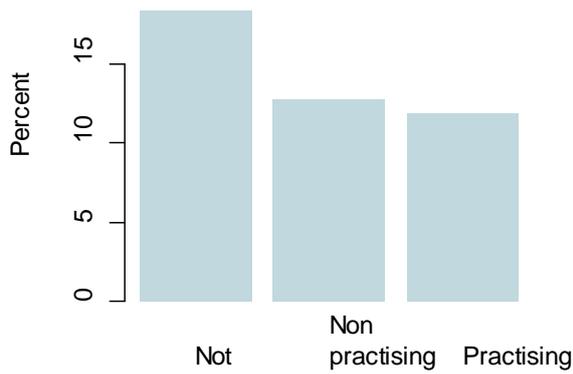
Average sports participation by whether watches other sport on TV



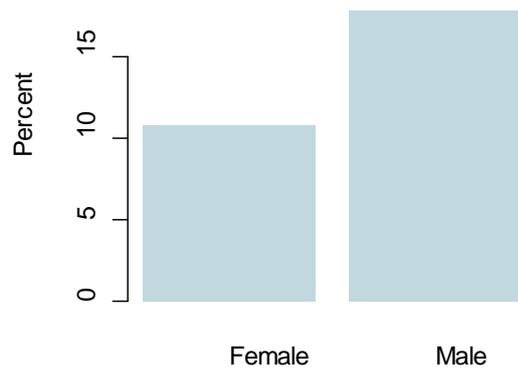
Average sports participation by radio available in household



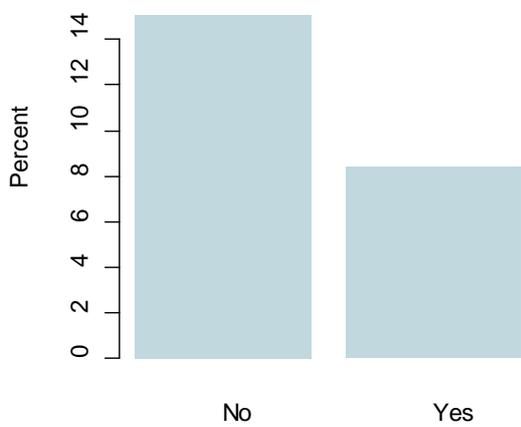
Average sports participation by religiosity



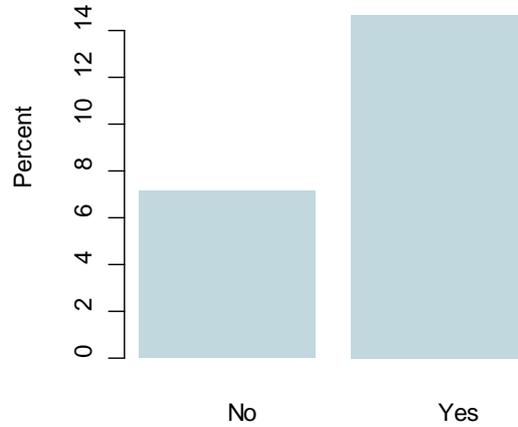
Average sports participation by gender



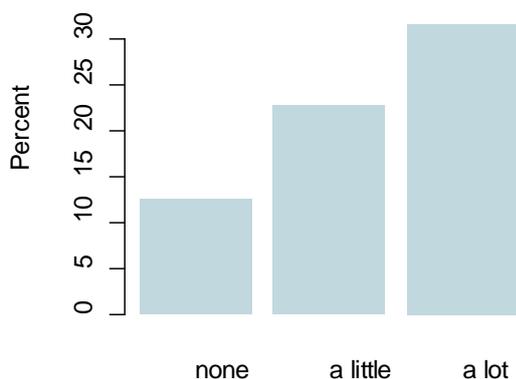
Average sports participation by whether a social housing tenant



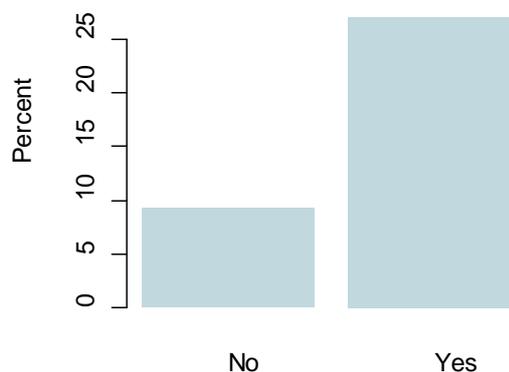
Average sports participation by whether a sports facility is within 20mins



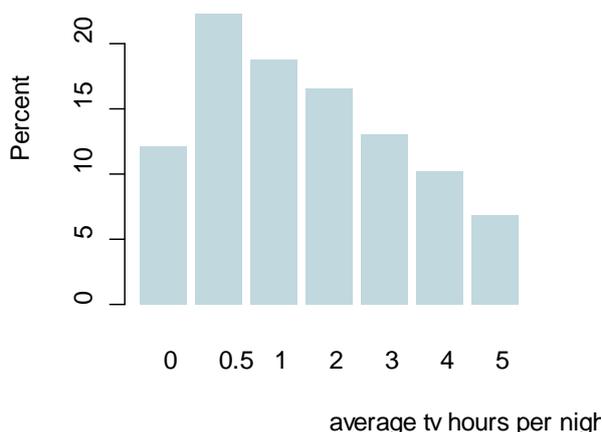
Average sports participation by whether attendee has influence over local sporting facilities



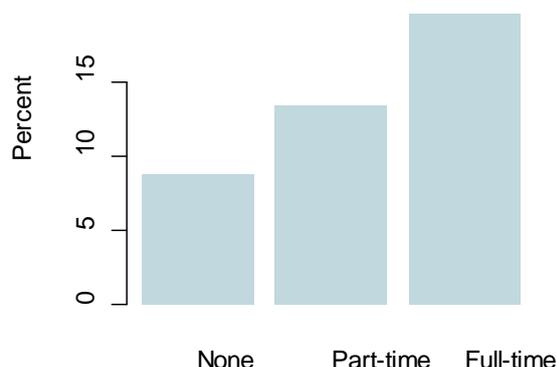
Average sports participation by whether views sports websites



Average sports participation by hours of TV watched on average per night



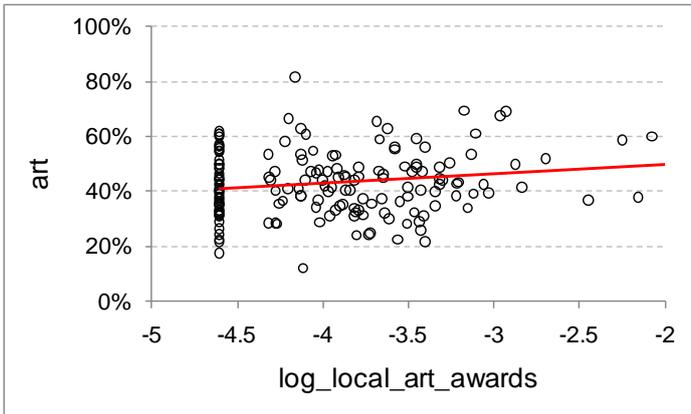
Average sports participation by Work Status



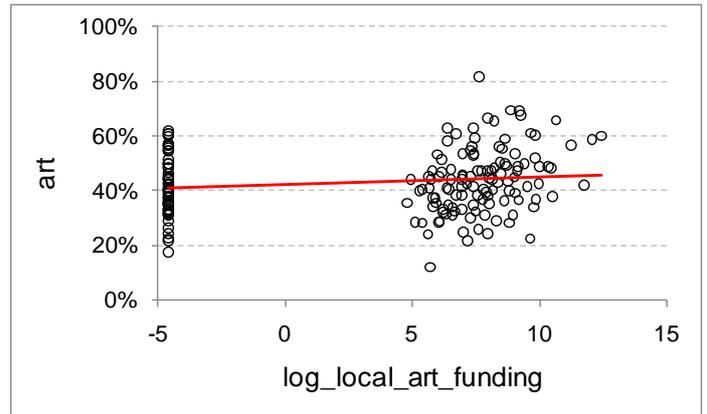
Asset bivariate plots

Plots of the asset variables (log transformed where necessary) against average engagement for local authorities were also created to see whether there was any evidence of bivariate relationships at the local authority level. The plots suggested an association between engagement and asset density for heritage, sport and museums – the heritage and museums associations being positive, whilst the sport association was negative – but all the associations were weak. The remaining plots did not suggest an association, but it was impossible to rule out the possibility that any associations were hidden by shortcomings in the quality of the data available or by the simplicity of the bivariate plotting (the associations being too complex to be identified using this method).

Average arts attendance in local authorities by the logarithm of the population weighted count of local Artsmark "RFO" awards



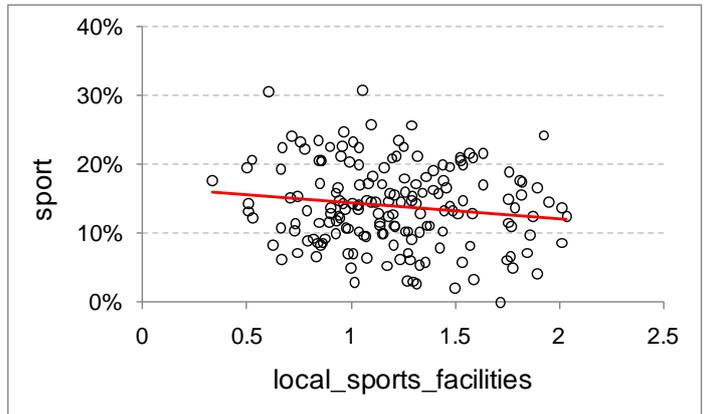
Average arts attendance in local authorities by the logarithm of the population weighted sum of local Artsmark "RFO" funding



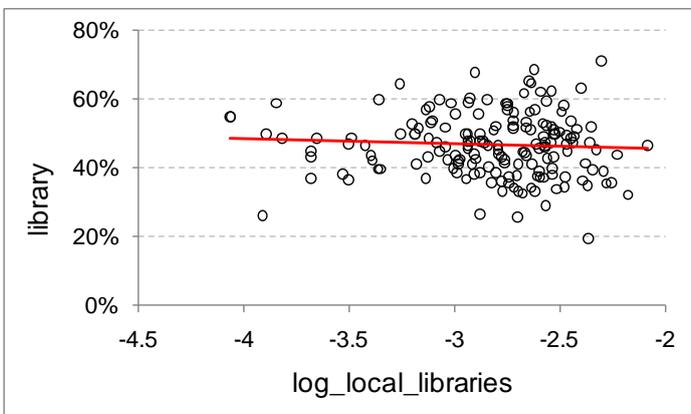
Average heritage attendance in local authorities by the logarithm of the population weighted count of local heritage sites



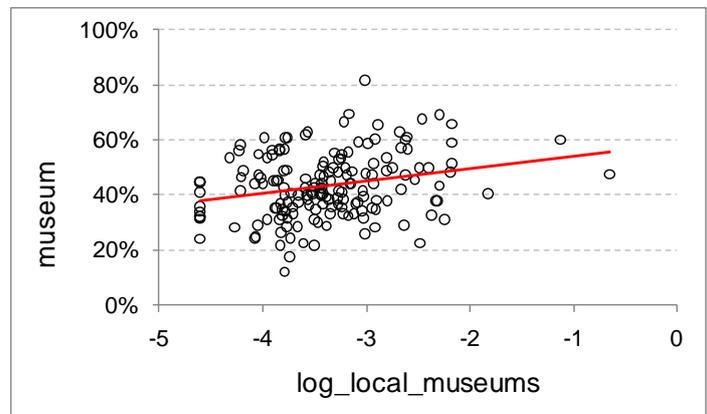
Average sports participation in local authorities by the population weighted count of local sports facilities



Average library attendance in local authorities by the logarithm of the population weighted count of local libraries



Average museum attendance in local authorities by the logarithm of the population weighted count of local museums



6. Appendix 6: Regression – Multicollinearity testing of explanatory variables

The issue of multicollinearity has been highlighted in the academic literature by several authors. When multicollinearity is present in a model, although the estimated coefficients are accurate, the standard errors of those estimates tend to become very large (variance inflation), which can lead to mistakes in model selection.

To test whether this was likely to be an issue, the variance inflation factor (VIF) and tolerance was calculated for each of the variables included in the models. A common rule of thumb is that a tolerance of less than 0.10 and/or a VIF of 10 and above indicates a multicollinearity problem².

The table below shows the calculated VIF and tolerance estimates. Only two of the VIFs were particularly large (**local_art_awards** and **log_local_art_awards**). This was due to **log_local_art_awards** being the log transformation of **local_art_awards**. As only the log transformed variable was added to the initial art model, this colinearity was not a problem in the modelling. Overall, the analysis did not identify any significant issues for model selection due to colinearity of explanatory variables.

² Greene, W.H., *Econometric Analysis*, Fourth Edition, Prentice-Hall, Upper Saddle River, New Jersey, 2000.

