

An Investigation into the Factors Affecting Fear of Crime in a Geographical Area

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Abstract

The following project details how computer visualisations have been used to aid in the understanding of the Fear of Crime in the UK in respect to a range of Social, Political and Economic factors.

We will look at a number of different factors or variables that potentially may affect the way one views the Level of Crime in a given area. The investigation will be carried out using region-centred information from across the whole of the UK.

The aim is to use visualisations to show trends in the Fear in Crime levels in line with varying levels of these factors. It is thought that by using the novel visualisation techniques described below will develop new ways of viewing complex, multi-variant data, enabling the identification of new relationships between previously disparate information.

We will base our visualisation on Chernoff Faces overlaid on maps, and investigate the use of Cartograms to provide more effective visualisation. We will map the most significant variables such as population density and actual crime levels to the face size and shape, and use the mouth curvature to represent the "fear of crime" (this should provide intuitive visualisation). We will experiment with mapping other variables such as income and unemployment to features such as eye size, nose length and pupil size, in order to produce the most effective presentation(s) of the statistics.

1. Introduction

Certain areas are often viewed as being crime black-spots - the proverbial "wrong side of the tracks". You only have to ask a local from any city which are the 'nicer' areas of the city to gauge the perception of crime in that area. It remains an open question as to how accurately such anecdotal observations reflect the actual levels of crime in those areas - when you delve deeper, the perception of high or low crime levels may be influenced by factors other than actual criminal activity - there can be a wide number of reasons why certain areas are tarnished with reputations for being poor, crime-ridden or violent. If the correlation between these views and the actual crime levels is low, an undeserved reputation can be detrimental to the area and people involved, and may ultimately

become self-fulfilling. The idea behind this research is to investigate trends between fear of crime and a number of potentially interlinking factors. By using novel data visualisation techniques, it will be possible to display the effects of certain combinations of factors on the perception of crime. With this data it is hoped that new cross-discipline associations between a wide number of social and political factors will be identified, with which new city planning measures may be drawn.

2. Data Extraction

The first stage of this project established a set of factors from which an increased Fear of Crime may

result. The research took in a wide range of statistics, including the obvious, actual Crime levels, and then taking in Political factors, such as investment, policing and migration, as well as Social variables, such as population densities, social classes and jobs. With this information, and using the novel modelling techniques that we describe here, it is thought that previously hidden trends between these seemingly unlinked concepts may begin to appear. A wide number of sources were used during the course of this study, including Government bodies, National Statistics and Census data. As a result unfortunately not all of the data could be gathered from the same year. However, our results will show the recent trends between each variable's change and the Fear of Crime.

2.1. Crime Data

The data on Crime was obtained from the Home Office statistics for 2004/2005 [HO05]. This data takes in details from Police recorded crime and the British Crime Survey (BCS). From this data it was possible to obtain data on the number of offences. It is assumed that the actual Crime levels will have an impact on the perceived levels of Crime.

2.2. Political Factors

The next step looked at finding other factors that might affect people's fear of crime. It could be hypothesised that if an area is perceived to have a high level of crime then it is likely to be because of a lack of effort on the side of the local governing bodies. For it is the governing bodies that build housing estates, provide funding for area development, organise Police distribution etc. – and these are the factors that have a major influence on the way an area is viewed. Therefore data was sought that might justify Fear of Crime from the actions of the politician or governor. The factors identified are listed below along side the questions they present for data modelling:

- Police Numbers per Region [Pol05] – Do higher Police Numbers decrease the Fear of Crime?
- Unemployment (Claimant) Statistics [Nom05] – Do higher unemployment levels relate to Crime levels, and thus impact on the Fear of Crime?
- Numbers of Jobs [Nom05] – With a link to the Unemployment statistics above, do increased job levels decrease the Fear of Crime by providing more people with more financial stability?

