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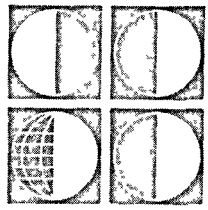

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ABSTRACT: A number of studies are reviewed to show that the mean level of measured intelligence in Scotland is approximately three to four IQ points lower than that in England. These results are a striking contrast with another set of findings showing that in the nineteenth century Scotland had a greater proportional output of people of intellectual distinction than did England. Evidence on Scottish-English differences in education, parental attention, and per capita income suggests that none of these factors can explain the difference in mean IQ. It is suggested that the principal cause of the reduced mean intelligence in Scotland lies in the selective emigration of the more intelligent, and evidence is reviewed to show that this emigration has occurred for at least a century.

Over the last forty years or so, evidence has accumulated to indicate that the mean level of measured intelligence in Scotland is a little lower than that in England. The object of this article is to document this evidence, to contrast these results with evidence indicating that in the nineteenth century intellectual achievement in Scotland was superior to that in England, to discuss how far environmental or genetic factors may be involved in the present relatively low mean IQ in Scotland, and to consider the role that selective migration of the more intelligent may have had in reducing the mean IQ in Scotland.

SCOTTISH-ENGLISH DIFFERENCES IN MEAN IQ

The first study to suggest that the mean measured intelligence in Scotland is lower than that in England appears to be the report of the Scottish Council for Research in Education (1933). This report presented the results of the survey of the intelligence of all Scottish eleven-year-old children that had been carried out in the previous year. The total number of children tested was 87,498. In addition, the investigators gave the test to all the eleven-year-olds in the town of Halifax, England. The Halifax children numbered 1,309 and were matched for age with 8,007 of the Scottish children. The result showed that children in Halifax scored, on the average, five IQ points higher than did the children in Scotland. A difference of this magnitude is, of course, statistically significant.

This difference was discussed by the investigators. They first considered whether it might be due to an urban-rural difference, since all the English children came from a town whereas the Scottish children came from both town and country. However, when Scottish children from towns were compared with the Halifax children the difference remained approximately the same, since there were no significant urban-rural differences among Scottish children. The investigators concluded that the explanation could not lie in any

urban-rural difference. The explanations favored for at least some of the difference were that the Halifax children were more experienced with tests and that they took the test as part of the scholarship examination for entrance to secondary schools, which would have increased their motivation to do well. The Scottish Council report suggested that these factors could reasonably account for three of the five points superiority of the English children. But what could account for the other two points of English superiority? On this question the investigators remained silent.

The next study to find a similar result was reported by McClelland (1945). The main investigation involved the intelligence testing of a sample of children in a Scottish city. At that period Scottish children used to take an examination for admission to secondary schools, and the sample tested consisted of all the children taking the examination in December of 1935 and June of 1936. The total number tested was 3,229, and the test used was one of the Moray House Tests. The test had been previously standardized on English children drawn from one county in England, which afforded an opportunity to compare the scores of the English and Scottish children. The mean IQ's were not given, but the results showed that at each of five percentiles the English children scored higher than the Scottish.

During World War II, large numbers of men conscripted into the armed forces in Great Britain were given intelligence tests, which afforded a further opportunity to compare results from Scotland and England. In 1943, all candidates for the Royal Navy were given Raven's Progressive Matrices Test. Data were collected for 89,764 men, of whom 11,223 came from Scotland. These data were subsequently published by Vernon (1947). Calculation of IQ's from the age-standardized raw scores given by Vernon shows that in relation to an IQ of 100 for Great Britain as a whole, the Scots obtained a mean IQ of 97.3.

A few years later Vernon (1951) published a further study of approximately 9,000 conscripted men, this time from the army, tested in 1947. A number of tests were given from which calculations were made of general intelligence (*g*), verbal-educational intelligence, and mechanical aptitudes. In each case the mean of the Scottish recruits was below that of the English. The means have been calculated for the purposes of the present article and give the English a mean IQ of 100.6 on the general intelligence tests, and the Scots a mean IQ of 96.6. The English also scored higher on both the other tests. All three test differences are statistically significant.