**Variance inflation factors (VIFs) and tolerances (1/VIF)
of explanatory variables used in modelling**

Variable	VIF	Tolerance
access	2.84	0.3518
age	2.32	0.4319
alcohol	1.21	0.8268
art_internet	1.54	0.65
art_tv	1.19	0.8413
bmegroup	1.38	0.7267
child_encouraged_creative	1.49	0.669
child_encouraged_perform	1.34	0.7454
child_encouraged_read	1.48	0.6741
child_encouraged_sport	1.31	0.7606
child_gallery_visit	1.48	0.6749
child_heritage_visit	1.42	0.7058
child_library_visit	1.23	0.8163
child_theatre_visit	1.21	0.8252
children	1.4	0.7126
community_cohesion	2.62	0.3822
coupled	1.32	0.7581
cultural_influence	1.47	0.6821
cycles	1.03	0.9687
education	1.88	0.531
heritage_internet	1.52	0.6595
highses	1.44	0.6954
history_tv	1.32	0.7548
income	1.69	0.5904
internet	1.65	0.6074
library_internet	1.18	0.8507
limiting_illness	1.25	0.8001
live_sport_tv	1.58	0.6314
local_art_awards	10.73	0.0932
local_art_funding	1.84	0.5449
local_gallery_satisfaction	2.05	0.4873
local_heritage_sites	3.09	0.3237
local_libraries	8.54	0.1171
local_library_satisfaction	1.55	0.6445
local_museums	4.08	0.2449

Variable	VIF	Tolerance
local_parks_satisfaction	1.84	0.5435
local_sport_facilities	3.2	0.3124
local_sports_satisfaction	1.44	0.6964
local_theatre_satisfaction	2.21	0.4521
log_local_art_awards	17.51	0.0571
log_local_art_funding	5.53	0.1807
log_local_heritage_sites	4.33	0.231
log_local_libraries	6.89	0.145
log_local_museums	4.55	0.2199
motor_vehicle	1.53	0.6546
museum_internet	1.56	0.6422
newspaper	1.07	0.9355
other_sport_tv	1.45	0.6881
radio	1.05	0.9536
religious	1.24	0.8093
science_tv	1.26	0.7912
sex	1.48	0.6742
social_housing	1.36	0.7342
sport_facility_nearby	1.05	0.9511
sport_internet	1.57	0.6359
sports_influence	1.45	0.6908
tv_hours	1.35	0.7434
work_status	1.79	0.5589

7. Appendix 7: Regression – Model specifications, selection and testing

Model specification

The types of model used to create the final estimates were logistic regression models with random-intercepts. Essentially, these models are equivalent to single level logistic regression models, except that they allow each area cluster or Local Authority (LA) to have its own value for the model intercept. The area intercepts are assumed to be normally distributed and uncorrelated with the errors at the individual level. The model formula is:

$$\begin{aligned}
 L_{ij} &= \text{Logit} \left\{ \Pr(y_{ij} = 1 | x_{1j}, x_{2j}, x_{3ij}, x_{4ij}, \dots, x_{nij}, \zeta_j) \right\} \\
 &= \beta_0 + \beta_1 x_{1j} + \beta_2 x_{2j} + \beta_3 x_{3ij} + \beta_4 x_{4ij} + \dots + \beta_n x_{nij} + \zeta_j
 \end{aligned} \tag{1}$$

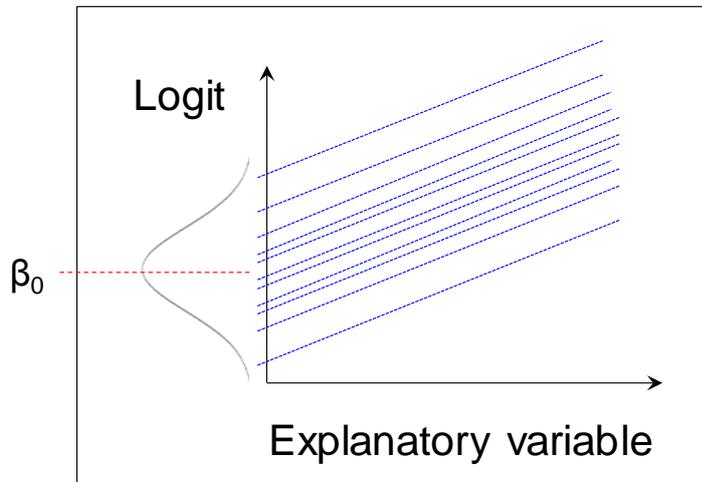
Where:

$i =$	Identifier for individual
$j =$	Identifier for area
$L_{ij} =$	Natural logarithm of odds of 'yes' response to a yes/no question
$y_{ij} =$	Response to yes/no question as a Boolean value
$\beta_0, \beta_1, \beta_2 =$	Coefficients of regression model
$x_{1j}, x_{2j} \dots =$	Explanatory variables at area level
$x_{3ij}, x_{4ij}, \dots, x_{nij} =$	Explanatory variables at individual level
$\zeta_{ij} =$	Random intercept for area

The model specification is demonstrated in the figure below for the case where there is one explanatory variable. The blue lines represent the fitted regression lines for each area. The random intercept is normally distributed about the overall intercept β_0 . The variance of this random-intercept distribution is estimated using multilevel regression software and is reported in the model results.

Logistic regression enables dichotomous response variables to be modelled. The actual modelled quantity is the logit, or natural logarithm of the odds of a particular value on a dichotomous variable. For example, the art model response variable was the natural logarithm of the odds of engaging in an arts attendance activity in the last year. Due to the logarithmic nature of the response variable, the estimates need to be transformed into odds ratios to become meaningful. The exponent of the model estimates are taken, giving odds ratios. These are multiples of the baseline odds of engaging, conditional on the value of the explanatory variable for which the effect is being estimated. For example, if the logit based estimate of the effect of being part of a couple on engaging in art was -0.1107 logits, the odds ratio would be $\exp(-0.1107)=0.895$. Therefore, the odds of engaging in art for someone who is part of a couple, conditional on all other explanatory variables, is 10.5% less than for someone who is not part of a couple ($(1-0.895) \times 100\%$).

Graphical representation of a simple random intercept logistic regression model



This type of regression modelling copes well with clusters (area groups) of differing sizes. Very small clusters of less than 10 units can be included in the analysis where there are a large number of clusters. The estimation method makes maximal use of the information in the dataset, with large clusters having more influence on the overall estimates for explanatory variables than small clusters. The individual level data was weighted using the Taking Part 2007/08 weight variable *fweighty3* (renamed **pweight1**). An average of this variable by area level was used as the area level weight (named **pweight2**). The software used to run the random-intercept models was the Stata *gllamm* package developed by Skrondal & Rabe-Hesketh. When using weights, the package estimates standard errors of model terms using robust estimation methods.

Model selection

The general model selection procedure was as follows:

1. All relevant explanatory variables were entered into the random-intercept model as marginal effects.
2. The random intercept was removed if found to be non-significant.
3. Non-significant marginal effects were then removed by a backward selection process until all remaining marginal effects were significant at the 5% level.
4. Certain interactions were tested and retained where significant.

The modelling selection steps taken for each of the models are outlined below with the associated p-values and any relevant commentary.

Art

- 1 log_local_art_funding high correlation with log_local_art_awards, use log_local_art_awards
 - 2 access 0.380 REMOVED
 - 3 newspaper 0.372 REMOVED
 - 4 Interaction between coupled and children 0.074 (keep for now)
 - 5 log_local_art_awards 0.351 REMOVED
 - 6 Tested log_local_art_funding not significant 0.370 REMOVED
 - 7 belong 0.457 REMOVED
 - 8 local_gallery_satisfaction 0.244 REMOVED
 - 9 motor_vehicle 0.084 REMOVED
 - 10 cycles 0.065 REMOVED
 - 11 Tested adding interaction of children and work_status MODEL FAILED TO CONVERGE
 - 12 Replaced interaction of children and coupled (0.054) with children and work_status (0.061)
 - 13 Keep interaction between children and coupled
 - 14 test log_local_art_awards $p=0.850$ REMOVED
 - 15 test log_local_art_funding $p=0.524$ REMOVED
 - 16 test sex*age $p=0.175$ REMOVED
 - 17 test highses*social_housing $p=0.973$ REMOVED
 - 18 test highses*income $p=0.095$ REMOVED
 - 19 test sex*coupled $p=0.121$ REMOVED
 - 20 test age*coupled $p=0.161$ REMOVED
 - 21 test income square term $p=0.074$ REMOVED
 - 22 Remove art_internet because of likely causality issue
 - 23 retest sex*age $p=0.895$ REMOVED
 - 24 retest coupled*age $p=0.170$ REMOVED
 - 25 retest motor_vehicle $p=0.101$ REMOVED
 - 26 retest cycles $p=0.071$ REMOVED
 - 27 retest children*work_status $p=0.127/0.963$ REMOVED
 - 28 retest sex*coupled $p=0.029$ RETAINED
 - 29 retest income square term $p=0.040$ RETAINED
-

Heritage

- 1 heritage_internet - causal issue - odds ratio 3.64 REMOVED
 - 2 access 0.649 REMOVED
 - 3 newspaper 0.410 REMOVED
 - 4 cycles 0.404 REMOVED
 - 5 community_cohesion 0.205 REMOVED
 - 6 sex 0.107 REMOVED
 - 7 radio 0.068 REMOVED
 - 8 test children*coupled p=0.007 RETAINED
 - 9 test children*work p=0.411/0.838 REMOVED
 - 10 test work_status*coupled p=0.240/0.910 REMOVED
 - 11 test highSES* income p=0.182 REMOVED
 - 12 test highSES*social_housing p=0.222 REMOVED
 - 13 test income square term p=0.573 REMOVED
 - 14 test age*coupled p=0.869 REMOVED
 - 15 test age*children p=0.507 REMOVED
 - 16 Random intercept model estimated
 - 17 limiting_illness 0.234 REMOVED
 - 18 Likelihood Ratio test of religious significant p=0.000 RETAINED
-

Library

- 1 newspaper 0.886 REMOVED
- 2 access 0.8636 REMOVED
- 3 log_local_libraries 0.7109 REMOVED
- 4 coupled 0.6617 REMOVED
- 5 limiting_illness 0.4477 REMOVED
- 6 social_housing 0.4316 REMOVED
- 7 highses 0.2608 REMOVED
- 8 radio 0.1605 REMOVED
- 9 belong 0.0692 REMOVED
- 10 test children*coupled p=0.016 RETAINED
- 11 test income*social_housing p=0.26 REMOVED

- 12 test work_status*children p=0.262/0.659 REMOVED
 - 13 test work_status*coupled p=0.163/0.569 REMOVED
 - 14 test religious*BMEgroup p=0.153/0.989 REMOVED
 - 15 test sex*age p=0.002 RETAINED
 - 16 test sex*children p=0.136 REMOVED
 - 17 test sex*coupled p=0.738 REMOVED
 - 18 test sex*BMEgroup p=0.248 REMOVED
-

Museum

- 1 coupled 0.5815 REMOVED
 - 2 social_housing 0.4153 REMOVED
 - 3 belong 0.4134 REMOVED
 - 4 local_museum_satisfaction 0.3783 REMOVED
 - 5 children 0.2712 REMOVED
 - 6 newspaper 0.1925 REMOVED
 - 7 cycles 0.0772 REMOVED
 - 8 log_local_museums 0.0623 REMOVED
 - 9 test children*coupled p=0.042 RETAINED
 - 10 test log_local_museums p=0.063 REMOVED
 - 11 test highs*social_housing p=0.711 REMOVED
 - 12 highs – borderline p=0.063 RETAINED
 - 13 test work_status*children p=0.203/0.471 REMOVED
 - 14 test highs*income p=0.240 REMOVED
 - 15 test sex*age p=0.011 RETAINED
 - 16 children*coupled now not significant p=0.074 REMOVED
 - 17 test sex*coupled p=0.003 RETAINED
 - 18 test age*coupled p=0.004 RETAINED
 - 19 children not significant p=0.217 REMOVED
 - 20 sex*age not significant p=0.146 REMOVED
 - 21 Likelihood Ratio test of religious significant p=0.0001 RETAINED
 - 22 income square term not significant p=0.143 REMOVED
-

Sport

- 1 highs 0.986 REMOVED
- 2 radio 0.889 REMOVED
- 3 BMEgroup*age 0.820 REMOVED
- 4 social_housing 0.754 REMOVED
- 5 religious 0.642 0.903 REMOVED not likely to be relevant
- 6 local_sports_satisfaction 0.687 REMOVED
- 7 age square term 0.598 REMOVED
- 8 local_parks_satisfaction 0.562 REMOVED
- 9 sport_facility_nearby 0.509 REMOVED
- 10 log_local_sports_facilities 0.418 REMOVED
- 11 access 0.443 REMOVED
- 12 internet 0.410 REMOVED
- 13 belong 0.374 REMOVED
- 14 other_sport_tv 0.306 REMOVED
- 15 newspaper 0.267 REMOVED
- 16 Forced Likelihood Ratio test alcohol $\chi^2(4)=8.15$ $p=0.0862$ REMOVED
- 17 cycles confounded with response REMOVED
- 18 alcohol re-entered, no model change REMOVED
- 19 Re-enter sport_facility_nearby 0.502 and other_sport_tv 0.348 REMOVED
- 20 Interaction between children and coupled not significant 0.982
- 21 Interaction between children and work_status not significant 0.664 0.650
- 22 Interaction between age and limiting_illness not significant 0.704
- 23 motor_vehicle 0.08 REMOVED
- 24 Interaction between children and coupled not significant 0.892
- 25 Interaction between children and work_status not significant 0.667 0.657
- 26 Interaction between children and sex not significant 0.112
- 27 coupled 0.081 REMOVED
- 28 Interaction between tv_hours and live_sport_tv not significant 0.992
- 29 Re-enter age square term 0.301 REMOVED
- 30 test local_sports_facilities $p=0.844$ REMOVED

- 31 test sex*age p=0.000 RETAINED
 - 32 test sex*coupled p=0.139 REMOVED
 - 33 test age*coupled p=0.347 REMOVED
 - 34 test income square term p=0.145 REMOVED
-

Model testing

In order to test how well the models fit the data, a model specification link test and a Hosmer-Lemeshow test was performed on each of the final models. The link test determines whether the addition to the model of a term comprised the square of the model prediction (**_hatsq**) improves the fit of a model where the only other explanatory variable is the prediction itself (**_hat**). The prediction should be significant, predicting the observed data well, whereas the square term should not be significant, as it does not add much to the explanatory power of the model. Due to software constraints, the link tests were performed on weighted single level robust logistic models. The results are presented below. They indicated that only the fit of the Heritage model could possibly be improved by addition of a square term. All other models passed the test.

Art link test results

Term	Coef.	Robust Std. Err.	p-value
_hat	0.9788	0.0300	0.000
_hatsq	0.0262	0.0192	0.172
_cons	-0.0218	0.0347	0.529

Heritage link test results

Term	Coef.	Robust Std. Err.	p-value
_hat	0.9140991	0.0483747	0.000
_hatsq	0.0496109	0.0243386	0.042
_cons	-0.008825	0.0377126	0.815

Library link test results

Term	Coef.	Robust Std. Err.	p-value
_hat	0.9980	0.0359	0.000
_hatsq	-0.0122	0.0380	0.749
_cons	0.0063	0.0324	0.845

Museum link test results

Term	Coef.	Robust Std. Err.	p-value
_hat	0.9956	0.0299	0.000
_hatsq	-0.0263	0.0227	0.247
_cons	0.0210	0.0335	0.531

Sport link test results

Term	Coef.	Robust Std. Err.	p-value
_hat	1.1276	0.1007	0.000
_hatsq	0.0429	0.0285	0.133
_cons	0.0556	0.0816	0.496

The Hosmer-Lemeshow test is the most commonly used fit test for logistic regression models. It divides the observations into groups by predicted probability and compares the predictions to the observed counts. The resulting table is used to calculate a Chi² statistic. The p-value of this statistic indicates whether the model is a good fit to the data. If the p-value is significant at the 5% level, the observed data is not predicted well by the model and the model is likely to be miss-specified. The Hosmer-Lemeshow results for the models are presented below. All of the models fit the data well using this test.

