Social Psychology
The social ecology of intelligence in the British Isles

Richard Lynn

Data are presented to show that there are differences in mean population IQ in different regions of the British Isles. Mean population IQ is highest in London and South-East England and tends to drop with distance from this region. Mean population IQs are highly correlated with measures of intellectual achievement, per capita income, unemployment, infant mortality and urbanization. The regional differences in mean population IQ appear to be due to historical differences which are measured back to 1751 and to selective migration from the provinces into the London area.

The social ecology of intelligence is concerned with the relationship between the mean IQ of populations and their social, economic, demographic and epidemiological characteristics. The subject has received relatively little attention. The classical work in the field is Thorndike's (1939) *Your City* and its development in Thorndike & Woodyard (1942), which took American cities as population units and demonstrated associations between mean population IQs and a number of indices of per capita income, literacy, health and crime. In Britain the first notable study was that of Burt (1937) on the populations of London boroughs which showed relationships between several social, economic and psychological variables including educational attainment but not intelligence. The only other significant study is that of Wiseman (1964) which was essentially a replication of Burt's prewar investigation but included measures of intelligence and used as its populations the boroughs of Manchester.

The present paper endeavours to extend this area of inquiry in two directions. In the first place, it presents a study of the social ecology of intelligence for the whole of the British Isles, taking different regions as the population units and examining the relationship between the mean IQs in different regions and a variety of social and economic phenomena. Secondly, it introduces historical data into the analysis and attempts to explain the contemporary associations between mean population IQ and various social and economic phenomena in terms of historical processes going back to the middle of the 18th century.

The paper falls into three parts. First, mean population IQs are estimated for 13 subpopulations in the British Isles. Secondly, data are given for a number of social and economic phenomena and the relationships between these and mean population IQs are demonstrated and discussed. Thirdly, indices are presented of historical differences in mean population IQs and of migration between the regions and the effects of these on contemporary mean population IQs are analysed.

The distribution of intelligence in the British Isles

There have been three major studies of the distribution of intelligence in the regions of Great Britain. The first was carried out by Vernon (1947) from the results of the administration of Raven's Progressive Matrices to approximately 90000 candidates for the Royal Navy during the Second World War. From these data Vernon calculated mean scores for nine geographical regions of Great Britain. The resulting mean IQs have been transformed by the writer into IQs based on an overall mean of 100 and SD of 15, and range from 102·1 for Eastern England to 97·3 for Scotland with other regions of England and Wales scoring between these two figures.

One of the problems in work on social ecology is to obtain populations for which there is a variety of economic and social data. The best populations in England and Wales from this point

of view are those of the Registrar General, who divides the country into a number of 'standard regions' for which considerable social data of various kinds are collected. These standard regions were altered in 1965. The regions used in the present study are the pre-1965 regions, at which time the population of England and Wales was divided by the Registrar General into 10 standard regions.

The intelligence test data reported by Vernon (1947) do not in all cases correspond precisely with the Registrar General's standard regions but consist of mean IQs for groups of counties. To transform Vernon's data to the Registrar General's regions each county was given the mean IQ of its group, and the counties were then recombined into the Registrar General's regions. For each county the mean IQ has been weighted by the population in the 1961 census to give a mean IQ for each standard region. The results of these calculations are shown in Table 1.

The second major study of regional differences in intelligence in Britain was also carried out by Vernon (1951) and was based on the test results of approximately 9000 conscripts into the army in 1947. On this occasion the country was divided into 12 regions and the highest mean IQ was obtained by the conscripts from South-East England and the lowest by the Scots. The data have again been transformed into mean IQs for the Registrar General's standard regions in the same way as the Royal Navy sample, as described above, and the results are shown in Table 1.

The third study of regional differences in mean population IQ in Britain is that of Douglas (1977). This investigation took as its subjects all children born in Great Britain in the first week of March, 1946. The children have been followed up and samples tested at the ages of 8, 11 and 15. The total number of children in this investigation was approximately 5000. Two intelligence tests were given at each age, and also tests of English and arithmetic. The intelligence test means are calculated as *t* scores and these have been transformed into a mean IQ for each region based on an overall mean of 100 (SD 15) for the total population. These data are based on the Registrar General's regions and so no transformations are necessary. The London–South-East region and the North West obtain the highest means and Scotland the lowest. The data are shown in Table 1.