Four years later a further investigation was published by Vernon et al. (1955). This study was undertaken to examine the apparent Scottish-English differences more closely. The investigators took two pairs of comparable small towns in England and Scotland and tested all the eight-year-olds, eleven-year-olds, and fourteen-year-olds. Taking the sexes separately, in five out of the six comparisons the English children had higher IQ's and in three of these the difference was statistically significant. The overall difference between the English and Scottish children was approximately 1.5 IQ points.

In 1946 a survey was begun in Britain of a sample of over 5,000 children born in the first week of March of that year. In subsequent years, a number of reports have been made on the sample, which provides one of the most thoroughly investigated cohorts in Great Britain (Douglas, 1964). Tests of intelligence were given at the ages of eight, eleven, and fifteen, and results comparing English and Scottish children have been reported by Douglas et al. (1966). In every case the English children scored higher. The mean IQ in this study

was standardized on 50. When the results are converted to a mean of 100, the overall means for the three age groups for verbal IQ are 100.4 for the English children and 99.0 for the Scottish children. For nonverbal IQ, the English mean was 100.9; the Scottish, 97.4.

The last major study to afford a comparison of Scottish and English intelligence is that of Davie et al. (1972). This investigation has been concerned with the progress of all babies born in Great Britain during the week March 3–9, 1958. When the children were age seven they were given a test of copying designs similar to that in the Stanford-Binet Test. The results are given for Scotland and for ten regions of England and Wales. These results are not presented in terms of IQ's, but of percentages of the subjects falling into different score bands. Examination of these results shows that the Scottish children obtained a lower mean score than those of any of the ten English regions.

Thus, there are seven studies showing that the mean level of measured intelligence in Scotland is a little below that in England. The differences range between approximately 1.5 and 5.0 IQ points. If a single working figure for the Scottish-English difference is required, probably the best results from the point of view of sampling and reliability are those derived from the Douglas nonverbal tests. These results yield a difference of approximately 3.5 IQ points or a mean Scottish IQ of approximately 96.5 in relation to an English mean IQ of 100.

SCOTTISH INTELLECTUAL ACHIEVEMENT

This series of results indicating that the mean IQ in Scotland is three or four IQ points below that in England presents a paradoxical contrast to another set of studies which shows that in the nineteenth century Scotland produced a higher percentage of people of intellectual achievement than did England. The relatively larger proportion of people achieving intellectual eminence coming from Scotland or, more strictly, the Scottish Lowlands, seems to have been first noted by Galton (1869). He inferred that the mean level of intelligence of the population as a whole in the Scottish Lowlands must be higher than that in England, arguing that a high mean would entail a larger proportion at the high tail of the intelligence distribution from which the intellectually eminent are drawn. However, Galton does not seem to have done very much work on this problem, and the first investigator to quantify Scottish and English outputs of the intellectually eminent was Arthur Conan Doyle (1888), at that time a researcher in psychological demography and only later to find his métier as the creator of Sherlock Holmes. Conan Doyle began by assembling a list of 1,150 of his most distinguished contemporaries. He then grouped them into those coming from England, Scotland, Wales, and Ireland, and finally he calculated their numbers as ratios of the populations recorded in the census of 1881. The results showed that Scotland had the highest ratio followed in descending order by England, Wales, and Ireland. A similar result was obtained by Havelock Ellis (1904).

The problem of the high output of intellectual achievement from Scotland in the nineteenth century was neglected for the next half-century but was taken up again by Clement and Robertson (1961). They took Fellows of the Royal Society as their criterion of intellectual distinction and calculated the number of Scottish Fellows in proportion to the numbers of Scots in Great Britain. This calculation was made at approximately quarter-century intervals. The results showed that in 1875 Scots were overrepresented among Fel-

lows by about 33 per cent, confirming the earlier results of Conan Doyle and Havelock Ellis. From this date onward, however, the proportion of Scots in the Royal Society has gradually declined. In 1900 the proportions of Scots and English were exactly equal; but by 1955 the proportion of Scots had declined to approximately half that of the English.