Hosmer-Lemeshow test for the Art model

Group	Predicted probability	Observed engaged	Predicted engaged	Total group size
1	0.130	16	19.8	198
2	0.162	34	28.9	197
3	0.193	33	35.2	197
4	0.219	40	40.6	197
5	0.241	41	45.5	197
6	0.265	54	49.9	197
7	0.285	51	54.3	198
8	0.306	72	58.2	197
9	0.323	53	61.9	197
10	0.344	70	65.7	197
11	0.366	76	69.9	197
12	0.386	82	74.1	197
13	0.404	84	78.2	198
14	0.422	85	81.5	197
15	0.440	92	85	197
16	0.459	85	88.6	197
17	0.476	99	92.2	197
18	0.496	89	95.9	197
19	0.515	113	99.9	198
20	0.535	90	103.3	197
21	0.554	109	107.2	197
22	0.570	96	110.8	197
23	0.588	106	114.1	197
24	0.605	114	117.6	197
25	0.622	119	120.8	197
26	0.640	127	124.9	198
27	0.656	109	127.6	197
28	0.672	127	130.8	197
29	0.687	129	133.8	197
30	0.701	144	136.7	197
31	0.715	132	139.4	197
32	0.728	151	142.8	198
33	0.742	142	144.7	197

34	0.757	147	147.6	197
35	0.772	152	150.6	197
36	0.788	161	153.6	197
37	0.801	157	156.5	197
38	0.813	161	159.9	198
39	0.827	150	161.6	197
40	0.839	159	164.1	197
41	0.854	173	166.6	197
42	0.866	172	169.4	197
43	0.879	170	171.9	197
44	0.891	179	175.1	198
45	0.904	182	176.8	197
46	0.917	179	179.4	197
47	0.930	187	181.9	197
48	0.945	189	184.7	197
49	0.961	187	187.6	197
50	0.995	190	191.7	197

number of observations = 9858

number of groups = 50

Hosmer-Lemeshow Chi2 (48 degrees of freedom) = 58.74

p-value = 0.1378

Hosmer-Lemeshow test for the Heritage model

Group	Predicted probability	Observed engaged	Predicted engaged	Total group size
1	0.233	56	36.9	202
2	0.281	53	52	201
3	0.321	55	60.5	201
4	0.356	69	68.6	202
5	0.387	76	74.5	201
6	0.416	88	80.8	201
7	0.444	71	86.3	201
8	0.468	87	92	202
9	0.494	100	96.8	201
10	0.517	92	101.8	201
11	0.537	117	106	201
12	0.556	108	110.5	202
13	0.576	108	113.7	201
14	0.595	118	117.7	201
15	0.614	121	121.5	201
16	0.632	124	125.9	202
17	0.650	127	128.8	201
18	0.664	133	132.1	201
19	0.680	136	135.2	201
20	0.696	145	139	202
21	0.710	140	141.3	201
22	0.724	139	144.2	201
23	0.738	147	147	201
24	0.751	150	150.5	202
25	0.763	150	152.2	201
26	0.775	157	154.6	201
27	0.786	154	157.6	202

Group	Predicted probability	Observed engaged	Predicted engaged	Total group size
28	0.798	147	159	201
29	0.809	161	161.5	201
30	0.820	156	163.7	201
31	0.829	170	166.6	202
32	0.839	172	167.6	201
33	0.848	170	169.5	201
34	0.858	171	171.4	201
35	0.867	180	174.2	202
36	0.875	176	175.1	201
37	0.884	180	176.8	201
38	0.892	178	178.5	201
39	0.900	176	180.9	202
40	0.907	182	181.6	201
41	0.914	192	183.1	201
42	0.921	186	184.4	201
43	0.928	183	186.8	202
44	0.935	190	187.2	201
45	0.942	188	188.6	201
46	0.950	195	190.2	201
47	0.957	187	192.6	202
48	0.966	198	193.2	201
49	0.975	194	195	201
50	0.994	200	197.6	201

number of observations = 10063

number of groups = 50

Hosmer-Lemeshow Chi2 (48 degrees of freedom) = 54.99

p-value = 0.2270

Hosmer-Lemeshow test for the Library model

Group	Predicted probability	Observed engaged	Predicted engaged	Total group size
1	0.167	30	28.5	201
2	0.194	42	36.7	201
3	0.212	45	40.9	201
4	0.228	40	44.3	201
5	0.242	36	46.9	200
6	0.253	42	49.7	201
7	0.265	44	52	201
8	0.277	60	54.5	201
9	0.289	54	56.9	201
10	0.299	61	58.8	200
11	0.311	66	61.2	201
12	0.321	69	63.4	201
13	0.331	74	65.5	201
14	0.341	60	67.1	200
15	0.352	77	69.6	201
16	0.364	60	71.9	201
17	0.375	79	74.3	201
18	0.385	70	76.4	201
19	0.396	74	78	200

Group	Predicted probability	Observed engaged	Predicted engaged	Total group size
20	0.407	91	80.7	201
21	0.419	83	82.9	201
22	0.428	95	85.1	201
23	0.438	78	86.6	200
24	0.449	78	89.2	201
25	0.460	100	91.3	201
26	0.472	84	93.6	201
27	0.482	100	95.8	201
28	0.492	97	97.3	200
29	0.503	100	100	201
30	0.515	100	102.4	201
31	0.525	106	104.5	201
32	0.536	110	106	200
33	0.547	113	108.9	201
34	0.558	113	111.1	201
35	0.569	121	113.3	201
36	0.582	117	115.7	201
37	0.595	111	117.7	200
38	0.609	127	120.9	201
39	0.621	129	123.6	201
40	0.635	122	126.3	201
41	0.651	129	128.6	200
42	0.667	137	132.4	201
43	0.683	126	135.6	201
44	0.698	143	138.7	201
45	0.716	138	142	201
46	0.734	150	145	200
47	0.757	150	150	201
48	0.784	149	154.9	201
49	0.823	163	161.7	201
50	0.940	167	171.3	200

number of observations = 10039

number of groups = 50

Hosmer-Lemeshow Chi2 (48 degrees of freedom) = 42.28

p-value = 0.7056

Hosmer-Lemeshow test for the Museum model

Group	Predicted probability	Observed engaged	Predicted engaged	Total group size
1	0.096	11	15	199
2	0.119	20	21.5	198
3	0.137	20	25.5	198
4	0.152	25	28.8	198
5	0.165	37	31.3	198
6	0.177	37	33.9	198
7	0.190	40	36.2	198
8	0.202	43	38.8	198
9	0.214	39	41.1	198
10	0.226	38	43.4	198
11	0.237	44	45.8	198
12	0.250	50	48.1	198

Group	Predicted probability	Observed engaged	Predicted engaged	Total group size
13	0.260	64	50.6	198
14	0.272	52	52.7	198
15	0.285	55	55.2	198
16	0.297	63	57.5	198
17	0.309	49	60.3	199
18	0.322	61	62.4	198
19	0.333	65	64.8	198
20	0.347	71	67.4	198
21	0.360	79	70	198
22	0.372	60	72.5	198
23	0.386	84	75.2	198
24	0.400	76	77.8	198
25	0.414	79	80.5	198
26	0.427	82	83.3	198
27	0.442	76	86	198
28	0.457	89	89	198
29	0.472	85	92.1	198
30	0.488	104	95	198
31	0.504	95	98.1	198
32	0.520	92	101.3	198
33	0.539	116	104.8	198
34	0.554	113	108.7	199
35	0.571	123	111.5	198
36	0.589	112	114.8	198
37	0.607	113	118.4	198
38	0.625	116	121.8	198
39	0.643	132	125.4	198
40	0.662	134	129.2	198
41	0.679	129	132.8	198
42	0.698	140	136.3	198
43	0.719	134	140.3	198
44	0.740	143	144.3	198
45	0.762	150	148.7	198
46	0.790	158	153.7	198
47	0.818	153	158.9	198
48	0.849	163	165	198
49	0.893	178	172.2	198
50	0.974	179	183	198

number of observations = 9903

number of groups = 50

Hosmer-Lemeshow Chi2 (48 degrees of freedom) = 44.28

p-value = 0.6258

Hosmer-Lemeshow test for the Sport model

Group	Predicted probability	Observed engaged	Predicted engaged	Total group size
1	0.015	1	2.3	200
2	0.019	1	3.4	200
3	0.022	3	4.1	200
4	0.025	8	4.7	200
5	0.028	8	5.3	200

6	0.031	7	5.9	200
7	0.034	4	6.5	200
8	0.037	4	7.1	200
9	0.040	6	7.6	200
10	0.043	10	8.3	200
11	0.047	9	9	200
12	0.050	9	9.7	200
13	0.054	8	10.3	199
14	0.058	13	11.2	200
15	0.061	22	11.9	200
16	0.065	17	12.6	200
17	0.069	14	13.4	200
18	0.073	16	14.2	200
19	0.077	13	14.9	200
20	0.081	15	15.7	200
21	0.085	17	16.5	200
22	0.089	18	17.3	200
23	0.094	19	18.2	200
24	0.099	23	19.2	200
25	0.103	21	20.1	199
26	0.108	21	21.1	200
27	0.113	22	22.1	200
28	0.119	23	23.3	200
29	0.126	14	24.5	200
30	0.132	18	25.8	200
31	0.139	34	27.1	200
32	0.146	29	28.5	200
33	0.154	38	30	200
34	0.162	33	31.6	200
35	0.171	32	33.3	200
36	0.181	34	35.2	200
37	0.193	37	37.4	200
38	0.205	34	39.7	199
39	0.218	36	42.2	200
40	0.233	42	45.1	200
41	0.248	50	48.1	200
42	0.266	43	51.4	200
43	0.285	59	55.1	200
44	0.304	56	58.9	200
45	0.332	64	63.4	200
46	0.363	75	69.5	200
47	0.395	74	75.9	200
48	0.439	80	83.2	200
49	0.503	88	93.5	200
50	0.763	127	113.7	199

number of observations = 9996

number of groups = 50

Hosmer-Lemeshow Chi2 (48 degrees of freedom) = 45.72

p-value = 0.5667

8. Appendix 8: System dynamics modelling – workshop invitees

The table below shows the individuals invited to the workshop help to scope the conceptual models of the drivers of engagement in culture and sport held at the DCMS on 27th August 2009.

Workshop invitees

Name	Organisation
Adam Cooper	DCMS
Michael Cooke	DCMS
Anita Charlesworth	DCMS
Jack Hindley	DCMS
Anna Payne	DCMS
Anne-Marie Andreoli	DCMS
Kathryn Barrett	DCMS
Andrew Vaughn	DCMS
Ingrid Samuel	DCMS
Ruth Evans	DCMS
Paul Clegg	DCMS
Silvia Anton	MLA
Paul Bristow	MLA
Yukimi Carson	ACE
Phil Cave	ACE
Catherine Bunting	ACE
Tom Campbell	LGA
Martyn Allison	IDeA
Russell Coughtry	GO
John Davies	EH
Owain Lloyd-James	EH
Louisa Moore	EH
Nick Rowe	SE
Ruth Alleyne	SE

9. Appendix 9: Data sources used in the system dynamics models

This appendix describes the data used in the model. Appendix 11 describes how this data is employed to calculate model parameters.

Parameter	Description	Source	Specific data elements (if applicable)	Comments
Population unaware	Number of people, by cohort, within the population who are either not aware that the given sport exists, or are aware of it, but not aware that it is something they could engage in	Taking Part 2007/08	Barrier questions	Assumed children have the same awareness/interest distribution as 30-49 age group (i.e. Governed by parents). Assumed distribution of non-engaging population in each sector is the same across all activities.
Population aware	Number of people, by cohort, within the population who aware that they could take part in given sport but do not have an interest in participating	Taking Part 2007/08	Barrier questions	
Population interested	Number of people, by cohort, within the population that are interested in taking part in given sport but cannot do so because they do not have sufficient health, time, or cannot afford it	Taking Part 2007/08	Barrier questions	
Population effective demand	Number of people, by cohort, within the population who are prevented from engaging in given sport because there isn't a sufficient supply of venues to do the sport in	Taking Part 2007/08	Barrier questions	
Population engaging	Number of people, by cohort, within the population who have actively engaged in given sport once in the last 4 four weeks	Taking Part 2007/08	sport - 4 weeks, other sectors - 12 months	For children, questions relating to engagement outside of school have been used.
TV reach	The proportion of the population that will be reached by the advertising/coverage	None	Assumed starts at 0	
TV_coeff_aware	A measure of the likelihood of someone becoming aware given that have been exposed to TV advertising/coverage	McGuire		Taken from a physical activity study, but widely applied elsewhere. Hierarchy of movement from exposure to engagement with a 50% drop out at each step. 2 steps from exposure to awareness
TV_coeff_interest	A measure of the likelihood of someone becoming interested given that they are already aware and are exposed to TV advertising/coverage	McGuire		Taken from a physical activity study, but widely applied elsewhere. Hierarchy of movement from exposure to engagement with a 50% drop out at each step. 2 steps from exposure to awareness

Parameter	Description	Source	Specific data elements (if applicable)	Comments
Newspapers reach	The proportion of the population that will be reached by the advertising/coverage	None	Assumed starts at 0	
Written_coeff_aware	A measure of the likelihood of someone becoming aware given that have been exposed to written advertising/coverage	McGuire		Taken from a physical activity study, but widely applied elsewhere. Heirarchy of movement from exposure to engagement with a 50% drop out at each step. 2 steps from exposure to awareness
Written_coeff_interest	A measure of the likelihood of someone becoming interested given that they are already aware and are exposed to written advertising/coverage	McGuire		Taken from a physical activity study, but widely applied elsewhere. Heirarchy of movement from exposure to engagement with a 50% drop out at each step. 2 steps from exposure to awareness
Public space cover	The proportion of the population that will be reached by the advertising/coverage	None	Assumed starts at 0	
Public_coeff_aware	A measure of the likelihood of someone becoming aware given that have been exposed to public space advertising/coverage	McGuire		Taken from a physical activity study, but widely applied elsewhere. Heirarchy of movement from exposure to engagement with a 50% drop out at each step. 2 steps from exposure to awareness
Public_coeff_interest	A measure of the likelihood of someone becoming interested given that they are already aware and are exposed to public space advertising/coverage	McGuire		Taken from a physical activity study, but widely applied elsewhere. Heirarchy of movement from exposure to engagement with a 50% drop out at each step. 2 steps from exposure to awareness
Education cover	The proportion of the population that will be reached by an education campaign. (This differs from an advertising campaign as it is much more targeted and intensive, and thus likely to have a greater effect)	None	Assumed starts at 0	
Edu_coeff_aware	A measure of the likelihood of someone becoming aware given that have been exposed to an education campaign	Assumption		Assumed awareness via education is guaranteed (1.0)
Edu_coeff_interest	A measure of the likelihood of someone becoming interested given that they are already aware and are exposed to an education campaign	McGuire		Taken from a physical activity study, but widely applied elsewhere. Heirarchy of movement from exposure to engagement with a 50% drop out at each step. 2 steps from exposure to awareness

Parameter	Description	Source	Specific data elements (if applicable)	Comments
WOM reach	Probability that within a week people have contact with family or friends. A measure of how much contact with friends and family the average member of a cohort has.	Taking Part 2007/08	Frequency of meeting friends/relatives	Both friends and family contact questions are measured on a scale of 0 (never) to 4 (most days) and the average level is found out. This is averaged and then translated onto a scale of 0 to 1. Assumed children are the same as 16-29 cohorts for meeting friends, and the same as the 30-49 cohorts for meeting relatives
Quality	The average enjoyment experienced by engagers, translated from a 1 to 10 scale in the survey to a 0 to 100 scale in the model.	Taking Part 2007/08	Average enjoyment experienced by engagers	Average of all engagers for each each activity is used to alleviate sample size issues. Average enjoyment for adults is applied to children as well.
% recommend	The proportion of activity engagers that would recommend the activity to a friend or relative.	Taking Part 2007/08	Would you recommend this activity to a friend or relative?	Cases where the sample size for this question was less than 20 have been derived using a combination of the average recommendation rate and the average enjoyment for each cohort (assumes recommendation is related to enjoyment).
Aware WOM adj	A proxy measure for how likely someone who is aware is to talk about the activity with friends or relatives.	Assumption		Assumed that aware population is able to contribute to WOM effect and be 1/3 as effective as 'Engagers WOM adj'
Interested WOM adj	A proxy measure for how likely someone who is interested in or effectively demanding an activity is to talk about the activity with friends or relatives.	Assumption		Assumed that the interested and effective demand population is able to contribute to WOM effect and be 2/3 as effective as 'Engagers WOM adj'.
Engagers WOM adj	The relationship between the likelihood of recommendation and the enjoyment of the activity, defined as [% recommend] / [Quality]. A proxy measure for how likely an engager is to talk about the activity with friends or relatives.	Derived from Taking Part 2007/08	Combination of likelihood of recommendation and enjoyment	Assumed children are the same as 16-29 cohort. It is assumed that the relationship between likelihood of recommendation and quality is linear and does not bottom out or trail off as quality approaches 0 or 100.
WOM_coeff_interest	A measure of how likely someone is to become interested via word of mouth effects	Assumption		Used in combination with the decay rates to calibrate the models.