A comparison of the data in the two Vernon studies and the Douglas study will show that the mean IQs of the regions in all three investigations are broadly consistent. There are two regions which normally obtain above-average mean IQs, namely the London–South East and the East. The remaining eight regions of England and Wales have mean IQs around 100, while in all three studies the Scottish score is the lowest. Since any particular study of population IQs is subject

Table 1. Population IQs derived from three studies, overall mean IQs, and similar data derived from Davie *et al.* (1972).

Region	Vernon Navy	Vernon Army	Douglas	Overall mean	Davie *et al.*
London–South Eastern	101·9	103·0	101·5	102·1	7·34
Eastern	102·1	101·7	101·4	101·7	7·35
East–West Ridings	101·6	101·2	100·6	101·1	7·14
Southern	100·0	101·5	101·2	100·9	7·38
North Midland	100·6	101·5	100·3	100·8	6·99
North Western	101·2	98·1	101·5	100·3	7·12
Northern	99·8	99·6	99·7	99·7	7·11
South Western	98·2	101·4	99·1	99·6	7·12
Wales	98·5	97·9	98·8	98·4	7·24
Midland	98·6	97·2	98·4	98·1	6·91
Scotland	97·3	96·6	98·1	97·3	6·73

to sampling errors the most reliable method of obtaining an accurate measure for the regions is to take the mean of the three readings. These means are shown in Table 1 and are proposed as the best estimates currently available of mean population IQs in the regions of Great Britain.

The reliability of the three studies of mean population IQs can be tested by intercorrelation. The correlation coefficients are as follows: Navy×Army, $r = +0.66$; Navy ×Douglas, $r = +0.92$; Army×Douglas, $r = +0.68$. All three correlations are statistically significant at the 1 per cent level.

In addition to these three studies there is one other investigation which deserves mention. This is a survey by the National Children's Bureau published by Davie, Butler and Goldstein (1972). This investigation has been concerned with all the babies born in Great Britain during the week 3–8 March 1958 and the sample has been examined, followed up and tested over the years of childhood. At the age of 7 the children were given a copying designs test similar to the subtest in the Stanford–Binet and results are presented for the standard regions of England, Wales and Scotland. The data are not given in terms of mean IQs or scores but in percentages of children falling into different score bands. It is possible to calculate approximate means from these data and these are also shown in Table 1. As will be seen, children from the London–South East and East regions obtained high mean scores, although in this study the highest mean was obtained by the children in the Southern region of England, and the lowest score was obtained by children in Scotland. It is not possible to convert these scores into IQs because the standard deviation is not given, so they cannot be combined with the other regional data. Nevertheless, there is a correlation of 0.74, statistically significant at the 1 per cent level, between these figures and the mean IQs derived from the first three studies. Thus the National Children's Bureau results lend further confirmation to the three other investigations and the high degree of general agreement between all four studies suggests that real differences in mean IQ are present between the 11 subpopulations in Great Britain.

In order to increase coverage, sample size and general interest it seemed desirable to extend the study to Ireland. It is convenient to divide Ireland into two populations, namely Northern Ireland and the Republic of Ireland. In Northern Ireland there have been several studies of reasonably representative samples of children and all have found lower mean IQs than in children in mainland Britain. Forbes carried out two surveys and obtained mean IQs of 91.4 and 96.9 (Forbes, 1945, 1955). Fee (1964) obtained a mean IQ of 97.4.

These three studies were all made on samples from particular geographical areas. The only investigation covering the province as a whole was made in 1969 and has been reported by Wilson (1973). The sampling procedure was to stratify all primary schools in the province by size, location and religion and from this a 10 per cent stratified sample of children was derived. The children tested were aged 7 and 10, the numbers involved being something over 2000 for each age group. The 7 year olds were given a Moray House Picture Intelligence Test, and the 10 year olds were given tests of verbal and non-verbal intelligence standardized by the British National Foundation for Educational Research. The mean IQs for these three tests were respectively 96.2, 100.0 and 94.0, giving an overall mean of 96.7.

Thus all the surveys of intelligence in Northern Ireland have found that the mean IQ is a little lower than in the mainland of Great Britain. Since the Wilson study is the most thorough in terms of sampling it is proposed that its result of 96.7 is adopted as the most reliable reading of the mean IQ in Northern Ireland.