The last year taken in the Clement and Robertson study is 1955. To bring their work up to a later date and to provide a check on their results, we have made a further study of the Scottish and English Fellows of the Royal Society. The sample consists of all Fellows of the Royal Society elected during the period 1930–71 who were born after 1900 in either Scotland or England (together with Wales). Next, the numbers for Scotland and England have been calculated as proportions of the populations recorded in the census of 1911. The reason for choosing the year 1911 is that the majority of the Fellows were born in the years 1900–20, so that 1911 gives the best index of the populations at the time of the Fellows' births. The results of these calculations show that the output of Fellows of the Royal Society from Scotland in the contemporary period is 6.1 per million while from England it is 11.6 per million. The figures on which these results are based are shown in Table 1. Clearly this result confirms Clement and Robertson's conclusion that the per capita output of Fellows of the Royal Society from Scotland is about half that from England.

TABLE 1

FELLOWS OF THE ROYAL SOCIETY (FRS) BORN IN ENGLAND AND SCOTLAND CALCULATED PER ONE MILLION OF THE TOTAL POPULATION

Location	Number FRS	Population 1911 (000)	Output FRS per Million
England.....	420	36,070	11.6
Scotland.....	29	4,761	6.1

This contemporary Scottish-English difference in the output of people of intellectual distinction is broadly consistent with the difference in mean IQ. If we take the English mean IQ as 100.0 and the Scottish mean IQ as 96.5, as proposed in the first section of this paper, and assume an SD of 15, then the English have 2.28 per cent of their population with IQ's over 130 whereas the Scots only have 1.10 per cent at this level of ability. If an IQ of 130 is taken as the cut-off point of the highly gifted, then the proportion of highly gifted in Scotland is reduced to slightly less than half that in England, or about the proportion found by Clement and Robertson and in our own study. The results here illustrate the substantial effects which quite small differences in mean population IQ can have at the extremes of the distribution.

The paradoxical historical studies indicating a high output of gifted individuals from Scotland in the nineteenth century are therefore resolved by the finding that this is no longer true. The output of gifted persons from Scotland today is only about half that from England and is just about what would be predicted on the basis of the 3.5 IQ point disparity between the two populations. This finding leaves the problem of why the output of gifted individuals from Scotland should have declined so sharply over the course of the last century. The most straightforward explanation seems to be that the mean IQ of the population has fallen during this period. This explanation in turn raises the question of what agency could have brought about such a fall. We shall suggest presently that the fall can be accounted for by selective migration of the more intelligent, but first we consider whether there are any environmental factors which might account for the relatively low mean IQ in Scotland at the present time.

ENVIRONMENTAL FACTORS

We turn now to the problem of the causes of the contemporary difference in mean measured intelligence in Scotland and England and consider first the question of whether there is any environmental factor which could be regarded as responsible. There is one line of explanation frequently invoked to explain group differences in intelligence, but which in this case can probably be summarily dismissed. This is the assertion that a test devised in one culture imposes a handicap on a group from another culture. No doubt this assertion is often justified, but in this case it is doubtful whether Scotland and England are sufficiently different for an explanation of this type to be plausible. In any case, three of the tests were originally devised in Scotland; these are the tests used in the 1932 Scottish Council's inquiry, the Moray House Test used by McClelland, and Raven's Progressive Matrices used in Vernon's 1947 investigation.

A factor that demands more consideration is education. The evidence here seems to suggest that in Scotland the schools place more emphasis on the acquisition of the basic cognitive skills of reading, writing, and arithmetic than is the case in England. For example, in 1940 Vernon wrote of the "appalling efficiency of Scottish teaching methods" which "raises the performance of Scottish elementary school children on tests of the three R's by anything from 10 per cent to 50 per cent over the English level" (Vernon, 1940).

Whatever may be thought of the efficiency of Scottish teaching methods, there is quite an accumulation of evidence to confirm Vernon's view that they are more effective than the more relaxed English methods. Perhaps the first finding to suggest that Scottish children are more effectively taught than English children, as far as the basic cognitive skills are concerned, was the investigation carried out in 1935 and 1936 by McClelland (1945). Reference has already been made to this study in which the investigator tested samples of school children from an English county and a Scottish city. The English children did better in the intelligence test. They also did better on an arithmetic test, although here the margin was reduced; but on the English tests there was virtually no difference between the two groups.