Parameter	Description	Source	Specific data elements (if applicable)	Comments
Default disability access %	The percentage of the population that is unable to access an activity due to health reasons that have limitations imposed on them by an illness or disability. This is a proxy measure of disability access into facilities.	Taking Part 2007/08	Proportion of those with health barriers that have disability limitations applicable to the given sector	Assumed children are the same as 16-29 cohort. Assumed distribution of disability limitations are the same for each activity within each sector. Limitations used for Sport are mobility, dexterity and physical coordination. For all other sectors, limitations used are mobility, communication and concentration.
Mobility %	The percentage of these with disability limitations who have specific mobility issues	Taking Part 2007/08	Proportion of those with a disability limitation that have mobility issues	Assumed children are the same as 16-29 cohort. Assumed same distribution for each activity within each sector
Communication % or Dexterity %	The percentage of those with disability limitations who have specific communication (arts, heritage, MLA) or dexterity (sport) issues	Taking Part 2007/08	Proportion of those with a disability limitation that have communication (arts, heritage, MLA) or dexterity (sport) issues.	Assumed children are the same as 16-29 cohort. Assumed same distribution for each activity within each sector
Concentration % or Physical coordination %	The percentage of these with disability limitations who have specific concentration/memory (arts, heritage, MLA) or physical coordination (sport) issues	Taking Part 2007/08	Proportion of those with a disability limitation that have concentration/memory (arts, heritage, MLA) or physical coordination (sport) issues.	Assumed children are the same as 16-29 cohort. Assumed same distribution for each activity within each sector
% Health barriers	The percentage of the population that is unable to access sport due to the perception that their health is not good enough. This percentage is offset by changes to disability access facilities (see above) i.e. facilities can be provided to reduce the limitations on engagement for disabled people.	Taking Part 2007/08	Proportion of those who report health as their main barrier out of the total number of interested, effective demanders and engagers.	Assumed children are the same as 16-29 cohort. Assumed same distribution for each activity within each sector

Parameter	Description	Source	Specific data elements (if applicable)	Comments
% Cost barrier	The percentage of the population that are unable to access the activity due to the perception that they cannot afford it or that it does not provide enough value for money.	Taking Part 2007/08	Proportion of those who report affordability as their main barrier out of the total number of interested, effective demanders and engagers.	Assumed children are the same as 16-29 cohort. Assumed same distribution for each activity within each sector
% Time barrier	The percentage of the population that is unable to access sport due to the perception that they do not have enough time.	Taking Part 2007/08	Proportion of those who report time as their main barrier out of the total number of interested, effective demanders and engagers.	Assumed children are the same as 16-29 cohort. Assumed same distribution for each activity within each sector
Supply	A measure of the number of people having decided to engage can engage due to the availability of venues nearby. The remaining proportion are those in effective demand.	Derived from Taking Part 2007/08	Combination of barrier and engagement questions	This supply proportion is maintained during modelling so there is no theoretical limit on the number of engagers.
% Interested losing interest	The percentage of people that are interested but are unable to access the activity, that lose interest over time	Assumption	Used to help calibrate models	
% Effective demand losing interest	The percentage of people that are able to access the activity but for which there is not enough supply, that lose interest over time	Assumption	Used to help calibrate models	
% Engagers losing interest	The percentage of engagers that stop engaging and lose interest over time	Assumption	Used to help calibrate models	
% Engagers LI ratio	The relationship between the % Engagers losing interest parameter and quality.	Derived from Taking Part 2007/08 and calibration data	Quality and calibrated % Engagers losing interest	Relationship defined as [% Engagers losing interest] / ((100-[Quality])/100). It is assumed that this relationship remains linear i.e. The % losing interest does not bottom out or tail off as quality approaches 0 or 100.
Timec ItoED	The time period over which the average person moves from being interested to part of the effective demand	Assumption		There is no evidence for the time to effect for our modelled relationships so sensible values

Parameter	Description	Source	Specific data elements (if applicable)	Comments
Timec EDtoE	The time period over which the average person moves from effective demand to being an engager	Assumption		have been used. It is assumed the time to effect is the same for each activity and sector.
Timec I_LI	The time period over which interested people who aren't engaging lose interest and move to being aware	Assumption		
Timec ED_LI	The time period over which people lose interest due to lack of supply and move to being aware	Assumption		
Timec E_LI	The time period over which engagers lose interest in the activity and move to being aware	Assumption		
Timec EtoED	The time period over which people disengage due to supply shortages and move from engaging to effective demand	Assumption		
Timec EEDtol	The time period over which people disengage due to no longer meeting accessibility and/or affordability criteria and move from engaging or effective demand to interested	Assumption		

10. Appendix 10: Data sources reviewed but not used in the model

The following table summarises the sources reviewed to identify data for the system dynamic model. The precise nature of the parameters required for the system dynamic model meant that these sources were unable to provide data.

Authors	Article	Date
A project by the Institute of Field Archaeologists and Atkins Heritage for the National Trust	Measuring the Social Contribution of the Historic Environment	2004
Aabø, New Library World, 106: 1218/1219, 487-495	Are public libraries worth their price? A contingent valuation study of Norwegian public libraries	2005
AEA Consulting for Tyne & Wear Museums, North East Museums Libraries and Archives Council, British Museums, Galleries & Archives	Tyne & Wear Museums, Bristol's Museums, Galleries & Archives: Social Impact Programme Assessment	2005
Aitchison and Edwards, Cultural Heritage NTO	Archaeology Labour Market Intelligence: Profiling the Profession 2007-08	2003
Alberini, Longo, Journal of Cultural Economics, 30, 4, 287-304	Combining the travel cost and contingent behaviour methods to value cultural heritage sites: Evidence from Armenia	Dec 2006
Alberini, Riganti and Longo, Journal of Cultural Economics, 27: 3/4, 193-213	Can People Value the Aesthetic and Use Services of Urban Sites? Evidence from a Survey of Belfast Residents	Nov 2003
Arts Council	Findings from the arts debate	2009
Arts Research Digest	Collection of research and articles on arts	2009
Bakhshi, Hasan et al, Mission Money Models Web publication	Measuring Intrinsic Value How to stop worrying and love economics	2008
Barget, Gouguet, Journal of Sports Economics, 8, 2, 165-182	The Total Economic Value of Sporting Events Theory and Practice	2007
Bedate, Herrero, Sanz, Journal of Cultural Heritage, 5, 1, 101-111	Economic Valuation of the Cultural Heritage: Application to Four Case Studies in Spain	Jan-Mar 2004
Beltrán, Rojas, Annals of Tourism Research, 23, 2, 463-478	Diversified Funding Methods in Mexican Archaeology	1996
Berit Hasler et al, National Environmental Research Institute, Denmark.	Valuation of Nature Restoration and Protection of Archaeological Artefacts in Great Aamose in western Zealand, Denmark	2006
Big Lottery fund	Outcomes framework	Unknown
Bohm, European Economic Review, 3, 2, 111-130	Estimating Demand for Public Goods: An Experiment	1972
Bolton Metropolitan Borough Council, MLA North West, Jura Consultants	Bolton's Museum, Library and Archive Services: An Economic Evaluation	Dec 2005
Boter, Rouwendal, Wedel, Journal of Cultural Economics, 29, 1, 19-33	Employing Travel Time to Compare the Value of Competing Cultural Organizations	Feb 2005

Authors	Article	Date
Boxall, Englin, Adamowicz, in Navrud (Ed), Ready (Ed), Value Cultural Heritage: Applying Environmental Valuation Techniques to Historic Buildings, Monuments and Artifacts, Edward Elgar Publishing Ltd, 296pp	The Contribution of Aboriginal Rock Paintings to Wilderness Recreation Values in North America	July 2002
Boyne, R. in The cultural industries : the British experience in international perspective. Berlin: Humboldt University, pp. 53-70.	Methodology and Ideology in the Evaluation of Cultural Investments	2006
Brown J, London. Imperial College	Economic Values and Cultural Heritage Conservation: Assessing the Use of Stated Preference Techniques for Measuring Changes in Visitor Welfare	2004
Bruce K. Johnson et al	The Value of Public Goods Generated by a Major League Sports Team: The CVM Approach	Sep 2000
CABE Space	Does Money Grow on Trees?	2005
Carlino and Coulson, Federal Reserve Bank of Philadelphia	Compensating differentials and the social benefits of the NFL	Sep 2002
Carson, Mitchell, Conaway, in Navrud (Ed), Ready (Ed), Value Cultural Heritage: Applying Environmental Valuation Techniques to Historic Buildings, Monuments and Artifacts, Edward Elgar Publishing Ltd, 296pp	Economic Benefits to Foreigners Visiting Morocco Accruing from Rehabilitating the Fes Medina	July 2002
Centre for Cities	Centre for cities: cities outlook 2009	2009
Centre for Cultural Policy Research (CCPR), the University of Glasgow	Impact database	2009
Chambers, Chambers, Whitehead, Department of Economics, Thomas Harriot College of Arts and Sciences, East Carolina Univeristy, Working paper, ecu9614	Contingent Valuation of Quasi-Public Goods: Validity, Reliability, and Application to Valuing a Historic Site	1996
Civic Trust	Heritage Open Days	Jan 2009
Clark, Maeer, Cultural Trends, Vol 17 Issue 1, 23 - 56	The Cultural Value of Heritage - evidence from the Heritage Lottery Fund March 2008	Mar 2008
CLG	National Indicators for Local Authorities and Local Authority Partnerships Consultation on the deferred indicators	2008
CLG, NCF	How encouraging positive relationships between people can help build community cohesion	2009
Commission for the Archetecture and the Built Environment	A sense of place what residents think of their new homes	2007
Commission for the Archetecture and the Built Environment	Paved with gold: The real value of good street design	2004
Commission for the Archetecture and the Built Environment	Quality of place and regional economic performance	Unknown
Commissioned for English Heritage, Dr Helen Graham et al	Literature Review Historic Environment, Sense of Place and Social Capital	2009
Communities and Local Government	Improving Opportunity, strengthening society (CLG)	Feb 2009

Authors	Article	Date
Communities and Local Government	Local Democracy, Economic Development and Construction Bill Local Economic Assessments	Jan 2009
Communities and Local Government	Predictors of community cohesion multi-level modelling of the 2005 Citizenship Survey	Feb 2008
Community Guide Branch, National Center for Health Marketing (NCHM), Centers for Disease Control and Prevention	Promoting physical activity	2009
Creative and Cultural Skills	The Cultural Heritage Blueprint	Dec 2008
Culture South West	PEOPLE, PLACES AND SPACES A Cultural Infrastructure Development Strategy for the South West of England	2008
CultureMap London :: A resource developed by Audiences London	Culture map	2009
Daffern and Mehdyzadeh, DCMS Economics Branch	The White Book: DCMS Guidance on Appraisal and Evaluation of Projects, Programmes and Policies	Dec 2004
DCMS	Valuing non-market benefits	Unknown
Del Saz Salazar, Montagud Marques, Journal of Cultural Heritage, 6, 1, 69-77	Valuing Cultural Heritage: The Social Benefits of Restoring an Old Arab Tower	Jan-Mar 2005
Delaney, O'Toole, Journal of Cultural Economics, 30, 4, 305-309	Willingness to pay: individual or household?	Dec 2006
Department for Communities and Local Government	citizenship survey 2007-08 (CLG)	Jun 2008
Department for Communities and Local Government	Citizenship survey (report and stats available)	Latest data: Dec 2009
Department for Communities and Local Government	Citizenship Survey: 2007-08 (April 2007 – March 2008), England & Wales	2008
Department for Communities and Local Government	Various community cohesion reports	2009
Department for Culture, Media and Sport	Taking part survey	Latest data: Dec 2009
Dobbs, Moore and Simpson, Northumbria University Centre for Public Policy	A scoping exercise to explore the impact of cultural activities on economically inactive adults	Mar 2004
Dobbs, Moore, Chimirri-Russel, Biddle and Law, Northumbria University Centre for Public Policy	An Evaluation of the Socio-economic Impact of Cragside on Rothbury	Jul 2006
ECOTEC Research and Consulting	The Economic and Social Impacts of Cathedrals in England	Jun 2004
EFTEC	Olympic Games Impact Study – Stated Preference Analysis	2005
English Heritage	Heritage Dividend	Unknown
English Heritage	Annual report 2007	2007
English Heritage	Capturing the public value of heritage	Jan 2006
English Heritage	Character and Identity: Townscape and heritage appraisals in housing market renewal areas	2008

Authors	Article	Date
English Heritage	EH Visitor survey 2008	2008
English Heritage	EH Visitors to Free Sites 2007	2007
English Heritage	English Heritage research agenda	Unknown
English Heritage	English heritage strategy 2005 – 2010: making the past part of our future	Unknown
English Heritage	English Heritage Visitor Survey 2007	2007
English Heritage	Heritage Open Days Visitor Research 2007	Nov 2007
English Heritage	Heritage Open Days Visitor Research 2008	Nov 2008
English Heritage	Scoping Study on the Socio-Economic Benefits of Heritage in the National Parks	2007/08
English Heritage	SURVEY OF VISITS TO VISITOR ATTRACTIONS 2003	2003
English Heritage	SURVEY OF VISITS TO VISITOR ATTRACTIONS 2004	2004
English Heritage	Survey of Visits to Visitor Attractions 2005	2005
English Heritage	SURVEY OF VISITS TO VISITOR ATTRACTIONS 2007	2007
English Heritage, the Heritage Lottery Fund, the Department for Culture, Media and Sport and the Department for Transport.	Valuation of Historic Environment	2005
Filmer-Sankey, Susan Lawson, Alan Baxter & Associates	Gloucester Heritage Urban Regeneration Company Heritage Audit	2008
Fred Coalter	A Wider Social Role for Sport	2008
Frontier Economics	Assessing the economic case for investment in 'Quality of Place'	Unknown
Garrod, Willis, Bjarnadottir, Cockbain, Cities, 13, 6, 423-430	The Non-Priced Benefits of Renovating Historic Buildings – A Case Study of Newcastle's Grainger Town	Dec 1996
Gibson (Ed), Pendlebury (Ed), Ashgate Publishing Group, pp 234	Valuing Historic Environments	May 2009
Grijalva, Berrens, Bohara, Shaw, American Journal of Agricultural Economics, 84, 2, 401-414	Testing the Validity of Contingent Behaviour Trip Responses	Jan 2003
GSP Limited	Built Heritage Management In Wellington City: Financial And Other Means To Appropriately Manage Built Heritage	Nov 2007
Hansen, Journal of Cultural Economics, 21, 1, 1-28	The Willingness-to-Pay for the Royal Theatre in Copenhagen as a Public Good	Mar 1997
Harless, Allen, College & Research Libraries, 60, 1, 56-69	Using the Contingent Valuation Method to Measure Patron Benefits of Reference Desk Service in an Academic Library	Jan 1999
Heritage Lottery Fund	Heritage Lottery Fund Reaserch and Evaluation	2009?
Heritage Lottery Fund	Social impact of heritage lottery funded projects	Jun 2006
Heritage Lottery Fund	Values and benefits of heritage	Jul 2008
Herritage Lottery Fund	Economic Impact of HLF Projects	Mar 2009
Hewison, Holden, Heritage Lottery Fund	DEMOS-Challenges and change Heritage and culture values	Nov 2004