In the Republic of Ireland the first major survey of intelligence was carried out in 1961 by MacNamara (1966). His sample of 928 English speaking children obtained a mean IQ of 75 on a British non-verbal intelligence test.

A second study was carried out by Hart & O'Sullivan (1970) in which the sample was 167 male adults in Dublin tested with Cattell's Culture Fair Test. The sample is a small one but it was well drawn and stratified to make the age and occupational distribution representative of the

Figure 1. Standard regions of England, Wales, Scotland and Ireland showing mean population IQs.

population of Dublin. The mean IQ of this sample was 88. The third major study of intelligence in the Irish Republic has been carried out by Byrt & Gill (1973, 1975). This involved the standardization of Raven's Standard Progressive Matrices on 3466 Irish children aged 6 to 13 drawn as a representative sample of the population from the whole of the country. The means were transformed into IQs based on British means of 100, and in all age groups the Irish children scored a little below the British. The overall mean difference is reported as approximately three IQ points, yielding a mean Irish IQ of 97. The difference between this and the British mean is statistically significant although comparatively small. Examination of the data reveals a small source of error, namely that the Irish samples were approximately 2 months older than the British standardization samples. This has led to a slight overestimation of the mean Irish IQ. Correction of the result for this error reduces the mean Irish IQ by approximately one point, giving a mean IQ of approximately 96.

   The discrepancies in the three results from the Republic of Ireland are far from satisfactory. Nevertheless, we are not concerned particularly with this problem in this paper. For our own purposes it seems clear that measured intelligence in the Republic of Ireland is a little lower than

in Britain. The most conservative reading of the results is to take the corrected Byrt & Gill figure of 96 as our working estimate of mean IQ in the Republic of Ireland.

The geographical locations of the regions together with the mean population IQs are shown in Fig. 1.

The relation of mean population IQ to social and economic variables

The mean population IQs in the 13 regions are now considered in relation to a number of social and economic phenomena. These phenomena consist of measures of intellectual achievement, per capita income, unemployment, infant mortality, crime and urbanization. For all these variables there is reasonably strong evidence of a relationship with intelligence at the individual level, i.e. individual intelligence is related positively to intellectual achievement, income and urbanization and negatively to infant mortality and crime. It would take considerable space to review this evidence fully but it is sufficiently well known for this to be unnecessary. The point is made to indicate that the investigation is predictive in the sense that it predicts that the known relationship of intelligence to various social and economic phenomena at the individual level will also be found at the group level. This set of predictions is reductionist in so far as it treats populations as simply aggregates of individuals.

The data are described below and are shown in Table 2. Where possible data are taken for the year 1961, the reason for this being that 1961 was a census year for which exact population figures are available.

1. *Intellectual achievement: (a) first-class honours degrees.* All first-class honours graduates of the year 1973 were taken from all the universities in the British Isles (with the exception of graduates of Birkbeck College, a London College for mature and part-time students whose inclusion would bias the results in favour of London). Each graduate was allocated to the region where he lived between the ages of 11 and 18. This information was derived from the location of the graduate's school. Most of the data were obtained from *The Times*, which publishes annually lists of students obtaining first-class degrees and the schools they attended. Students who had been to boarding schools were written to requesting information on their home residence. Information from the Republic of Ireland universities was obtained from the college records.

Table 2. Regional data for social and economic phenomena

Region	Mean IQ	Fellows of the Royal Society	First class honours degrees 1973	Per capita income (£)	Unem- ployment	Infant mortality	Crime	Urban- ization
London–South Eastern	102·1	8·7	5·32	351·1	1·0	20	21·7	91·8
Eastern	101·7	6·2	4·58	242·7	1·1	18	14·4	65·7
East–West Ridings	101·1	7·3	3·29	274·0	1·0	24	17·2	86·2
Southern	100·9	6·5	5·00	274·5	1·1	19	14·4	65·2
North Midland	100·8	5·7	3·55	271·6	1·0	20	13·8	65·8
North Western	100·3	5·7	3·83	271·9	1·6	25	18·2	91·6
Northern	99·7	5·0	2·73	240·9	2·5	23	17·7	77·2
South Western	99·6	5·2	4·39	222·9	1·4	18	13·4	61·0
Wales	98·4	4·1	3·34	232·1	2·6	24	17·0	69·1
Midland	98·1	5·2	3·11	302·2	1·4	22	17·2	83·1
Scotland	97·3	2·5	3·92	242·2	3·2	26	21·0	70·4
Northern Ireland	96·7	1·6	3·89	177·1	7·5	27	7·0	54·0
Republic of Ireland	96·0	0·6	2·18	127·1	5·7	31	5·3	37·3

The total number of students obtaining first-class honours degrees was 3477, and information was obtained on place of residence for 3340 of these, representing 96·06 per cent of the total.