2.3. Social Factors

The next set of data looked at the Social factors involved in the Fear of Crime. A wide as possible gauge of factors here, looking firstly at the nature of the population within the area, spiralling out to how business activity is fostered within the area. The variables extracted were:

- Population [Nom05] – Do higher populated regions suggest a higher Fear of Crime?
- Social Class Percentages [Wic05] – Do higher social classes lead to an decreased Fear of Crime?
- Ethnic Groupings [Wic05] – Does ethnic diversity lead to an increased Fear of Crime?

Data from all of these categories was prepared for each region of England. Other properties were considered for inclusion in the visualisations, including Council Tax valuations [Off05], Immigration Levels [Wic05] and Council Funding into general maintenance. However it was felt these would not provide effective information when viewed regionally.

However, with this a net of wide-ranging concepts, all of which may or may not have an association with Fear of Crime, was established. With which our novel modelling techniques were applied.

3. Previous Work in this Area

This field of research is clearly one which has had a fair degree of interest in the recent years. Many researchers from fields as wide as geography, sociology and computer science have already the visualised data about crime and the fear of crime. Numerous visualisation techniques have been used to assist in the analysis of these subjects, including hierarchical lists, hyperbolic trees, time line tools, periodic pattern tools, GIS tools and self organizing maps [CAP*05][FEI*05][Chi06].

4. Our Novel Approach

Our approach to these issues is different from the researchers mentioned above. We will employ the use of Chernoff faces mapped onto Cartograms in order to provide a multi-variant view of this complex issue. We believe that in order to visualize the links between factors about the area and the fear of crime, you need visualisations capable of mapping the many variables that have an effect on crime statistics. As is explained below, Chernoff Faces allow a wide number of features to be mapped at one time. Cartograms allow use to expand this idea further, by displaying how these factors change over each region of England, and thus improving the possibility of noticing interesting trends in the data. Our model will allow the interchanging of factors represented on the face, thus allowing the user to personalise the way they view the data.

5. Methods

5.1. Chernoff Faces

Chernoff Faces are a technique for visualising multi-variant data by mapping the variables onto facial features of a cartoon face. The technique was developed by Herman Chernoff and has proved very

popular, because our brains have sophisticated systems for recognizing faces and interpreting expressions. Few other techniques can present as many variables as concisely as a Chernoff Face.

People have developed numerous variations of the facial visualisation, supporting different facial features and hence allowing more or less variables to be mapped. A popular website featuring software for Chernoff Face generation uses the values listed in the image below:

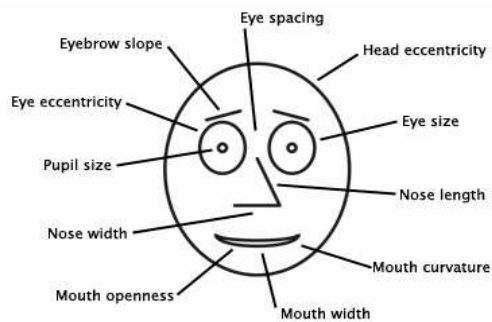


Figure 1: Example Chernoff Face features [MW05]

Due to their popularity, several free Java applets exist that can generate Chernoff Faces from the user's own data. We plan to base our Chernoff Faces on the Java applets developed by Steve Champeon [Cha05] and John Wiseman [Wis05], since they provide the source code which we can adapt for our requirements.

5.2. Cartograms

Map makers have for many years searched for a way to construct cartograms, maps in which the sizes of geographic regions such as countries or provinces appear in proportion to their population or some other analogous property. Such maps are invaluable for the representation of census results, election returns, disease incidence, crime statistic and many other kinds of human data.

Unfortunately, to scale regions and still have them fit together, one is normally forced to distort the regions' shapes, potentially resulting in maps that are difficult to read. Many methods for making cartograms have been proposed, some of them are extremely complex, but all suffer either from this lack of readability or from other pathologies, like overlapping regions or strong dependence on the choice of coordinate axes.

We plan to present a technique based on ideas borrowed from elementary physics that suffers none of these drawbacks. Our method will be conceptually simple and produces useful, elegant, and easily readable maps.

We plan to illustrate the method with applications to the results of the factors that affect the crime

perception from the research in the map of England and the geographical distribution of these factors [GN05].