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Holt, Elliott, Moore, Public Libraries, 38, 2, 98-108	Placing a Value on Public Library Services	1999
Huu Tuan, Navrud, Environmental and Resource Economics, 38, 1, 51-69	Valuing cultural heritage in developing countries: comparing and pooling contingent valuation and choice modelling estimates	Sep 2007
Institute of Historic Building Conservation	Valuing Historic Places	Unknown
Jeff Dayton-Johnson, Dalhousie, Department of Economics	Subsidising Stan: Measuring the social benefits of cultural spending	2003
Johnson, Mondello, Whitehead, Journal of Sports Economics, 7, 3, 267-288	Contingent Valuation of Sports: Temporal Embedding and Ordering Effects	2006
Johnson, Whitehead, Contemporary Economic Policy, 18, 1, 48-58	Value of Public Goods from Sports Stadiums: The CVM Approach	Jan 2000
Kansas Arts Commission and Krider et. al, 257	Economic Scope, Impact and Marketing Study of the Kansas Arts Commission	Jul 1999
Kinghorn, Willis, Museum Management and Curatorship, 22, 1, 43-58	Estimating Visitor Preferences for Different Art Gallery Layouts Using a Choice Experiment	Mar 2007
Kling, Revier, Sable, Urban Studies, 41, 10, 2025-2041	Estimating The Public Good Value of Preserving a Local Historic Landmark: The Role of Non-Substitutability and Citizen Information	2004
Living Places	Mapping the Cultural Sector	Jan 2009
Living Places	OUTCOME FOCUSED CULTURAL ASSET ASSESSMENT METHODOLOGY LEARNING TOOL	Unknown
Local Government Association	taking part counts the contribution of art, culture and sport to national outcomes	2007
Local Government Association, Produced jointly with DCMS and other partners.	A passion for excellence: an improvement strategy for sport and culture	2008
Local Government Association. Produced jointed with DCMS and other organisations	Realising the potential of cultural services	Unknown
Maddison, Mourato, in Navrud (Ed), Ready (Ed), Value Cultural Heritage: Applying Environmental Valuation Techniques to Historic Buildings, Monuments and Artifacts, Edward Elgar Publishing Ltd, 296pp	Valuing Different Road Options for Stonehenge	July 2002
Madureira	Multi-attribute valuation of cultural landscape: individual's preferences regarding rural heritage and nature-related attributes	Unknown
Martin, Journal of Cultural Economics, 18, 4, 255-270	Determining the Size of Museum Subsidies	Dec 1994
Maskey, Vishakha et al, Agricultural and Resource Economics Review.	What Is Historic Integrity Worth to the General Public? Evidence from a Proposed Relocation of a West Virginia Agricultural Mill	2007
Mazzanti, Journal of Economic Studies	Discrete choice models and valuation experiments	2003
McNabola	Briefing 4: Increasing Attendance and Participation	2008

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MLA South East	Assessment of the contribution of museums, libraries and archives to the visitor economy	Jul 2008
Morey, Rossmann, Chestnut, Ragland, in Navrud (Ed), Ready (Ed), Value Cultural Heritage: Applying Environmental Valuation Techniques to Historic Buildings, Monuments and Artifacts, Edward Elgar Publishing Ltd, 296pp	Valuing reduced acid deposition injuries to cultural resources: marble monuments in Washington, DC	July 2002
Morrison, Westi, Journal of Behavioral Economics, 15, 3, 57-72	Subsidies for the Performing Arts: Evidence on Voter Preference	Autumn 1986
Mourato, Kontoleon, Danchev, in Navrud (Ed), Ready (Ed), Value Cultural Heritage: Applying Environmental Valuation Techniques to Historic Buildings, Monuments and Artifacts, Edward Elgar Publishing Ltd, 296pp	Preserving Cultural Heritage in Transition Economies: A Contingent Valuation Study of Bulgarian Monasteries	July 2002
Mudie, Renaissance, East of England, Museums for Changing Lives, pp. 108	Schools' Use of Museums in the North East	Apr 2006
National Audit Office	Income generated by museums and galleries	2004
Navrud, Strand, in Navrud (Ed), Ready (Ed), Value Cultural Heritage: Applying Environmental Valuation Techniques to Historic Buildings, Monuments and Artifacts, Edward Elgar Publishing Ltd, 296pp	Social Costs and Benefits of Preserving and Restoring The Nidaros Cathedral	July 2002
North East Historic Environment Forum	Economic Cultural and Social Impact of Heritage in the North East	2005
Oskala, Keaney, Chan, Bunting, Arts Council	Encourage children today to build audiences for tomorrow. Evidence from the Taking Part Survey on how childhood involvement in the arts affects arts engagement in adulthood	Mar 2009
Ove Arup & Partners Ltd, North East Historical Environmental Forum	Economic, Cultural and Social Impact of Heritage in the North East (case studies)	2005
Owen, Venn, Price and Featherstone, BMG Research	Cultural Demand in the West Midlands	2009
Özdemiroglu, E. and Mourato, S. CCEM working Paper. http://www.uni-hamburg.de/Wiss/FB/15/Sustainability/CCEMpaper.pdf	Valuing Our Recorded Heritage	2001
Pagiola, S., World Bank Economists Forum, Alexandria	Valuing the Benefits of Investments in Cultural Heritage: The Historic Core of Split	1999
Papandrea, Journal of Cultural Economics, 23, 3, 147-164	Willingness to Pay for Domestic Television Programming	Aug 1999
Parsons, Smith, Journal of Sports Economics, Vol. 9, No. 1, 43-66	The Price of Thoroughbred Yearlings in Britain	2008
Pollicino, M. and Maddison, D. unpublished paper, Institute of Archaeology, University College London and Institute of Economics, University of Southern Denmark.	Using Contingent Valuation to Value Maintenance Options for Oxford's Historic Buildings	2004

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Pollicino, Maddison, Journal of Cultural Economics, 25, 2, 131-148	Valuing the Benefits of Cleaning Lincoln Cathedral	May 2001
Poor, Smith, Journal of Cultural Economics, 28, 3, 217-229	Travel Cost of a Cultural Heritage Site: the case of historic St. Mary's City of Maryland	Aug 2004
Powe, Willis, Leisure Studies, 15, 4, 259-275	Benefits Received by Visitors to Heritage Sites: A Case Study of Warkworth Castle	Sep 1996
Productivity Commission Inquiry Report, 37	Conservation of Australia's Historic Heritage Places	Apr 2006
Pung, Clarke, Patten, New Review of Academic Librarianship, 10, 1, 79-102	Measuring The Economic Impact of The British Library	April 2004
Riganti, Willis, in Navrud (Ed), Ready (Ed), Value Cultural Heritage: Applying Environmental Valuation Techniques to Historic Buildings, Monuments and Artifacts, Edward Elgar Publishing Ltd, 296pp	Component and temporal value reliability in cultural goods: the case of Roman Imperial remains near Naples	July 2002
Sagger	Creative Industry Clusters	Unknown
Santagata, Signorello, Journal of Cultural Economics, 24, 3, 181-204	Contingent Valuation of a Cultural Public Good and Policy Design: the Case of 'Napoli Musei Aperti'	August 2000
Schwer, Daneshvary, Journal of Media Economics, 8, 3, 95-109	Willingness to Pay for Public Television and the Advent of Look-Alike Cable-Television Channels – A Case Study	July 1995
South East England Development Agency	Demonstrating the case for Culture	Unknown
Sport England	Active people surveys	2009
Sport England	Participant questionnaire for measuring satisfaction	Unknown
Sport England	Value of sport monitor	2009
Thompson, Berger, Blomquist, Allen, Journal of Cultural Economics, 26, 2, 87-113	Valuing the Arts: A Contingent Valuation Approach	May 2002
Throsby, Research paper / School of Economic and Financial Studies, Macquarie University, no. 210, Research paper (Macquarie University. School of Economic and Financial Studies), no. 210, 106 p	The Regional Economic Impact of the Mildura Arts Centre	1980
Tohmo, Journal of Socio-Economics, 33, 2, 229-240	Economic value of a local museum: factors of willingness to pay	April 2004
Turok, University of Glasgow	Economic aspects of place-making The evidence base	Mar 2008
UK Film Council	A Qualitative Study of Avid Cinema-goers	Nov 2007
Unknown - summary of various reports	Findings on heritage funded projects	2009
Valuation projects, Economics for the Environment Consultancy Ltd. (EFTEC)	The Economic and Financial Sustainability of the Management of the Historic Sanctuary of Machu Picchu	1999
Walton, Longo, Dawson, Journal of Sports Economics, 9, 3, 304-317	A Contingent Valuation of the 2012 London Olympic Games	2008
West Midlands Regional Observatory	Culture, People & Place: The Social and Environmental Role of Culture in the West Midlands West Midlands Cultural Observatory	2009
Whitehead, Finney, Journal of Cultural Economics, 27, 3-4, 231-240	Willingness to Pay for Submerged Maritime Cultural Resources	Nov 2003

Authors	Article	Date
Willis, Journal of Cultural Economics, 26, 4, 307-324	Iterative Bid Design in Contingent Valuation and the Estimation of the Revenue Maximising Price for a Cultural Good	Nov 2002
Willis, Journal of Environmental Planning and Management, 37, 3, 267-278	Paying for Heritage: What Price for Durham Cathedral?	1994
Yorkshire and The Humber Historic Environment Forum	HISTORIC ENVIRONMENT STRATEGY FOR YORKSHIRE AND THE HUMBER REGION	2008

11. Appendix 11: System dynamics model parameter estimation

This appendix describes how the data in appendix 10 was combined to estimate the system dynamics model parameters.

Parameter	Type	Definition
TV aware	Parameter	$([TV_reach] * [TV\ aware\ coeff]) / 100$
TV interest	Parameter	$([TV_reach] * [TV\ interest\ coeff]) / 100$
Written aware	Parameter	$([Written_reach] * [Written\ aware\ coeff]) / 100$
Written interest	Parameter	$([Written_reach] * [Written\ interest\ coeff]) / 100$
Public space aware	Parameter	$([Public_space_reach] * [Public\ space\ aware\ coeff]) / 100$
Public space interest	Parameter	$([Public_space_reach] * [Public\ space\ interest\ coeff]) / 100$
Education aware	Parameter	$([Education_reach] * [Education\ aware\ coeff]) / 100$
Education interest	Parameter	$([Education_reach] * [Education\ interest\ coeff]) / 100$
AllUnaware	Parameter	$SUM([Unaware])$
AllAware	Parameter	$SUM([Aware])$
AllInterested	Parameter	$SUM([Interested])$
AllEffDemand	Parameter	$SUM([Effective\ demand])$
AllEngagers	Parameter	$SUM([Engagers])$
TotalPop	Parameter	$[AllUnaware] + [AllAware] + [AllInterested] + [AllEffDemand] + [AllEngagers]$
TotalPopCohort	Parameter	$[Aware]+[Effective_demand]+[Engagers]+[Interested]+[Unaware]$
WOM adjustment	Parameter	$IF [TotalPopCohort]=0 THEN 0 ELSE (([aware_WOM_adj]*[Aware])+([interested_WOM_adj]*([Effective_demand]+[interested]))+([engagers_WOM_adj]*[Engagers]))/[TotalPopCohort]$
WOM aware	Parameter	$[WOM_reach]*[WOM\ adjustment]$
WOM interest	Parameter	$[WOM_reach]*[WOM_adjustment]*[Quality]/100*[WOM\ coeff\ interest]$

Parameter	Type	Definition
become aware	Flow	$([TV_aware] + [Written_aware] + [Public_space_aware] + [Education_aware] + [WOM_aware]) * [Unaware]$
become interested	Flow	$([TV_interest] + [Written_interest] + [Public_space_interest] + [Education_interest] + [WOM_interest]) * [Aware]$
total scales	Parameter	$([Disability1_scale] * [Disability1_prop]) + ([Disability2_scale] * [Disability2_prop]) + ([Disability3_scale] * [Disability3_prop])$
act health barrier	Parameter	$[health_barrier] * (1 - ([dfit_disability_limit] * [total_scales]))$
cost adjustment	Parameter	IF cost_switch=0 THEN -1 ELSE cost_proportion
total barrier	Parameter	IF [cost_adjustment] < 0 THEN IF [cost_barrier]+[act_health_barrier]+[time_barrier] > 1 THEN 1 ELSE [cost_barrier]+[act_health_barrier]+[time_barrier] ELSE IF ([cost_adjustment]/100)+[act_health_barrier]+[time_barrier] > 1 THEN 1 ELSE ([cost_adjustment]/100)+[act_health_barrier]+[time_barrier]
eff demand plus engagers	Parameter	$[Effective_demand] + [Engagers]$
eff demand plus engagers prop	Parameter	IF [TotalPopCohort]=0 THEN 0 ELSE $[eff_demand_plus_engagers] / [TotalPopCohort]$
int_proportion	Parameter	IF ([Interested]+[eff_demand_plus_engagers])=0 THEN 0 ELSE $[Interested] / ([Interested] + [eff_demand_plus_engagers])$
Able to afford and access	Flow	IF [int_proportion] < [total_barrier] THEN 0 ELSE $([int_proportion] - [total_barrier]) * [Interested] / [timec_ItoED]$
Unable to afford or access	Flow	IF [int_proportion] < [total_barrier] THEN $([total_barrier] - [int_proportion]) * [Effective_demand] / [timec_EEDtoI]$ ELSE 0
eng_prop	Parameter	IF SUM([eff_demand_plus_engagers])=0 THEN 0 ELSE $SUM([Engagers]) / SUM([eff_demand_plus_engagers])$