There are various ways of calculating the proportions of first-class honours graduates produced by each region. Probably the most satisfactory is to express the numbers of firsts in each region per 1000 of the total age cohorts recorded in the census of 1961. In this year the cohorts were approximately 9 years old. The reason for going back to 1961 for a population base is that the criterion taken for residence is the school attended and the 1961 figures reduce the distorting effects of subsequent migration between the regions. However, the numbers in the regions have not changed appreciably during this period, so that it does not matter greatly which year is taken for picking up the total numbers of young people in the regions aged approximately 21 in 1973. (An alternative method of calculating the regional output of firsts is to express the output as a percentage of those attending university. This method yields similar figures.)

2. *Intellectual achievement: (b) Fellowships of the Royal Society.* A second measure of intellectual achievement taken for the regions is Fellowships of the Royal Society. These are well-known distinctions for scientific work in the British Isles and are open equally to citizens of both the United Kingdom and the Republic of Ireland. The population consists of all Fellows of the Royal Society elected during the period 1931–71 who were born after the year 1911. The number of individuals in this population is 321 and it proved possible to ascertain the place of birth of 98 per cent of these. The Fellows were allocated to the region in which they were born and the numbers of Fellows born in each region were then calculated per million of the total population of the region recorded in the census of 1911. These are the data shown in Table 2. The year 1911 was taken as the population base because the majority of the sample was born between the years 1911–20, so that the populations in 1911 represent approximately the numbers in the regions around the time most of the Fellows were born. (The populations of the regions relative to one another do not change greatly over the period, so that it does not make much difference to the results which census year is taken for the population base.)

3. *Per capita income.* Figures for per capita incomes for the regions of the United Kingdom are collected by the United Kingdom Inland Revenue. These have been analysed by McCrone (1965) for the standard regions of the UK for the year 1959/60. These results have been used and a figure for the Republic of Ireland calculated from the United Nations Statistical Yearbook.

4. *Unemployment.* The data are the percentages of the labour force unemployed in the regions for the year 1961 (Statistical Abstracts of the UK and of Ireland).

5. *Infant mortality.* The data are the numbers of deaths during the first year of life expressed per 1000 live births for the year 1961 (Registrar Generals' Reports).

6. *Crime.* The data are offences known to the police for 1961 and expressed per 1000 population (Statistical Abstracts of the UK and of Ireland).

7. *Urbanization.* The data are the percentages of the population living in county boroughs, municipal boroughs and urban districts in 1961 (Census).

These seven social and economic variables together with the figures for the mean population IQs were intercorrelated and the correlation matrix is shown in Table 3. It will be noted that all the variables are correlated in the expected direction with the exception of the crime rates which show a positive correlation with mean population IQ. An explanation for this result is suggested below and in the meantime crime rates are excluded from consideration. Another variable whose causal relation with the rest is unclear is urbanization and this is also set aside for later consideration. The remaining six variables were factored by principal components analysis and the results are shown in Table 4.

It is apparent that a strong first factor is present, accounting for 77 per cent of the variance. It is suggested that the first factor should be interpreted as intelligence. This interpretation rests partly on the high loading of intelligence on the factor and partly on the considerable weight of existing evidence indicating that intelligence is a determinant of these social and economic

Table 3. Product moment correlations between mean population IQ and social and economic variables. Significance levels: 0·55 > 5 per cent, 0·68 > 1 per cent.