Thus, the Scottish children had a higher level of educational achievement in relation to their mean IQ than did the English children. The study was rather sketchily reported by present-day standards, but it is worth citing as the earliest report it has proved possible to find of a pattern of abilities among Scottish children that has been repeatedly confirmed in later studies. This pattern is one of high scores on tests of educational attainment in relation to intelligence, and especially high scores in tests of English. The most straightforward explanation of this pattern is probably that educational methods are more efficient in Scotland than in England.

The superior efficiency of Scottish teaching was suggested by a study published by Vernon in 1938. The study involved the administration of Burt's Graded Reading Test, standardized on London children, to some 1,500 children in Glasgow. The results showed that Scottish children at age 6–8 were approximately half a year ahead of London children, and by age 10–12 this superiority had increased to over a year (Vernon 1938). Once again it may be noted that tests do not invariably favor the population for which they are first devised and standardized.

A similar result was obtained by Vernon in his later study of the abilities of con-

scripted army recruits. These results showed that the greatest English-Scottish difference was in mechanical aptitude and the least in the verbal-educational tests. This finding suggests that good schooling, or possibly some other environmental influence, has accelerated the Scottish level of verbal-educational achievement over what would be expected from the level of general intelligence and mechanical aptitude.

The same result was found in the investigation of Douglas et al. (1966). In their study of over 5,000 Scottish and English children they found that the nonverbal IQ's were consistently lower in Scotland. On the verbal IQ tests the differences were less, and on tests of educational achievement the Scottish children tended to do better than the English. This pattern was further confirmed in the investigation of Vernon et al. (1955) in their comparison of a pair of matched English and Scottish towns. The investigators gave a number of tests of intelligence and educational attainment and found that on the intelligence tests the English children did better than the Scottish, but on the tests of educational attainment the Scottish children did better.

The last major survey of Scottish and English children, that of Davie et al. (1972), confirms again the pattern of abilities among Scottish children. The mean nonverbal ability of Scottish seven-year-olds was found to be lower than that of English children; but the mean reading ability of the Scottish children was higher than that in England. Thus, the investigations show consistently that the verbal and scholastic attainments of Scottish children tend to be more advanced than those of English children, especially when the academic achievement is considered in relation to intelligence. Scottish children have a pattern of test results that is characteristic of children from favorable environments: high verbal ability and educational attainment in relation to nonverbal intelligence.

Is there any direct evidence that Scottish educational methods are more favorable than English methods for the development of the basic cognitive skills? The answer to this question appears to be that there is. One of the factors is probably the greater emphasis put on formal learning by Scottish teachers, as shown in the study by Pringle et al. (1966) of their sample of British children born in 1958. These investigators found that about 30 per cent of English children had begun systematic learning of phonetics by the age of five and a half, whereas in Scotland 54 per cent of children had done so. Similarly, in arithmetic, 60 per cent of English children had started formal written arithmetic before the age of six, whereas 75 per cent had done so in Scotland. Thus, there is a tendency for Scottish children to be given what amounts to a "head start" program in reading and arithmetic.

There is also a stronger tradition of education in Scotland than in England. In the 1930's Thomson (1936) calculated that, proportionate to the population, more than twice as many children entered secondary education in Scotland as in England and twice as many Scots as English went to a university. Some thirty years later Lipset (1964) calculated that in the mid-1950's 5.1 per cent of the 20–24 age group in Scotland attended a university, as against 3.7 per cent in England. In the mid-1960's it was noted that educational expenditure amounted to £33 per capita in Scotland as against £29 in England (MacArthur, 1967).

Taken as a whole, the evidence makes it doubtful whether the lower mean intelligence of Scottish children could be attributed to an inferiority of the educational system in Scotland. On the contrary, the high scholastic achievements of Scottish

children in relation to their intelligence, the earlier grounding that Scottish children receive in the basic cognitive skills of reading and arithmetic, the greater expenditure on education in Scotland, and the larger output of graduates suggest that it is the English who are relatively underprivileged in educational provision.