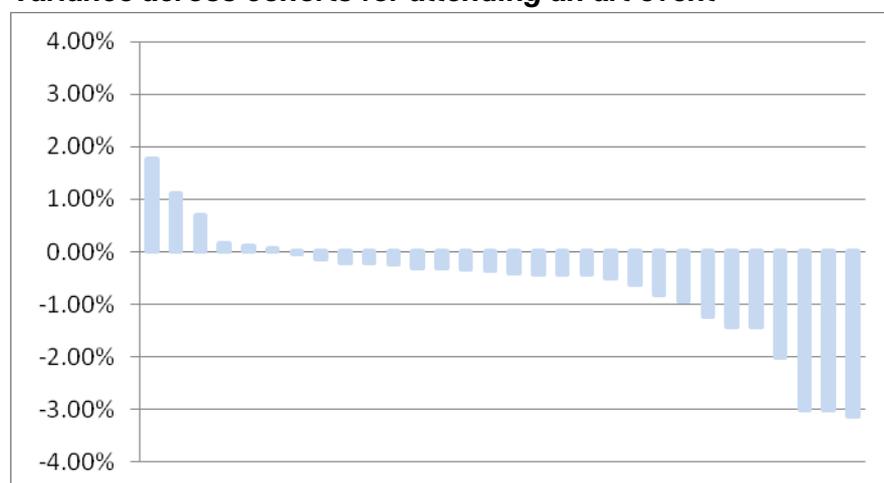
Parameter	Type	Definition
become engagers	Flow	IF [eng_prop] < [Supply] THEN $([supply] - [eng_prop]) * [Effective_demand] / [timec_EDtoE]$ ELSE 0
No longer able to afford or access	Flow	IF [int_proportion] < [total_barrier] THEN $([total_barrier] - [int_proportion]) * [Engagers] / [timec_EEDtoI]$ ELSE 0
capacity shortage	Flow	IF [eng_prop] > [Supply] THEN $([eng_prop] - [Supply]) * [Engagers] / [timec_EtoED]$ ELSE 0
losing interest	Flow	$([demand\ proportion] * [Demand]) / [timec\ I_LI]$
losing interest2	Flow	$([eff.\ demand\ proportion] * [Eff.\ demand]) / [timec\ ED_LI]$
losing interest3	Flow	$[engagers_proportion] * (1 - ([Quality] / 100)) * [Engagers] / [timec_E_LI]$

12. Appendix 12: System dynamics model baseline calibration results

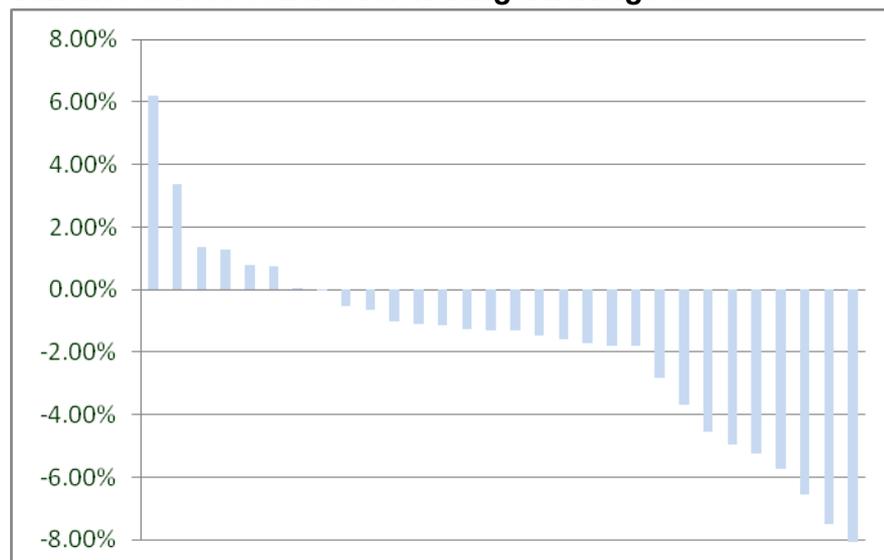
Model variances

The charts below show the level of variance between the number of engagers identified in the 2007/8 Taking Part survey compared to the model baseline predictions. Charts are presented at a combined activity level, and show the variation for each cohort model, organised in descending order. A positive variance figure represents the model slightly over-predicting the number of engagers, while a negative figure means that the model is slightly under-predicting.

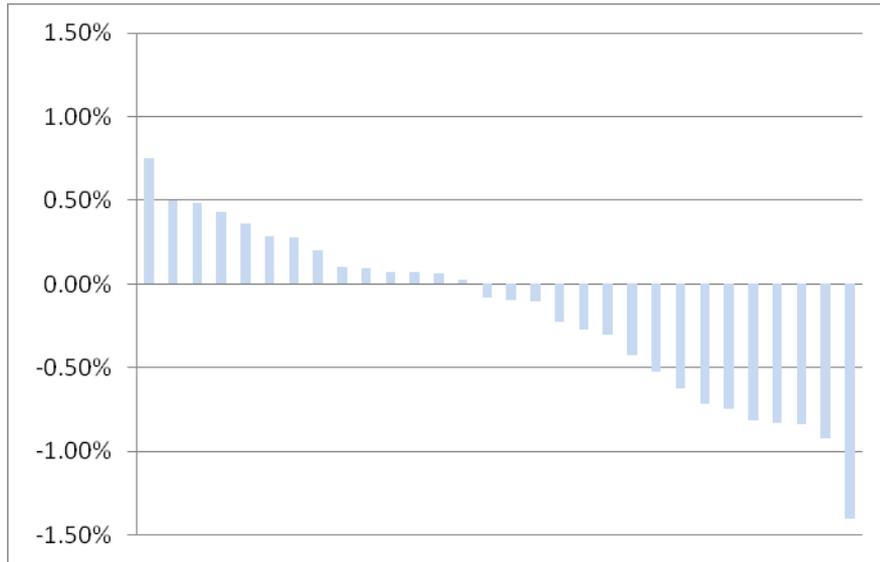
Variance across cohorts for attending an art event



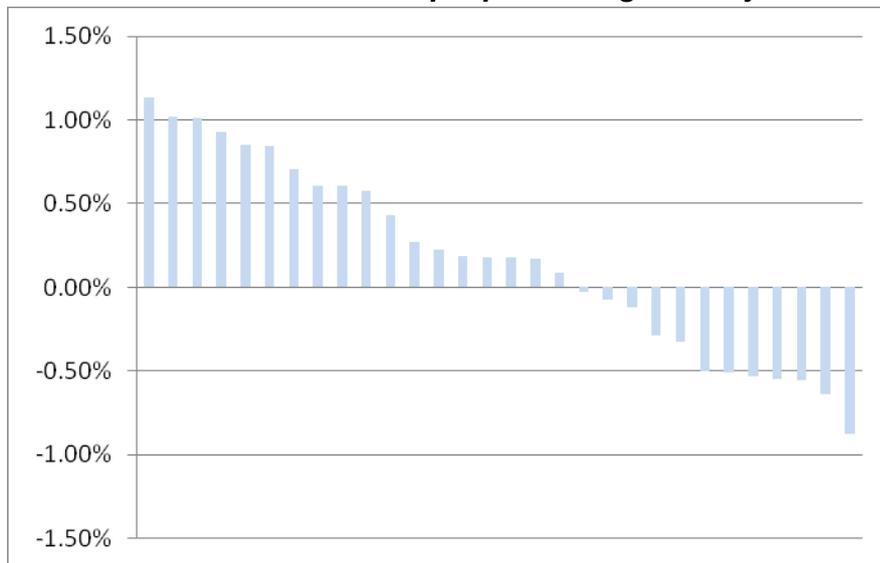
Variance across cohorts for visiting a heritage site



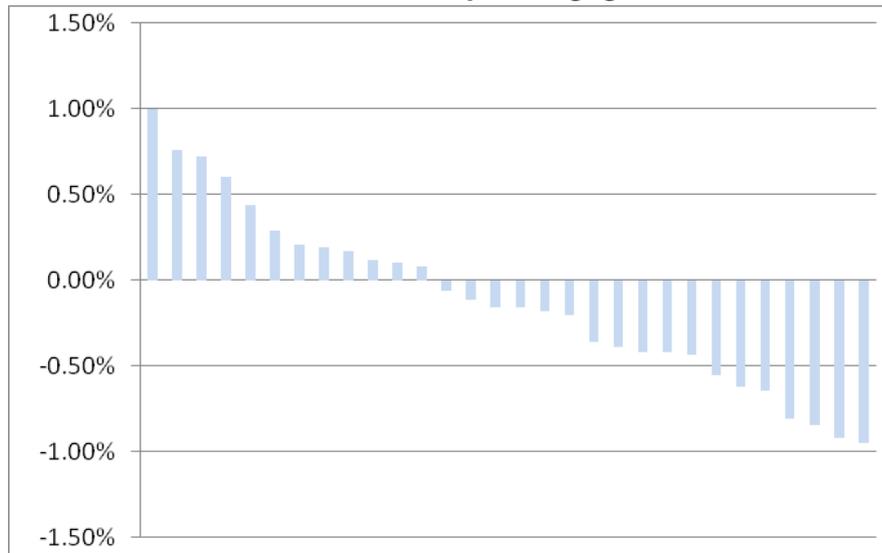
Variance across cohorts for visiting museum or gallery



Variance across cohorts for a people visiting a library



Variance across cohorts for all Sport engagement



13. Appendix 13: Calibration sources reviewed

The table below summarises the studies reviewed to identify calibration data. Unfortunately, none of the source provided data that could be used to directly calibrate the system dynamics model.

Title	Author	Date
From indifference to enthusiasm: patterns of arts attendance in England	The Arts Council - Catherine Bunting, Tak Wing Chan, John Goldthorpe, Emily Keaney, Anni Oskala	Apr-08
Changing the way people think about health-enhancing physical activity: do mass media campaigns have a role?	Cavill, Nick and Bauman, Adrian Journal of Sports Sciences, 22: 8, 771 — 790	2004
Main technical report: Attending heritage sites A quantitative analysis of data from the Taking Part survey	Centre for Economics and Business Research	Jul-07
Attendance and Public Participation in the Performing Arts: A Review of the Empirical Literature (Working paper)	Bruce A. Seaman	Aug-05
Driving Up Participation: The Challenge For Sport Academic Review Papers Commissioned By Sport England As Contextual Analysis To Inform The Preparation Of The Framework For Sport In England	Sport England (Rowe, N., Beasley, N., Adams, R., Long, J., Kay, T., Collins, M., Kirk, D., Coalter, F., Gratton, C., Taylor, P., Elson, M. & Ravenscroft, N.)	Apr-04
Sport and Community Development: A Manual Research Report no. 86	Fred Coalter, Director, Centre for Leisure Research, University of Edinburgh	Jul-02
The Social Stratification of Theatre, Dance and Cinema Attendance, Cultural Trends	Chan, T. W. & Goldthorpe, J. H.	2005
Social Stratification and Cultural Consumption: Music in England, European Sociological Review	Chan, T. W. & Goldthorpe, J. H.	2006
Social stratification and cultural consumption: The visual arts in England, Poetics	Chan, T. W. & Goldthorpe, J. H.	2007

Understanding Participation in Sport: A Systematic Review, Sport England	Foster, C., Hillsdon, M., Cavill, N., Allender, S. & Cowburn, G.	2005
A Cultural Map of the United Kingdom 2003, Cultural Trends	Gayo-Cal, M., Savage, M., & Warde A.	2006
Where Is the Child's Environment? A Group Socialization Theory of Development, Psychological Review,	Harris, J. R.	1995
Encourage Children Today to build Audiences for Tomorrow: Evidence from the Taking Part survey on how Childhood Involvement in the Arts Affects Engagement in Adulthood,	Arts Council (Oskala, A., Keaney, E., Chan, T. W. & Bunting, C.)	2009
The Omnivore Thesis Revisited: Voracious Cultural Consumers, European Sociological Review	Sullivan, O. & Katz-Gerro, T.	2006
Social capital, networks and leisure consumption, Sociological review	Warde, A. & Tampubolon, G.	2002
A literature review of the evidence base for culture, the arts and sport policy	Scottish Executive	2004

14. Appendix 14: System dynamic models policy scenario results

The effect of policy scenarios on the number of people attending an art event

Age	Gender	Income level	Baseline attendance (000s)	Improved quality	Reduced quality	Access: mobility	Access: Communication	Access: Concentration / memory	All can afford	10% can't afford	Promotion	Decrease in perceived availability
11-15 years	Male	Low	490	0.23%	-0.22%	0.04%	0.01%	0.01%	0.54%	-9.04%	0.05%	-3.08%
11-15 years	Male	Average	672	0.23%	-0.22%	0.04%	0.01%	0.01%	0.07%	-8.70%	0.03%	-2.79%
11-15 years	Male	High	352	0.23%	-0.22%	0.04%	0.01%	0.01%	0.03%	-8.89%	0.04%	-2.80%
11-15 years	Female	Low	523	0.20%	-0.19%	0.10%	0.02%	0.03%	0.59%	-8.66%	0.03%	-2.50%
11-15 years	Female	Average	640	0.20%	-0.19%	0.03%	0.01%	0.01%	0.25%	-9.00%	0.03%	-2.50%
11-15 years	Female	High	279	0.21%	-0.21%	0.03%	0.01%	0.01%	0.08%	-8.79%	0.04%	-2.48%
16-29 years	Male	Low	573	0.71%	-0.68%	0.15%	0.03%	0.02%	0.69%	-8.95%	0.30%	-10.78%
16-29 years	Male	Average	2,099	0.49%	-0.47%	0.09%	0.02%	0.02%	0.24%	-8.89%	0.15%	-7.17%
16-29 years	Male	High	1,557	0.38%	-0.37%	0.08%	0.01%	0.01%	0.40%	-9.69%	0.16%	-5.91%
16-29 years	Female	Low	820	0.38%	-0.37%	0.32%	0.06%	0.09%	1.39%	-9.25%	0.18%	-5.85%
16-29 years	Female	Average	2,193	0.29%	-0.28%	0.05%	0.01%	0.01%	0.59%	-8.78%	0.07%	-3.96%
16-29 years	Female	High	1,203	0.22%	-0.22%	0.04%	0.01%	0.01%	0.85%	-8.91%	0.05%	-3.06%
30-49 years	Male	Low	455	1.00%	-0.98%	3.56%	0.84%	1.15%	5.94%	-8.52%	1.60%	-14.94%
30-49 years	Male	Average	2,823	0.51%	-0.50%	0.42%	0.05%	0.02%	0.86%	-9.62%	0.30%	-7.77%
30-49 years	Male	High	2,914	0.23%	-0.23%	0.04%	0.01%	0.01%	0.09%	-9.78%	0.09%	-3.09%
30-49 years	Female	Low	961	0.65%	-0.64%	0.68%	0.03%	0.32%	4.24%	-6.98%	0.40%	-10.72%
30-49 years	Female	Average	3,086	0.29%	-0.28%	0.16%	0.01%	0.07%	1.11%	-9.25%	0.10%	-4.51%
30-49 years	Female	High	2,401	0.23%	-0.23%	0.10%	0.07%	0.01%	0.30%	-9.30%	0.05%	-3.08%
50-64 years	Male	Low	431	1.36%	-1.33%	11.26%	2.22%	3.41%	6.55%	-8.78%	2.84%	-18.56%
50-64 years	Male	Average	1,648	0.72%	-0.71%	1.45%	0.27%	0.19%	0.42%	-11.45%	0.74%	-10.76%
50-64 years	Male	High	1,429	0.23%	-0.22%	0.04%	0.01%	0.01%	0.30%	-9.70%	0.09%	-3.09%
50-64 years	Female	Low	892	0.83%	-0.81%	3.88%	0.85%	1.03%	3.14%	-9.35%	0.83%	-12.91%
50-64 years	Female	Average	1,988	0.39%	-0.38%	0.44%	0.09%	0.01%	0.79%	-9.51%	0.19%	-5.85%
50-64 years	Female	High	994	0.23%	-0.22%	0.28%	0.01%	0.01%	0.95%	-8.82%	0.09%	-3.09%
Over 65 years	Male	Low	783	1.82%	-1.77%	21.25%	4.11%	4.30%	4.62%	-12.60%	4.66%	-23.13%