1. Population IQ							
2. Fellows of the Royal Society	94						
3. First-class honours degrees	60	57					
4. Per capita income	73	87	54				
5. Unemployment	−82	−87	−39	−78			
6. Infant mortality	−78	−76	−68	−62	77		
7. Crime	51	64	35	82	−68	−39	
8. Urbanization	60	75	29	87	−65	−34	86

Table 4. Principal components analysis

	Factor 1
Population IQ	94
Fellows of the Royal Society	96
First-class honours degrees	70
Per capita income	87
Unemployment	−89
Infant mortality	−87
Eigenvalue (%)	76·99

variables. This interpretation implies that the mean population IQs should be regarded as the cause of the other variables. When causal relationships between the variables are considered, it is obvious that some of the variables are dependent on others. For instance, people do not become intelligent as a consequence of getting a first-class honours degree. Rather, they get firsts because they are intelligent. The most plausible alternative causal variable, apart from IQ, is per capita income, since the remaining four are clearly dependent variables. The arguments against positing per capita income as the primary cause among this set of variables are twofold. First, among individuals it is doubtful whether there is any good evidence that differences in income in affluent nations are a major cause of differences in intelligence. This was the conclusion reached by Burt (1943) in a discussion of this problem. On the other hand, even Jencks (1972) admits that IQ is a determinant of income. Secondly, the very substantial increases in per capita incomes that have taken place in advanced Western nations since 1945 do not seem to have been accompanied by any significant increases in mean population IQ. In Britain the longest time series is that of Burt (1969) on London schoolchildren from 1913 to 1965 which showed that the mean IQ has remained approximately constant. Similarly in the United States the mean IQ of large national samples tested by two subtests from the WISC has remained virtually the same over a 16 year period from the early 1950s to the mid-1960s (Roberts, 1971). These findings make it doubtful whether the relatively small differences in per capita incomes between the regions of the British Isles can be responsible for the mean IQ differences. It seems more probable that the major causal sequence is from the IQ differences to the income differences although it may be that there is also some less important reciprocal effect of incomes on IQ. This is a problem which could do with further analysis.

One point in this set of data which deserves some consideration concerns the magnitude of the regional differences in first-class honours degrees and Fellowships of the Royal Society (FsRS). On both these criteria of intellectual distinction the London–South East region scores

about double the average for the regions as a whole and the two Irish regions about half, and the range between the two extremes is of the order of 400 per cent. It may be questioned whether differences of this magnitude can be reasonably explained in terms of population differences in mean IQ of two or three points or even the 6·1 IQ points which differentiate the two extreme cases of London–South East and the Republic of Ireland. The answer to this point is that apparently trivial differences in the mean IQ of populations entail substantial differences in the proportions at the extremes of the distribution. For example, a difference of three IQ points between two populations in mean IQ entails differences of approximately 100 per cent in the proportions of the populations falling in the IQ ranges over 130 and below 70, e.g. a population with a mean IQ of 103 has about twice as many individuals with IQs of 130+ and about half as many with IQs of less than 70 (compared with a population with a mean IQ of 100). It seems reasonable to suppose that first-class honours graduates and Fellows of the Royal Society are drawn from those with IQs over 130. If this is granted it is evident that the six IQ point disparity between London–South East and the Republic of Ireland would entail a disparity of around 400 per cent in the proportions of the population achieving first-class honours degrees and FsRS. Thus the regional differences in intellectual achievements are broadly of the magnitude that would be expected from the differences in mean population IQ.

Causes of the regional differences in mean population IQ

We turn now to a consideration of the causes of the differences in mean population IQ in the different regions of the British Isles. These causes are not considered from the point of view of the contribution of heredity or environment and this problem is left as an open question. The causes considered here are historical. There are two hypotheses which are suggested as plausible. The first is that the contemporary mean population IQ differences are reflections of historical differences perhaps going back some considerable time and transmitted down the generations. The second hypothesis is that the contemporary mean IQ differences have arisen from the selective migration of more intelligent individuals out of some regions and into others. Since it is the London region that has the highest mean IQ it does not seem improbable that over the course of centuries intelligent individuals have migrated to London and raised the mean IQ there, while at the same time depressing the mean IQ in their own regions.

In order to test these two hypotheses it is necessary to obtain indices of mean population IQs for the regions for historical periods and also of migration. As far as population IQ is concerned it is not possible to obtain direct measures for historical periods. However, it is proposed that this problem can be overcome by taking the proportion of the population attaining some criterion of intellectual distinction as an index of the mean population IQ. It has already been shown that in the contemporary period the proportion of the population obtaining Fellowships of the Royal Society is highly correlated with the mean population IQs ($r = 0.94$) and this supports the contention that one can be taken as an approximate index of the other.

