Advances in the Human Cartography of the UK

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INTRODUCTION

This paper concentrates on the mapping of census data and on the UK in particular but hopefully has wider implications for the mapping of human geography more generally both using other sources and in other countries. The first detailed census atlas of the UK census, excluding Northern Ireland, was drawn by David Rhind and his colleagues using data from 1971 and the then revolutionary technology of laser plotting. That atlas illustrated over 30 variables in remarkable geographical detail for the time, using the innovative technology to individually colour every kilometre square of the country according to the social characteristics of the local population. In practice the areas the plotter drew were slightly larger than a kilometre square as they were pushing the technology of those times to its limits. Thirty years later, conventional maps of the human geography of the UK are very similar in appearance.

New technology has greatly facilitated the creation of census atlases and has been the key driver in increasing numbers being produced following each successive census after 1971. Following the 1981 census of population many separate atlases were drawn of the different countries of the UK, and smaller parts of the UK, but none of the UK as a whole and many using what was then called a line plotter to colour areas through ‘hatching’. A later publication explored the use of mapping with unconventional areas, but changing the areas being mapped had little impact on the patterns seen. By 1991 technology had advanced but line plotters were still utilized to produce the first census atlas published shortly after the release of that census’s data, the direct precursor of the maps shown below: People and Places 1991.

Later the Ordnance Survey, then under the direction of David Rhind, produced an atlas based largely on the 1991 census. Their atlas used continuous colour to shade areas from 1971 and the then revolutionary technology of laser plotting. That atlas illustrated over 30 variables in remarkable geographical detail for the time, using the innovative technology to individually colour every kilometre square of the country according to the social characteristics of the local population. In practice the areas the plotter drew were slightly larger than a kilometre square as they were pushing the technology of those times to its limits. Thirty years later, conventional maps of the human geography of the UK are very similar in appearance.

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Later the Ordnance Survey, then under the direction of David Rhind, produced an atlas based largely on the 1991 census. Their atlas used continuous colour to shade areas and was the first of a census in the UK to both be printed in full colour and include Northern Ireland in places, although often as a single spatial unit. Two more detailed atlases were drawn of the same census and of changes since 1981; each included some equal population cartograms, but neither included Northern Ireland and only two-colour separation was used. One used local authority wards as opposed to districts as its underlying spatial unit, but despite the differences in scale the resulting patterns were very similar. It is only recently that production costs have decreased sufficiently to allow a full-colour atlas to be drawn of the whole of the UK without the financial sponsorship of a national mapping or census agency. The maps shown here are examples from that new atlas.

MAPPING THE 2001 UK CENSUS

Mapping data such as census variables on a conventional map of United Kingdom local authorities means that urban areas with large populations but small areas are virtually invisible to the viewer. Conversely, the large rural areas with small populations dominate the map. When mapping data about people, it is therefore sensible to use a different spatial metaphor, one that reflects population size. Therefore we use cartograms where the area of each local authority is proportional to its population. A population cartogram attempts to maintain topology while showing where people are found. Administrative areas with larger populations cover a larger area on the cartogram than those with smaller populations. The result is a visualization where the urban areas where the most people are found are revealed while areas with lower populations no longer predominate.

For the maps shown here initially a hexagonal cartogram of UK parliamentary constituencies was created. The rationale behind starting with constituencies is that each constituency has roughly the same number of electors. Although the ratio of electorate to total population in each constituency will differ according to the age structure, those not entitled to register to vote and those who fail to register, choosing constituencies gives us the administrative areas that are most similar in terms of population size. Hexagons were chosen because an area tends to have just under six other areas adjacent to it and therefore maintaining topology is less complicated. However, topological discrepancies remain; this could have been solved by using a variety of different shapes but would have made the overall task much more complex and reduced the visual simplicity that hexagons provide.

The next step was to create local authority boundaries. Constituencies do not necessarily fit within local authorities: a local authority may be comprised of several constituencies while some individual constituencies may contain two local authorities and a constituency may fall into two local

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authorities; therefore a best fit had to be applied. To maintain the clear visualization, constituencies were only split into at most two parts and then only vertically. At the same time the topology of local authorities had to be maintained. Further geographies such as health authorities, government statistical regions, travel-to-work areas and the old counties were also determined. This procedure was a time-consuming manual process. To illustrate why it is worthwhile here we show some of the resulting cartograms drawn from the 2001 Census of population, together with the change since 1991.

FIGURE 1
Figure 1 shows some of the major cities of the UK on both a conventional map and cartogram.

FIGURES 2 AND 3
Figure 2 shows the population and change since 1991 of each local authority on a conventional map while Figure 3 is of the same data on a cartogram. On the conventional map it is impossible to discern any detail in London and other large urban areas such as Manchester and Birmingham while the more sparsely populated rural areas are visually preponderant. In comparison the cartogram clearly shows the class of each area and even a single half hexagon, such as that representing the Isles of Scilly on the tip of the south west peninsula is easily discernible. The change cartogram clearly shows population growth in the south of the UK and decreases in much of the north. In the subsequent figures only the cartograms are presented.