Over 65 years	Male	Average	1,247	0.73%	-0.72%	3.27%	0.20%	0.54%	0.03%	-11.06%	0.61%	-10.75%
Over 65 years	Male	High	243	0.56%	-0.55%	4.07%	1.37%	0.70%	0.03%	-11.51%	0.46%	-8.39%
Over 65 years	Female	Low	1,642	1.27%	-1.25%	22.52%	3.67%	1.97%	3.68%	-12.55%	3.25%	-16.88%
Over 65 years	Female	Average	1,166	0.73%	-0.71%	5.16%	0.95%	0.49%	0.03%	-10.96%	0.63%	-10.74%
Over 65 years	Female	High	84	0.77%	-0.76%	20.45%	3.68%	1.25%	3.05%	-11.80%	1.23%	-12.99%
Total			36,590	0.49%	-0.47%	2.29%	0.40%	0.34%	1.06%	-9.65%	0.50%	-7.00%

The effect of policy scenarios on the number of people visiting a heritage site

Age	Gender	Income level	Baseline attendance (000s)	Improved quality	Reduced quality	Access: mobility	Access: Communication	Access: Concentration / memory	All can afford	10% can't afford	Promotion	Decrease in perceived availability
11-15 years	Male	Low	459	0.41%	-0.40%	1.07%	0.01%	0.01%	0.84%	-9.55%	0.13%	-5.09%
11-15 years	Male	Average	668	0.28%	-0.27%	0.04%	0.01%	0.01%	0.05%	-8.89%	0.04%	-2.64%
11-15 years	Male	High	348	0.24%	-0.23%	0.03%	0.01%	0.01%	0.06%	-9.44%	0.05%	-2.38%
11-15 years	Female	Low	495	0.44%	-0.42%	0.17%	0.01%	0.01%	0.78%	-8.74%	0.11%	-5.10%
11-15 years	Female	Average	626	0.24%	-0.24%	0.04%	0.01%	0.01%	0.23%	-9.54%	0.04%	-2.62%
11-15 years	Female	High	280	0.24%	-0.23%	0.03%	0.01%	0.00%	0.07%	-8.57%	0.04%	-2.11%
16-29 years	Male	Low	577	0.78%	-0.75%	0.19%	0.03%	0.02%	0.66%	-9.07%	0.31%	-9.27%
16-29 years	Male	Average	2,132	0.45%	-0.43%	0.08%	0.01%	0.01%	0.21%	-9.24%	0.12%	-5.11%
16-29 years	Male	High	1,577	0.44%	-0.43%	0.08%	0.01%	0.01%	0.99%	-8.85%	0.16%	-5.11%
16-29 years	Female	Low	793	0.77%	-0.74%	0.29%	0.03%	0.02%	1.18%	-8.66%	0.27%	-9.26%
16-29 years	Female	Average	2,166	0.44%	-0.42%	0.07%	0.01%	0.01%	0.16%	-9.03%	0.11%	-4.86%
16-29 years	Female	High	1,176	0.45%	-0.43%	0.07%	0.01%	0.01%	0.54%	-8.86%	0.16%	-4.86%
30-49 years	Male	Low	453	0.97%	-0.95%	3.24%	0.97%	0.97%	4.38%	-11.02%	1.86%	-11.30%
30-49 years	Male	Average	2,810	0.58%	-0.56%	0.36%	0.02%	0.02%	0.43%	-10.37%	0.25%	-7.22%
30-49 years	Male	High	2,892	0.28%	-0.27%	0.05%	0.01%	0.01%	0.11%	-9.73%	0.07%	-3.11%

30-49 years	Female	Low	951	0.87%	-0.84%	0.74%	0.03%	0.20%	3.10%	-8.04%	0.43%	-11.18%
30-49 years	Female	Average	3,061	0.40%	-0.39%	0.15%	0.04%	0.07%	0.34%	-9.92%	0.10%	-5.00%
30-49 years	Female	High	2,402	0.24%	-0.23%	0.03%	0.01%	0.01%	0.23%	-9.52%	0.05%	-2.42%
50-64 years	Male	Low	429	1.31%	-1.27%	14.25%	2.61%	3.24%	5.40%	-10.27%	1.82%	-16.29%
50-64 years	Male	Average	1,638	0.71%	-0.69%	0.40%	0.03%	0.19%	0.59%	-11.32%	0.46%	-9.34%
50-64 years	Male	High	1,435	0.26%	-0.26%	0.04%	0.01%	0.01%	0.01%	-10.12%	0.13%	-2.62%
50-64 years	Female	Low	882	1.04%	-1.01%	2.72%	0.47%	0.90%	2.13%	-10.21%	0.79%	-12.97%
50-64 years	Female	Average	1,963	0.49%	-0.48%	0.58%	0.10%	0.01%	0.86%	-9.45%	0.15%	-6.20%
50-64 years	Female	High	975	0.38%	-0.37%	0.32%	0.01%	0.14%	0.76%	-8.76%	0.08%	-4.30%
Over 65 years	Male	Low	793	2.19%	-2.10%	20.68%	3.48%	4.20%	2.95%	-13.19%	3.52%	-23.90%
Over 65 years	Male	Average	1,228	0.76%	-0.74%	4.11%	0.28%	0.79%	0.02%	-11.50%	0.53%	-9.36%
Over 65 years	Male	High	236	0.93%	-0.90%	1.73%	0.03%	0.81%	0.03%	-10.85%	0.60%	-11.22%
Over 65 years	Female	Low	1,655	1.47%	-1.42%	23.02%	3.85%	1.75%	1.79%	-13.62%	1.97%	-17.71%
Over 65 years	Female	Average	1,164	0.76%	-0.74%	5.79%	1.72%	0.59%	0.02%	-11.13%	0.47%	-9.34%
Over 65 years	Female	High	85	0.69%	-0.68%	21.09%	1.95%	3.86%	4.91%	-10.41%	1.00%	-9.37%
Total			36,349	0.59%	-0.56%	2.33%	0.40%	0.34%	0.74%	-9.96%	0.40%	-6.92%

The effect of policy scenarios on the number of people visiting a library

Age	Gender	Income level	Baseline attendance (000s)	Improved quality	Reduced quality	Access: mobility	Access: Communication	Access: Concentration / memory	All can afford	10% can't afford	Promotion	Decrease in perceived availability
11-15 years	Male	Low	372	1.22%	-1.23%	0.00%	0.00%	0.25%	0.13%	-11.77%	2.72%	-3.93%
11-15 years	Male	Average	492	1.35%	-1.36%	0.00%	0.00%	0.00%	0.15%	-12.16%	3.56%	-3.95%
11-15 years	Male	High	272	1.21%	-1.21%	0.00%	0.00%	0.00%	0.00%	-11.19%	2.76%	-3.64%
11-15 years	Female	Low	354	1.47%	-1.48%	0.20%	0.31%	0.31%	0.51%	-12.34%	3.80%	-4.81%

11-15 years	Female	Average	509	1.01%	-1.01%	0.00%	0.00%	0.00%	0.00%	-10.94%	1.89%	-3.32%
11-15 years	Female	High	233	0.82%	-0.83%	0.00%	0.00%	0.00%	0.08%	-10.86%	1.79%	-2.39%
16-29 years	Male	Low	265	3.91%	-3.86%	0.00%	0.00%	0.46%	0.00%	-19.01%	30.93%	-7.18%
16-29 years	Male	Average	863	4.32%	-4.24%	0.00%	0.00%	0.00%	0.00%	-19.74%	38.87%	-7.07%
16-29 years	Male	High	526	4.24%	-4.17%	0.00%	0.00%	0.00%	0.00%	-21.93%	46.23%	-7.33%
16-29 years	Female	Low	529	2.42%	-2.42%	0.26%	0.39%	0.39%	1.04%	-13.20%	10.12%	-6.02%
16-29 years	Female	Average	1,201	2.68%	-2.68%	0.00%	0.00%	0.00%	0.00%	-15.76%	13.26%	-6.32%
16-29 years	Female	High	653	3.08%	-3.07%	0.00%	0.00%	0.00%	0.00%	-16.02%	18.17%	-6.15%
30-49 years	Male	Low	340	2.48%	-2.50%	2.63%	0.75%	0.75%	0.52%	-18.01%	15.19%	-5.54%
30-49 years	Male	Average	1,369	3.08%	-3.07%	0.34%	0.00%	0.00%	0.67%	-17.86%	20.24%	-6.90%
30-49 years	Male	High	1,324	3.24%	-3.23%	0.00%	0.00%	0.00%	0.00%	-18.31%	22.31%	-6.68%
30-49 years	Female	Low	725	1.78%	-1.79%	0.93%	0.00%	0.37%	0.75%	-14.26%	6.86%	-4.87%
30-49 years	Female	Average	1,958	2.04%	-2.06%	0.26%	0.13%	0.26%	0.00%	-15.49%	8.45%	-5.29%
30-49 years	Female	High	1,537	1.83%	-1.84%	0.07%	0.07%	0.00%	0.29%	-15.00%	7.90%	-4.48%
50-64 years	Male	Low	310	2.92%	-2.92%	9.95%	1.66%	3.32%	0.00%	-18.94%	19.30%	-6.63%
50-64 years	Male	Average	868	3.17%	-3.16%	0.77%	0.51%	0.00%	0.64%	-17.91%	21.39%	-6.91%
50-64 years	Male	High	629	3.33%	-3.32%	0.00%	0.00%	0.00%	0.00%	-18.84%	24.19%	-6.69%
50-64 years	Female	Low	546	2.73%	-2.74%	5.10%	0.85%	1.13%	0.37%	-18.64%	18.13%	-5.84%
50-64 years	Female	Average	1,044	2.69%	-2.70%	0.79%	0.26%	0.00%	0.00%	-18.00%	16.06%	-6.09%
50-64 years	Female	High	448	3.40%	-3.38%	0.00%	0.00%	0.00%	0.00%	-18.42%	24.19%	-6.70%
Over 65 years	Male	Low	626	3.39%	-3.38%	20.02%	3.76%	4.14%	0.99%	-20.22%	30.92%	-5.94%
Over 65 years	Male	Average	812	2.64%	-2.64%	5.82%	0.00%	0.99%	0.00%	-16.15%	13.76%	-5.80%
Over 65 years	Male	High	154	2.85%	-2.84%	3.53%	2.37%	1.20%	0.00%	-14.58%	13.39%	-6.68%
Over 65 years	Female	Low	1,172	2.96%	-2.97%	26.75%	5.56%	2.01%	0.31%	-20.22%	23.59%	-5.88%
Over 65 years	Female	Average	814	2.45%	-2.45%	5.31%	1.98%	0.00%	0.68%	-14.68%	11.69%	-5.45%
Over 65 years	Female	High	63	2.18%	-2.19%	20.86%	2.11%	4.22%	0.00%	-18.42%	12.31%	-5.46%
Total			21,007	2.65%	-2.63%	3.10%	0.65%	0.45%	0.26%	-16.64%	16.63%	-5.80%

The effect of policy scenarios on the number of people visiting a museum

Age	Gender	Income level	Baseline attendance (000s)	Improved quality	Reduced quality	Access: mobility	Access: Communication	Access: Concentration / memory	All can afford	10% can't afford	Promotion	Decrease in perceived availability
11-15 years	Male	Low	298	1.57%	-1.55%	0.15%	0.03%	0.02%	3.52%	-11.32%	3.08%	-8.08%
11-15 years	Male	Average	475	1.11%	-1.09%	0.11%	0.02%	0.01%	0.77%	-12.30%	1.50%	-5.90%
11-15 years	Male	High	260	0.83%	-0.82%	0.09%	0.02%	0.01%	0.12%	-12.72%	0.91%	-4.72%
11-15 years	Female	Low	297	1.55%	-1.53%	3.49%	0.03%	0.02%	7.52%	-8.17%	3.29%	-8.09%
11-15 years	Female	Average	384	1.35%	-1.33%	0.13%	0.02%	0.02%	2.17%	-13.31%	2.77%	-7.05%
11-15 years	Female	High	207	0.87%	-0.86%	0.09%	0.02%	0.01%	1.10%	-11.59%	1.06%	-4.73%
16-29 years	Male	Low	236	3.30%	-3.23%	0.21%	0.04%	0.03%	3.19%	-18.50%	21.58%	-10.86%
16-29 years	Male	Average	991	2.62%	-2.58%	0.21%	0.04%	0.02%	0.57%	-17.90%	10.45%	-10.65%
16-29 years	Male	High	791	3.05%	-2.98%	0.22%	0.04%	0.03%	0.03%	-16.78%	11.33%	-11.55%
16-29 years	Female	Low	393	2.73%	-2.69%	1.61%	0.04%	0.02%	9.63%	-9.54%	12.79%	-10.25%
16-29 years	Female	Average	1,186	1.98%	-1.95%	0.16%	0.03%	0.02%	3.31%	-13.50%	6.42%	-8.69%
16-29 years	Female	High	737	1.91%	-1.89%	0.14%	0.03%	0.02%	0.02%	-15.56%	5.87%	-7.66%
30-49 years	Male	Low	248	2.28%	-2.27%	7.21%	2.21%	2.64%	10.76%	-13.64%	18.88%	-7.33%
30-49 years	Male	Average	1,620	1.72%	-1.71%	0.50%	0.03%	0.02%	1.95%	-16.08%	6.21%	-7.67%
30-49 years	Male	High	1,997	0.93%	-0.92%	0.10%	0.02%	0.01%	0.18%	-14.11%	1.38%	-5.33%
30-49 years	Female	Low	515	1.92%	-1.91%	3.19%	0.03%	1.42%	13.71%	-6.68%	8.72%	-8.22%
30-49 years	Female	Average	1,807	1.47%	-1.47%	0.71%	0.11%	0.27%	2.92%	-14.56%	5.13%	-6.57%
30-49 years	Female	High	1,642	1.04%	-1.03%	0.40%	0.31%	0.11%	1.60%	-12.31%	1.49%	-5.90%
50-64 years	Male	Low	248	2.49%	-2.47%	24.86%	4.46%	6.13%	8.11%	-16.03%	19.15%	-8.38%
50-64 years	Male	Average	1,041	1.56%	-1.55%	1.30%	0.22%	0.21%	2.72%	-15.68%	6.54%	-6.60%