The measures obtained are termed achievement quotients because this is the most accurate description of what they are. The methods used for calculating these achievement quotients are now described. Data for the variables are shown in Table 5.

1. *Achievement quotients, 1901.* Fellowship of the Royal Society was used as the criterion of intellectual achievement. The sample consists of all fellows born between 1891–1910. The total number is 486. Information on place of birth was obtained for 98 per cent of the subjects. Fellows born outside the British Isles were excluded from the analysis. Achievement quotients were calculated by expressing the numbers of fellows born in each region per million of the populations recorded in the census of 1901.

2. *Achievement quotients, 1851.* For the year 1851 Fellowship of the Royal Society is no longer a usable criterion because of inadequacy of information on places of birth. An alternative criterion is entries in the Dictionary of National Biography. This is a collection of biographies of

Table 5. Achievement quotients for four historical periods and migration 1751–1951

	Achievement quotients 1751	Achievement quotients 1801	Achievement quotients 1851	Achievement quotients 1901	Migration 1751–1951
London–South Eastern	16·73	23·18	6·63	15·5	1·21
Eastern	7·16	8·48	1·95	14·2	0·68
East–West Ridings	8·75	7·42	1·45	10·5	1·20
Southern	8·18	8·99	2·39	6·8	0·96
North Midland	4·87	5·33	2·15	8·1	0·91
North Western	6·35	8·36	1·42	8·3	1·37
Northern	10·73	7·57	1·03	6·3	0·93
South Western	7·12	9·93	2·44	14·1	0·50
Wales	8·57	7·50	1·81	11·3	0·91
Midland	6·10	8·31	1·70	8·3	1·04
Scotland	10·36	16·04	3·83	8·4	0·71
Northern Ireland	2·57	2·64	0·83	2·4	0·38
Republic of Ireland	2·57	2·64	0·90	1·4	0·08

all persons of distinction born in the British Isles. The great majority of entries are people who have attained distinction by intellectual efforts and are mainly scientists, writers, artists and musicians, scholars and people in public life such as statesmen and military men. The procedure was to take all entries born in the decade 1851–60 and allocate them to the regions where they were born. There are 757 entries in total, of which 88 were born abroad and were eliminated. There were only three subjects whose place of birth could not be ascertained. This leaves a sample of 666 who were allocated to their regions of birth. Achievement quotients were calculated by expressing the number of subjects from each region per 100000 of the populations recorded in the census of 1851.

3. *Achievement quotients, 1801.* The same method was used as for 1851. The DNB has 1586 entries born in the decade 1801–10, of whom place of birth was ascertained for 1365 representing 86 per cent of the total. Regional populations were taken from the 1801 census for Great Britain and from Connell (1950) for Ireland (the first census in Ireland was not carried out until 1821). DNB entries were expressed as proportions of the 1801 populations for the different regions.

4. *Achievement quotients, 1751.* These were calculated as for 1801 and 1851. The DNB has 931 entries born in the decade 1751–60, of whom place of birth was ascertained for 756 representing 81 per cent of the total. Populations were taken from Mitchell & Deane (1962) and Connell (1950). Regional achievement quotients were calculated by expressing DNB entries as proportions of the 1751 populations.

5. Migration. A measure of migration between the regions was obtained from the growth of population. The data are the average annual percentage increases in population from 1751 to 1951. It is assumed that rates of natural increase have been approximately constant between the regions and hence that differences in population growth are largely reflexions of net emigration or immigration. It is not possible to demonstrate directly that migrations have been selective for intelligence, but evidence considered below suggests that this has been the case.

To summarize, it is assumed that historical regional differences in the achievement quotients for the years 1751, 1801, 1851 and 1901 provide indices of differences in mean population IQs and that population growth over the period 1751–1951 provides an index of migration. It is now possible to examine how far these historical variables have determined contemporary mean population IQs and also urbanization and crime rates which were left over from the analysis in the earlier part of the paper.
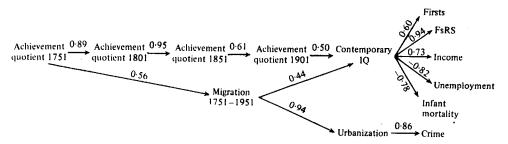
Figure 2. Path analysis showing hypothesized causal sequence.