A second major environmental factor that affects the development of intelligence is the quality of the home. Perhaps the two most important factors here are generally considered to be the amount of attention which parents give their children and the degree to which they encourage their children scholastically. Is it possible that Scottish parents provide a less stimulating environment for their children than English parents? This question has been investigated by Davie et al. (1972) in their study of all the children born in Great Britain in the first week of March, 1958. Parental attitudes toward the upbringing of children was one of the subjects studied in this investigation, and the Scottish-English differences were as follows. First, the proportion of fathers and mothers either very interested in or indifferent toward their children was "very similar" in England and Scotland. Second, a higher proportion of Scottish parents wished their children to stay at school beyond the minimum school-leaving age. Third, Scottish parents devoted more time to their children, for example, in taking them out for walks, picnics, shopping, and so forth. Fourth, a smaller proportion of Scottish mothers had worked either before the child started school or afterward. And fifth, more Scottish than English parents read to their children (Davie and Pringle, 1968; Pringle, 1969; Davie et al., 1972). These results suggest that Scottish parents tend to provide a more stimulating environment for their children and are more concerned about their education than are English parents.

A third major environmental factor generally regarded as affecting intelligence is socioeconomic status. In this respect Scotland is at a disadvantage compared with England. Thus, McCrone (1965) estimates the per capita gross national product in Scotland as approximately 10 per cent lower than that in England, and other indices of per capita income and socioeconomic status show differences of the same order of magnitude. However, it is doubtful whether this amount of economic disadvantage could account for the relatively low Scottish mean IQ. In Britain, since the end of World War II, national income has been rising at about 3.5 per cent a year, so that per capita income in Scotland lags about three years behind that in England. The mean IQ disparity between Scotland and England is 3.5 IQ points, so that if the economic difference determined the IQ disparity we should have to conclude that the mean IQ in Britain is rising by about 3.5 IQ points every three years. It is doubtful whether anyone would think it probable that this is the case.

The only study of secular trends in mean IQ in Britain during the postwar years of fast economic growth is that of Burt (1969), who found an increase of only 0.12 IQ points in samples of London children over the period 1945–65. A similar result has been obtained in the United States by Roberts (1971) who found no increase in American children's means obtained on selected Wechsler subtests over a sixteen-year period. Thus, both the Burt and the Roberts results indicate that in affluent societies like Britain and the United States the increases in per capita incomes which have taken place in the period since 1945 have had negligible effects on mean population IQ's. This finding makes it doubtful whether the relatively low per capita income in Scotland can account for the lower mean IQ. The more likely explanation is that the

lower mean IQ reduces the industrial and commercial efficiency of the Scots and is responsible for the relatively low per capita income in Scotland.

Our suggested conclusion is that there is no known environmental factor capable of explaining the relatively low mean IQ in Scotland. This conclusion is strengthened by the pattern of abilities of Scottish children, consisting of a high level of educational attainment in relation to intelligence and a higher verbal than nonverbal IQ, which is in general characteristic of children from favorable environments. If this conclusion is accepted it would seem that we should consider the possibility that genetic factors may be involved in the mean IQ difference between the Scots and the English.

SELECTIVE MIGRATION FROM SCOTLAND

The suspicion that genetic factors may be implicated in the level of Scottish intelligence would gain credence if it could be shown that some influence has been operating which could have brought about a decline in the mean intelligence level in Scotland. Such an influence could be the long-standing tendency of the more intelligent Scots to emigrate while the less intelligent have remained in Scotland.

The first study to indicate that emigration from Scotland has been selective is apparently that of Clement and Robertson (1961). They investigated the lives of well-known Scottish inventors from the middle of the seventeenth century up to World War I. Since the beginning of the eighteenth century, approximately 50 per cent of these inventors died outside Scotland. The authors argue that this is evidence of selective emigration. It seems impossible to dispute that eminent Scottish inventors must have had an IQ substantially above the average, and a 50 per cent emigration rate is a high figure, suggesting a selective emigration of the more intelligent Scots over a period of two centuries.