50-64 years	Male	High	1,000	1.04%	-1.02%	0.45%	0.02%	0.01%	0.69%	-13.00%	1.37%	-5.89%
50-64 years	Female	Low	489	2.40%	-2.37%	7.09%	1.70%	2.73%	6.18%	-13.91%	11.24%	-9.74%
50-64 years	Female	Average	1,123	1.59%	-1.58%	1.76%	0.26%	0.02%	2.13%	-15.47%	4.89%	-7.64%
50-64 years	Female	High	753	1.00%	-0.98%	0.86%	0.02%	0.39%	1.71%	-10.88%	1.28%	-5.32%
Over 65 years	Male	Low	453	3.32%	-3.25%	39.89%	6.42%	8.03%	2.69%	-21.28%	25.97%	-11.27%
Over 65 years	Male	Average	806	2.01%	-2.00%	11.05%	1.78%	0.89%	0.54%	-16.69%	8.01%	-7.73%
Over 65 years	Male	High	163	2.31%	-2.27%	4.14%	2.02%	1.02%	0.02%	-15.38%	6.70%	-9.18%
Over 65 years	Female	Low	802	3.19%	-3.12%	53.60%	8.93%	3.91%	5.98%	-18.29%	22.63%	-11.62%
Over 65 years	Female	Average	706	1.82%	-1.80%	17.09%	4.67%	2.08%	2.00%	-15.31%	5.39%	-8.64%
Over 65 years	Female	High	56	2.25%	-2.22%	22.57%	7.46%	3.73%	2.72%	-16.51%	8.60%	-10.14%
Total			21,725	1.75%	-1.72%	4.93%	0.91%	0.69%	2.55%	-14.46%	6.72%	-7.66%

The effect of policy scenarios on the number of people doing sport

Age	Gender	Income level	Baseline attendance (000s)	Improved quality	Reduced quality	Access: mobility	Access: Dexterity	Access: Physical coordination	All can afford	10% can't afford	Promotion	Decrease in perceived availability
11-15 years	Male	Low	467	0.23%	-0.23%	0.03%	0.01%	0.01%	0.45%	-10.29%	0.16%	-1.73%
11-15 years	Male	Average	640	0.24%	-0.24%	0.03%	0.01%	0.01%	0.37%	-9.93%	0.12%	-1.74%
11-15 years	Male	High	342	0.22%	-0.21%	0.03%	0.01%	0.01%	0.01%	-10.23%	0.16%	-1.36%
11-15 years	Female	Low	398	0.70%	-0.69%	1.64%	0.55%	0.55%	0.45%	-12.28%	0.94%	-6.09%
11-15 years	Female	Average	485	0.58%	-0.58%	0.89%	0.57%	0.83%	1.43%	-11.60%	0.91%	-4.99%
11-15 years	Female	High	219	0.32%	-0.32%	0.05%	0.02%	0.02%	0.01%	-13.03%	0.60%	-2.62%
16-29 years	Male	Low	523	1.19%	-1.16%	0.18%	0.07%	0.06%	1.74%	-8.54%	1.47%	-8.61%
16-29 years	Male	Average	1,801	0.58%	-0.58%	0.10%	0.04%	0.04%	0.02%	-12.19%	0.70%	-4.99%

16-29 years	Male	High	1,469	0.40%	-0.39%	0.06%	0.03%	0.02%	0.02%	-11.34%	0.39%	-3.23%
16-29 years	Female	Low	452	1.51%	-1.49%	4.23%	1.42%	1.41%	1.16%	-16.27%	4.54%	-11.83%
16-29 years	Female	Average	1,302	1.00%	-0.99%	1.79%	1.15%	1.68%	2.92%	-13.40%	2.53%	-8.43%
16-29 years	Female	High	738	0.72%	-0.72%	0.12%	0.05%	0.04%	0.03%	-16.27%	1.93%	-6.10%
30-49 years	Male	Low	277	1.06%	-1.06%	27.06%	11.37%	12.99%	5.83%	-16.64%	4.25%	-8.66%
30-49 years	Male	Average	2,051	0.98%	-0.97%	2.52%	1.07%	1.07%	2.54%	-12.40%	2.42%	-7.67%
30-49 years	Male	High	2,237	0.61%	-0.61%	0.10%	0.04%	0.04%	0.02%	-13.28%	1.18%	-5.00%
30-49 years	Female	Low	457	1.32%	-1.31%	17.03%	5.26%	5.83%	13.43%	-9.01%	5.49%	-10.54%
30-49 years	Female	Average	1,629	0.99%	-0.98%	8.14%	1.13%	3.24%	7.68%	-11.38%	3.47%	-7.98%
30-49 years	Female	High	1,539	0.46%	-0.46%	0.72%	0.68%	0.67%	5.83%	-10.26%	1.30%	-3.83%
50-64 years	Male	Low	203	0.79%	-0.79%	80.87%	32.39%	38.34%	1.78%	-30.17%	3.15%	-7.15%
50-64 years	Male	Average	861	1.37%	-1.36%	21.49%	5.53%	6.30%	2.38%	-18.32%	6.03%	-10.14%
50-64 years	Male	High	899	0.68%	-0.68%	3.15%	0.05%	0.04%	6.08%	-9.83%	1.50%	-6.09%
50-64 years	Female	Low	303	1.32%	-1.31%	63.30%	27.19%	22.60%	5.16%	-26.27%	7.28%	-10.29%
50-64 years	Female	Average	739	1.71%	-1.69%	21.61%	10.15%	10.14%	15.11%	-9.05%	9.38%	-11.84%
50-64 years	Female	High	470	1.32%	-1.31%	16.19%	12.03%	0.07%	5.25%	-14.27%	5.50%	-9.63%
Over 65 years	Male	Low	276	0.72%	-0.72%	183.23%	44.06%	55.21%	3.37%	-46.93%	3.72%	-6.08%
Over 65 years	Male	Average	477	1.02%	-1.02%	65.62%	16.95%	13.16%	0.04%	-27.02%	4.83%	-8.17%
Over 65 years	Male	High	146	1.03%	-1.03%	20.50%	4.11%	4.10%	0.04%	-18.15%	3.23%	-8.44%
Over 65 years	Female	Low	376	0.92%	-0.91%	236.80%	77.12%	69.44%	5.90%	-56.78%	4.32%	-8.61%
Over 65 years	Female	Average	380	0.94%	-0.93%	83.99%	20.94%	25.16%	3.27%	-28.60%	4.67%	-7.67%
Over 65 years	Female	High	24	0.90%	-0.91%	154.16%	74.69%	49.27%	0.03%	-45.16%	6.86%	-6.10%
Total			22,180	0.82%	-0.81%	14.92%	4.78%	4.74%	3.10%	-14.42%	2.52%	-6.53%

15. Appendix 15: System dynamics model socio-economic scenarios

The effect of demographic change on engagement in culture and sport

Age	Gender	Income level	Art	heritage	Museum	Library	Sport
11-15 years	Male	Low	-6.45%	-6.84%	-6.41%	-6.45%	-6.46%
11-15 years	Male	Average	-6.45%	-6.66%	-6.42%	-6.45%	-6.46%
11-15 years	Male	High	-6.45%	-6.64%	-6.43%	-6.45%	-6.47%
11-15 years	Female	Low	-6.67%	-7.06%	-6.63%	-6.66%	-6.67%
11-15 years	Female	Average	-6.67%	-6.87%	-6.64%	-6.67%	-6.67%
11-15 years	Female	High	-6.67%	-6.84%	-6.65%	-6.68%	-6.68%
16-29 years	Male	Low	6.12%	3.31%	6.12%	6.07%	6.06%
16-29 years	Male	Average	6.08%	3.76%	6.12%	6.07%	6.04%
16-29 years	Male	High	6.07%	3.14%	6.13%	6.07%	6.04%
16-29 years	Female	Low	5.14%	2.38%	5.18%	5.13%	5.14%
16-29 years	Female	Average	5.12%	3.03%	5.17%	5.13%	5.13%
16-29 years	Female	High	5.11%	2.18%	5.16%	5.13%	5.12%
30-49 years	Male	Low	0.06%	-0.95%	-0.01%	-0.04%	-0.04%
30-49 years	Male	Average	-0.01%	-0.60%	-0.01%	-0.03%	-0.04%
30-49 years	Male	High	-0.05%	-0.27%	-0.03%	-0.03%	-0.05%
30-49 years	Female	Low	-0.09%	-1.01%	-0.11%	-0.15%	-0.14%
30-49 years	Female	Average	-0.15%	-0.47%	-0.13%	-0.15%	-0.15%
30-49 years	Female	High	-0.16%	-0.26%	-0.13%	-0.16%	-0.17%
50-64 years	Male	Low	4.14%	-0.32%	4.04%	4.01%	4.00%
50-64 years	Male	Average	4.06%	0.63%	4.03%	4.01%	4.01%
50-64 years	Male	High	3.99%	1.80%	4.02%	4.01%	4.00%
50-64 years	Female	Low	4.12%	0.58%	4.09%	4.04%	4.05%
50-64 years	Female	Average	4.05%	1.23%	4.07%	4.04%	4.06%
50-64 years	Female	High	4.03%	1.66%	4.05%	4.04%	4.05%
Over 65 years	Male	Low	14.57%	3.34%	14.43%	14.36%	14.35%
Over 65 years	Male	Average	14.42%	4.88%	14.39%	14.36%	14.36%
Over 65 years	Male	High	14.39%	6.49%	14.41%	14.36%	14.36%
Over 65 years	Female	Low	8.50%	1.39%	8.45%	8.37%	8.38%
Over 65 years	Female	Average	8.43%	3.23%	8.42%	8.37%	8.37%
Over 65 years	Female	High	8.45%	0.82%	8.43%	8.37%	8.36%
Total			3.12%	0.68%	2.94%	2.97%	2.33%

The effect of GDP growth on engagement in culture and sport

Age	Gender	Income level	Art	heritage	Museum	Library	Sport
11-15 years	Male	Low	-1.81%	-1.81%	-1.82%	-1.81%	-1.81%
11-15 years	Male	Average	1.16%	1.17%	1.16%	1.17%	1.17%
11-15 years	Male	High	0.35%	0.35%	0.35%	0.35%	0.35%
11-15 years	Female	Low	-1.51%	-1.51%	-1.51%	-1.50%	-1.51%
11-15 years	Female	Average	0.22%	0.22%	0.21%	0.22%	0.22%
11-15 years	Female	High	2.34%	2.34%	2.34%	2.34%	2.34%
16-29 years	Male	Low	-1.03%	-0.72%	-1.03%	-1.02%	-1.02%
16-29 years	Male	Average	-0.28%	-0.20%	-0.28%	-0.27%	-0.27%
16-29 years	Male	High	0.75%	0.46%	0.74%	0.75%	0.75%
16-29 years	Female	Low	-1.08%	-0.70%	-1.09%	-1.07%	-1.08%
16-29 years	Female	Average	-0.08%	-0.06%	-0.09%	-0.08%	-0.08%
16-29 years	Female	High	0.93%	0.50%	0.92%	0.93%	0.93%
30-49 years	Male	Low	-0.89%	-0.22%	-0.88%	-0.88%	-0.88%
30-49 years	Male	Average	-0.38%	-0.18%	-0.38%	-0.38%	-0.38%
30-49 years	Male	High	0.60%	0.27%	0.60%	0.60%	0.60%
30-49 years	Female	Low	-1.32%	-0.64%	-1.32%	-1.31%	-1.32%
30-49 years	Female	Average	-0.04%	-0.02%	-0.04%	-0.04%	-0.04%
30-49 years	Female	High	0.68%	0.28%	0.67%	0.68%	0.68%
50-64 years	Male	Low	-1.04%	-0.31%	-1.02%	-1.01%	-1.02%
50-64 years	Male	Average	-0.11%	-0.04%	-0.10%	-0.09%	-0.10%
50-64 years	Male	High	0.62%	0.33%	0.62%	0.63%	0.62%
50-64 years	Female	Low	-1.40%	-0.62%	-1.40%	-1.39%	-1.39%
50-64 years	Female	Average	0.34%	0.15%	0.34%	0.35%	0.34%
50-64 years	Female	High	0.86%	0.45%	0.85%	0.86%	0.85%
Over 65 years	Male	Low	-1.59%	-0.69%	-1.57%	-1.56%	-1.56%
Over 65 years	Male	Average	1.41%	0.62%	1.42%	1.43%	1.42%
Over 65 years	Male	High	1.19%	0.68%	1.19%	1.20%	1.20%
Over 65 years	Female	Low	-1.50%	-0.57%	-1.49%	-1.48%	-1.48%
Over 65 years	Female	Average	2.77%	1.37%	2.77%	2.78%	2.78%
Over 65 years	Female	High	2.25%	0.44%	2.25%	2.27%	2.26%
Total			0.08%	0.05%	0.15%	0.05%	0.11%

16. Appendix 16: Additional heritage model results

At the request of English Heritage, an additional model was developed of heritage engagement defined as whether a person has visited a non-religious historic building open to the public in the last 12 months. Model selection was undertaken using robust single level logistic regression, with the final model estimation including a random intercept. The results of this additional analysis are shown below. The asset variable “Log of population weighted local historic buildings” was based on the same data as the original heritage sites variable in the first heritage model, but contained only Grade I and Grade II* listed buildings (it did not contain scheduled monuments).

Model terms	Odds ratio	Coefficient	Std. Err.	p-value	Less/More likely
Socio-economic characteristics					
Age	1.0353	0.0347	0.0107	0.001	
Age squared	0.9997	-0.0003	0.0001	0.012	
Member of a BME group interacted with age	0.9785	-0.0218	0.0084	0.009	
Member of a BME group vs. not	0.9530	-0.0481	0.3340	0.885	
High social-economic status vs. not	1.3288	0.2843	0.0687	0.000	
Income	1.0544	0.0530	0.0133	0.000	
Religion: non-practicing vs. not religious	0.9405	-0.0613	0.0794	0.440	
Religion: practicing vs. not religious	1.2323	0.2089	0.0970	0.031	
Living as a couple vs. not	1.3029	0.2646	0.0865	0.002	
Children living in household vs. not	1.1540	0.1433	0.1510	0.343	
Children interaction with living as a couple	0.5899	-0.5278	0.1693	0.002	
Illness or disability vs. not	0.8173	-0.2018	0.0843	0.017	
Work status: part time vs. not working	0.8692	-0.1401	0.1143	0.220	
Work status: full time vs. not working	0.6659	-0.4066	0.1018	0.000	
Social housing tenant vs. not	0.6161	-0.4843	0.1030	0.000	
Educated to other higher level vs. degree level	0.6382	-0.4492	0.1066	0.000	
Educated to A-level vs. degree level	0.5717	-0.5591	0.1024	0.000	
Educated to trade apprentice level vs. degree level	0.3979	-0.9216	0.1699	0.000	
Educated to 5+ GCSEs A*-C level vs degree level	0.5105	-0.6724	0.1020	0.000	
Educated to <5 GCSEs A*-C level vs degree level	0.4496	-0.7994	0.1533	0.000	
Educated other qualifications vs degree level	0.3551	-1.0354	0.1751	0.000	
Educated to no qualifications vs. degree level	0.3033	-1.1929	0.1288	0.000	
Media access					
Watches history on TV vs. not	2.3977	0.8745	0.0643	0.000	

Radio available in house vs. not	1.8238	0.6009	0.1681	0.000	
Has access to internet vs. not	1.8150	0.5961	0.0873	0.000	
Hours of TV watched per day	0.8516	-0.1606	0.0232	0.000	
Accessibility of engagement					
Log of population weighted local historic buildings	1.1994	0.1818	0.0382	0.000	
Index of service accessibility	1.0259	0.0256	0.0074	0.001	
Childhood experience					
Average no. of times taken to heritage sites p.a. as child	1.1353	0.1269	0.0131	0.000	
<i>constant</i>	-	-4.4101	0.7720	0.000	

number of individual respondents = 10059

number of local authorities = 346

variance of random intercept = 0.1290

standard error of random intercept = 0.0255