The relationships between the entire set of variables are best analysed by path analysis, a method of analysis which sets out a series of variables in causal sequence (Duncan, 1966). The proposed path diagram is shown in Fig. 2. The relationship between independent and dependent variables is shown by the path coefficients. Where the variables are arranged in a simple causal chain linking one independent variable to one dependent variable, the path coefficient is the same as the product moment correlation. All the product moment correlations shown in the path diagram are statistically significant (5 per cent: 0·55; 1 per cent: 0·68). Where two independent variables determine one dependent variable the path coefficients are the beta coefficients determined from regression analysis. In the present path diagram there is only one case of this kind, namely the dependence of contemporary mean IQ on the achievement quotients for 1901 and migration 1751–1951. Here the multiple regression of achievement quotients for 1901 and migration 1751–1951 on contemporary IQ is 0·81 and is statistically significant at the 1 per cent level. This indicates that 65 per cent of the variance in contemporary regional mean IQ is determined by these two antecedent variables.

The path diagram shown in Fig. 2 should be largely self explanatory. The important points in the diagram are as follows:

1. The achievement quotients for 1751, 1801, 1851 and 1901 are envisaged as a simple causal chain, that is to say regional achievement quotients at any point in time are significantly and substantially determined by regional achievement quotients 50 years earlier. It is suggested that the chief mechanism in this chain lies in the transmission of phenotypic intelligence from one generation to the next. This transmission may take place through either environmental or genetic factors or some mixture of the two.

2. Contemporary regional mean population IQs are envisaged as being determined partly by the achievement quotients for 1901 (themselves envisaged as an index of IQs in 1901) and partly by the effects of migration over the period 1751–1951. The values of the two path coefficients linking achievement quotients for 1901 to IQ (0·50) and migration to IQ (0·44) are approximately equal, indicating that the two antecedent variables have had about the same effect on contemporary mean population IQs.

The explanation of the apparent effect of migration on contemporary mean population IQs is probably that the migration has been to some degree selective for intelligence. This explanation is supported by several studies indicating that migrants tend to have above average intelligence (e.g. Douglas, 1964; Maxwell, 1969).

3. The path linking achievement quotients for 1751 to migration 1751–1951 suggests that historical differences in mean population IQ and associated per capita income were causal to subsequent migrations, i.e. people have tended to migrate out of the poorer regions and into the more affluent ones. The relationship between migration and mean population IQ would therefore seem to be one of positive feedback, each variable tending to augment the other.

4. Our major concern is with general associations between mean population IQ and social variables among this set of populations. However, the cases of Scotland and Ireland considered

as individual entities may be sufficiently interesting to deserve some comment. Scotland is remarkable in so far as her relative position has deteriorated from second place in the achievement quotients for 1801 and 1851, to sixth place in 1901 and 11th place in contemporary mean IQ. This apparent decline suggests exceptionally severe selective migration of the more able. There is reasonably strong evidence that selective migration has indeed taken place since the 18th century (e.g. Clement & Robertson, 1961). In contemporary times the effect of selective migration from Scotland can be quantified from Maxwell's (1969) follow up study on the 1000 sample tested as part of the 1947 Scottish survey of 11 year olds. In this sample 17·2 per cent emigrated and their mean IQ was 108·1. These figures imply a fall in the mean Scottish IQ of 1·7 points for that generation and around four IQ points over the course of a century. The apparent effect of selective migration in producing a decline in intelligence in Scotland has been discussed more fully in a separate publication (Lynn, 1977).

5. The two Irish regions show considerable regularity in coming in the last two places among the regions from 1751 to the present day. To preserve the simplicity of the model it has been assumed that this has been a consistent expression of lower mean IQ. However, the critic may argue that the low position of the Irish regions in historical times can be more reasonably explained in terms of the discrimination against the population and relative lack of educational opportunities, rather than in terms of lower phenotypic intelligence and per capita income. It is difficult to see how a test could be devised to distinguish between these two hypotheses. Until such a test is made both possibilities should perhaps be left open. Either could have been responsible for the extensive emigration which has taken place from Ireland since 1846 and in which a selective element may have been present.