A study carried out by MacKay (1969) has reached a similar conclusion. MacKay investigated the migration of graduates from the University of Aberdeen since the year 1860. The university has kept biographical records of its graduates' careers since this date, and MacKay has analyzed these records to determine the extent of emigration from 1860 to 1955. His results show that the emigration of male graduates has been running at approximately 50 per cent over the course of the hundred-year period, about the same figure as that estimated by Clement and Robertson.

To sustain the hypothesis that selective migration has been largely responsible for the relatively low mean Scottish IQ, it is necessary to show that the high rate of emigration of intelligent Scots has not been balanced by an equally high general rate of emigration from Scotland. Historical analysis of migration flows in the British Isles from census data between 1871 and 1960 indicates that the average annual migration from Scotland has been approximately 0.45 per cent. This figure is nowhere near as great as the 50 per cent estimates for the emigration of highly intelligent Scots.

Among studies of contemporary emigration from Scotland, the best as far as selective intelligence is concerned is that of Maxwell (1969). His investigation was a follow-up inquiry of the 1947 national survey of eleven-year-olds. He took the sample of every child born in Scotland on the first day of the even months of 1936. This was the group given the Stanford Binet test in 1947. In the follow-up Maxwell reported the group's whereabouts in the late 1960's. He found that 17.2 per cent of the group had emigrated from Scotland and that the mean IQ of this group

was 108.1 (Maxwell, 1969, p. 73). This fact suggests that emigrants from Scotland are both numerous and substantially above average in intelligence.

Taking the evidence as a whole, it seems reasonable to conclude that there has been some selective migration from Scotland of the more intelligent Scots for a considerable period. The evidence for selective migration is consistent with the evidence for a reduced mean intelligence level in Scotland. Indeed, it would have been remarkable, considering the evidence for selective migration, if the mean IQ in Scotland were now the same as that in England. As it is, the two lines of evidence indicating selective migration and a lowered mean intelligence level among the residual Scottish population accord well with one another.

The final question to be asked is whether the selective migration from Scotland has been sufficient to account for the difference in the mean IQ of approximately 3.5 IQ points which separates the Scottish and English mean IQ's today. If Maxwell's data from the 1936 cohort is taken as representative of selective migration from Scotland over the last century, the effect can be quantified as follows. With 17.2 per cent emigrating and having a mean IQ of 108.1, the mean IQ of the residual population after the first generation of emigrants has left will be 98.3. The children of this residual population will show some regression toward the mean. If we take the narrow heritability of intelligence at 0.64, as estimated by Loehlin et al. (1975), the regression will be approximately 0.6 IQ points, which will give the children of the residual Scottish population a mean IQ of 98.3 + 0.6, or 98.9. Thus, selective migration of the magnitude reported by Maxwell entails a fall in the mean IQ of the residual Scottish population of approximately 1.1 IQ points each generation. Continued over a century, selective emigration of this magnitude would be sufficient to produce a fall in the mean Scottish IQ to around 96.5.

CONCLUSION

The proposal that the relatively low mean IQ in Scotland in contemporary times is largely due to selective migration over the course of three or four generations rests on two independent lines of evidence. The first and strongest is the direct evidence that selective migration has occurred and that it has been of sufficient magnitude to account for the present disparity of approximately 3.5 IQ points between Scotland and England. The second line of evidence comes from studies of intellectual achievement indicating that in the mid nineteenth century the output of gifted individuals from Scotland—and by inference the mean population IQ—was at least as high as in England. Although perhaps not strong in itself, this evidence does corroborate the selective migration findings insofar as it indicates that the reduced mean IQ in Scotland is of fairly recent origin. The most important gap in the thesis is the absence of direct evidence that in the middle of the nineteenth century the mean IQ in Scotland was the same as that in England. In spite of this lack, it is suggested that the case is sufficiently strong to make the phenomenon of the Scottish IQ an interesting one, particularly because it is probably the best instance hitherto identified of selective migration over several generations leading to a significant fall in mean population IQ.

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