FIGURE 4
Figure 4 shows population density. Local authorities that are small in area tend to have larger populations and therefore higher population density. London has the highest density and the Highland Council Area in Scotland the lowest. As the local authority boundaries have not changed over the time period under consideration, change in density since 1991 is due to population change. As was shown in Figure 3 the population of the UK has moved southwards; as a result population density in the south has increased, particularly in London and the South East. Conversely, those local authorities in the north that have seen declines in the number of people living there have also seen a decrease in density.

FIGURE 5
Figure 5 shows population potential. Population potential is a measure of how concentrated is the population near to each area. To calculate it, for each area sum the population of each other area of the UK, having divided those populations by the distance in metres to the area of interest.
Figure 2. Population shown on a conventional map

Figure 3. Population shown on cartogram
Figure 4. Population density

Figure 5. Population potential
The populations of geographically close areas have a greater effect on any particular area than do the numbers of people in more distant areas. Population potential is highest in London and the South East and lowest in the peripheral areas of Scotland, Northern Ireland the South West. The change map shows clearly the gradient of the increase in potential which declines away from Central London.

**FIGURE 6–8**

Figure 6 through Figure 8 show the results of models based on census and other variables rather than mapping individual census variables. The models used for 2001 are in an early stage of development and therefore these are preliminary mappings.

Figure 6 shows a preliminary mapping of the proportion of households living in poverty in the United Kingdom in 2001 and the change since 1991. The poverty measure used is the Breadline Britain measure (see endnotes) that defines a household as poor if the majority of people in Britain, at the time of calculation, would conclude that the resources available to that household constituted living in poverty. Therefore, if living standards rise unequally across society, poverty increases as poorer households are unable to access the resources that are seen as necessities. The areas with the highest rates of poverty are found in East London and Glasgow; the proportion of households living in poverty has increased everywhere apart from Northern Ireland.

Figure 7 shows a preliminary mapping of the proportion of households receiving high income and the change since 1991. The measure is based on an estimate of those households which have a total net income of over £60,000 a year. Such households predominate in London and the South East, where the jobs that provide such high incomes are found. The greatest increases are similarly found in London, implying that more high earners are living in the capital rather than commuting from the surrounding area. The rest of the country has generally seen a minuscule increase in the proportion of high income households, with Northern Ireland having a decrease in such households.

Figure 8 shows a preliminary mapping of the proportion of wealthy households and the change since 1991. Wealth is a measure of assets that a household possesses; for most households this is in the form of housing equity. The highest proportion of wealthy households is found in a ring around London; this is also where the greatest increase has been. These cartograms are a small sample what can be mapped from the UK censuses. They clearly show detail that is indiscernible on a conventional map.

**CONCLUSION**

The first census in the UK to be made available in digital form was taken in 1971. Although advances in computing were necessary for this to have occurred, they were not in themselves sufficient for this innovative step. Instead it was...
Figure 7. Percentage of households with high income

Figure 8. Percentage of wealthy households
the actions of a relatively radical government in the period 1964–70 which paved the way both in the appointment of key civil servants and in the changing of social attitudes to allow for information about the population to be made available to at least a few people in a form which could be mapped by computer. ‘People in Britain: A Census Atlas’ reflected those times and aspirations as much as the technology and advances in cartography of the day.

The 1980s and 1990s were much less radical times for the UK government, the civil service, census taking and the resulting human cartography. Funding for academic research was severely curtailed. Statistical sections of the civil service were decimated. As computer technology improved more atlases were produced but they were often produced despite the prevailing conditions of their times rather than because of them. A cartographer interested in the new computer technology of the late 1970s would probably have had a far more optimistic view of what the next two decades were to bring than what in fact emerged. In UK universities very few appointments were made in the 1980s while student numbers soared and resources were cut. This was a period in which academics doggedly carried on, but often looked back to the recent past as a golden era when they had more time and the resources for such work.

The late 1990s and the first few years of this century brought no new nirvana. The one great advance that there has been is that the census results from 2001 are now available to anyone who wishes to study them and even the smallest of computers can now handle them. However, almost all mapping software is now designed by large private corporations. The vast bulk of maps being produced of the 2001 census in the UK are less innovative than those plotted of the census taken over 30 years ago. UK universities, the places from which innovations in human cartography of the UK were traditionally most likely to emerge are very different entities now. There are two million students to be taught every year in Higher Education in the UK. Despite this huge number of students UK universities have become reliant on research contract overheads to fund their operations. Between the increased need for teaching and demand for ‘cost recovery’ there is less and less space for innovation. If an innovative new atlas is produced it is now produced without funding in the spare time academics have between conducting the teaching and funded research which they are being paid to do.

All these developments are not necessarily to be lamented, but the ivory tower cocoons which have incubated advances in the cartography of human geography in the UK are less and less easy places within which to experiment with new ideas, methods, technologies and maps. Advances in the human cartography of the UK in future may come more often from outside the universities and perhaps from outside the UK. Indeed it would be refreshing to see the UK mapped from other perspectives. Just as a cartographer in the 1970s may have been overly optimistic concerning the future, we may be a little pessimistic as far as advances in cartography in universities are concerned. More positively, new methods of mapping human geography will be developed, but it is becoming increasingly likely that this will happen outside of the UK, outside of academia, and outside of the traditional discipline of cartography.

ENDNOTES