6. Urbanization in the regions is envisaged as a function of historical migration out of rural areas and into urban areas. Although urbanization is associated with mean population IQ it is not suggested that this is a direct causal relationship. There seems no particular reason why an urban environment should raise intelligence and it seems more parsimonious to explain the association between urbanization and mean population IQ as largely a result of migration in which there has been a selective element.

7. Crime rates are envisaged as solely a function of urbanization. The positive correlation between crime rates and mean population IQ ($r = +0·51$) is surprising in view of the many findings of a negative relation among individuals. The discrepancy may arise because the results for individuals are based on apprehended criminals and these are probably biased samples with overrepresentation of the less intelligent. On the other hand our own data are all crimes known to the police and are a more accurate measure of crime rates. When urbanization is partialled out the correlation between crime rates and mean population IQ drops to zero. Perhaps this is the true relationship between crime and intelligence.

Acknowledgements

References

BURT, C. (1937). *The Backward Child.* London: University Press.

BURT, C. (1943). Ability and income. *British Journal of Educational Psychology*, 13, 83–98.

BURT, C. (1969). Intelligence and heredity: Some common misconceptions. *Irish Journal of Education*, 3, 75–94.

BYRT, E. & GILL, P. (1973). Unpublished MA thesis, University College, Cork.

BYRT, E. & GILL, P. (1975). Article, *Irish Times*, March 20, p. 13.

CLEMENT, A. G. & ROBERTSON, R. H. S. (1961). *Scotland's Scientific Heritage.* Edinburgh: Oliver & Boyd.

CONNELL, K. H. (1950). *The Population of Ireland, 1750–1845.* Oxford: Clarendon Press.

DAVIE, R., BUTLER, N. & GOLDSTEIN, H. (1972). *From Birth to Seven.* London: Longman.

DOUGLAS, J. W. B. (1964). *The Home and the School*. London: MacGibbon & Kee.

DOUGLAS, J. W. B. (1977). Unpublished data.

DUNCAN, O. D. (1966). Path analysis: Sociological examples. *American Journal of Sociology*, **72**, 1–16.

FEE, F. (1964). A survey of the intelligence and attainments of County Antrim children at the beginning of the secondary stage. Unpublished report.

FORBES, J. K. (1945). The distribution of intelligence among elementary school children in Northern Ireland. *British Journal of Educational Psychology*, **15**, 39–45.

FORBES, J. K. (1955). A comparison between the qualifying examination papers in English and Arithmetic and standardised tests. In *Selection of Pupils for Secondary Schools*, Advisory Council for Education in Northern Ireland. Belfast: HMSO.

HART, I. & O'SULLIVAN, B. (1970). Inter-generational social mobility and individual differences among Dubliners. *Economic and Social Review*, **2**, 1–18.

JENCKS, C. (1972). *Inequality*. New York: Basic Books.

LYNN, R. (1977). Selective emigration and the decline of intelligence in Scotland. *Social Biology*, **24**, 173–182.

MACKAY, D. I. (1969). *Geographical Mobility and the Brain Drain*. London: Allen & Unwin.

MACNAMARA, J. (1966). *Bilingualism and Primary Education*. Edinburgh: Edinburgh University Press.

McCRONE, G. (1965). *Scotland's Economic Progress 1951–1960*. London: Allen & Unwin.

MAXWELL, J. (1969). *The Level and Trend of National Intelligence*. London: London University Press.

MITCHELL, B. R. & DEANE, P. (1962). *Abstract of British Historical Statistics*. Cambridge: Cambridge University Press.

ROBERTS, J. (1971). Intellectual development of children as measured by the Wechsler Intelligence Scale. Washington, D.C.: Department of Health, Education and Welfare.

THORNDIKE, E. L. (1939). *Your City*. New York: Harcourt, Brace.

THORNDIKE, E. L. & WOODYARD, E. (1942). Differences within and between communities in the intelligence of the children. *Journal of Educational Psychology*, **33**, 641–656.

VERNON, P. E. (1947). The variations of intelligence with occupation, age and locality. *British Journal of Statistical Psychology*, **1**, 52–63.

VERNON, P. E. (1951). Recent investigations of intelligence and its measurement. *Eugenics Review*, **43**, 125–137.

WILSON, J. A. (1973). Pupil achievement in Northern Ireland primary schools. *Irish Journal of Education*, **8**, 102–116.

WISEMAN, S. (1964). *Education and Environment*. Manchester: Manchester University Press.