An example Cartogram, this one demonstrating the mean IQ scores, by UK county, for people taking part in the BBC Quiz 'Test the Nation', is shown below:

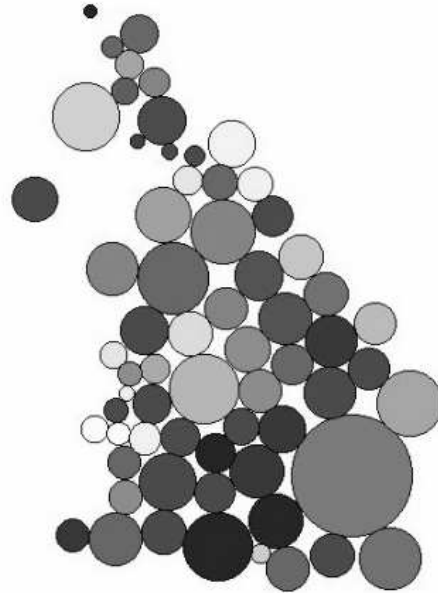


Figure 2: Example of a UK County Cartogram [Cit05]

5.3. The Application of Chernoff Faces and Cartograms to Crime Statistics

Our project employs Chernoff Faces and Cartograms to provide novel and interesting visualisations of data relating to crime and the fear of crime in England.

As explained above, this data will be obtained from a range of sources, and extracted using the import tools we have developed. The Cartogram was constructed using the Regional Boundaries of England; this data was extracted from the UK Border Information Database [Edi05].

The collated data was then mapped to the features of the Chernoff Faces, producing a face for each region that succinctly represents the data. These faces were then laid on to the map of regions, producing our Cartogram.

The properties selected for each facial feature are shown in Figure 3. The choices made as to best convey their effect on a person's Fear of Crime.

The application was constructed using Java's Graphics packages. Values were assigned to each feature by determining the scaled relationship between value for

the Region and the maximum value in that category. For example, say London offers the greatest

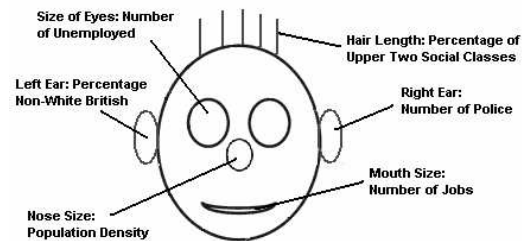


Figure 3: Assignment of Properties to Facial Features

population density, it would be assigned the maximum nose size of 30, following this if the South East presented a density of half of London's, its nose size value would be scaled to around 15.

In order to make the characteristics easier to distinguish, the features of the face were coloured according to the distinctions between them.

6. Evaluation

The final application offers an interesting perspective on the range of data affecting Fear of Crime. The concepts upon which this visualisation is based offer a great deal of potential, and while our application demonstrates the effectiveness of such graphics there is room for improvement.

It was unfortunate that it was not possible to create the cartogram with Chernoff Faces for each county. While this would enable a more detailed UK-wide examination of fear of crime, we felt it would result in a too cluttered visualisation. However, certainly one expansion in this respect would be to allow the user selection of a region to better explore these statistics at county-level.

Another improvement to the current application would be the inclusion of more properties. Clearly the extension in this respect would offer a broader perspective on Fear of Crime. Other potential improvements include the user selection of properties to best suit the query specifications. Moving away from the current setup, possible improvements must include the remove of perimeter preservatons, certainly, as the nature of Chernoff Faces might suggest, with some view towards moving to Dorling-type Cartograms (as seen in Figure 2).

7. Conclusion

This project has demonstrated the use of novel data modelling techniques in determining new trends in how Fear of Crime rises throughout English regions. Using a wide range of Social and Political datasets, trends between the data that affect the levels of

perceived Crime will be clearly apparent across all regions using the Chernoff Cartogram methods mentioned above. We feel that given the way that Chernoff faces enable people to absorb and understand a wide range of data, that these are an excellent method for displaying the multi-variant nature of the factors affecting Fear of Crime.

8. References

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