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Measuring social segregation between London's secondary schools, 2003 – 2008/9

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Measuring social segregation between London's secondary schools, 2003 – 2008/9

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Abstract
Segregation is a spatial outcome of spatial processes that therefore needs to be measured spatially. This is the axiom from which local indices of segregation are developed and applied to the local markets within which schools compete. The indices are used to measure patterns of social segregation between London's state-funded secondary schools, education authorities, types of selecting and non-selecting schools, and, longitudinally, for cohorts of pupils entering the schools in each of the years from 2003 to 2008. The paper finds sizeable differences between apparently competing schools in the proportions of free school meal eligible pupils they recruit, with selective schools especially and also faith schools under-recruiting such pupils. Whilst there is some evidence that differences between schools have decreased over the period, the trend is considered to be an artefact of using free school meals as a measure of disadvantage, a measure that the paper ultimately questions.

Keywords segregation, index, secondary schools, selective schools, faith schools, London

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Introduction

> Reliable and meaningful measurement of residential segregation is essential to the study of the causes, patterns, and consequences of racial and socioeconomic segregation. Nonetheless, prior work on residential segregation has been limited by a reliance on methodological tools that do not fully capture the spatial distributions of race and poverty (Reardon & O'Sullivan 2004, p.122)

It has been observed that segregation is a spatial outcome of spatial processes. Nevertheless, many indices of segregation are not spatial in that they construct averages over somewhat arbitrary residential or functional regions such as census tracts, electoral wards or local education authorities. The locations of the objects between which segregation is said to be occurring – for instance, schools or neighbourhoods – is of relevance only insofar as it places those objects within regions. Their relationships to each other at a sub-regional scale, their distances apart for example, are of no consequence.

A focus on non-spatial indices of segregation has dominated the literature measuring the effects of school choice policies on patterns of school admissions in England and Wales. Although the merits and demerits of various indices have been thoroughly discussed (see, *inter alia*, Allen & Vignoles 2007; Goldstein & Noden 2004; Goldstein & Noden 2003; Gorard 2000; Gorard 2004; Gorard 2007; Gorard 2011; Gorard 2009; Johnston & Jones 2010; Johnston & Jones 2011), the debate has not addressed the importance of measuring segregation spatially. This despite Gibson's & Asthana's (2000, p.139) prescient observation that "in trying to establish whether or not the marketization of education has had a polarizing effect, the unit of analysis must […] be the local market within which schools (and parents faced with placement decisions) actually operate."

To that end, this paper develops a series of local and spatial indices of segregation to capture the competitive effects between schools. It begins with a summary of the types of segregation index commonly found in the literature on schools research before going-on to introduce some spatial counterparts. Those local indices are then applied to a case study of London secondary schools looking first at pupils who entered the schools in the academic year 2008-9 and then at other cohorts from the year 2003 onwards. The indices are used to measure patterns of segregation between local education authorities

(LEAs) within London, between different types of schools, and to examine whether levels of segregation have, on average, changed over the study period.

The results of the study suggest apparently competing secondary schools receive differing proportions of FSM eligible pupils with especially selective schools but also some faith schools recruiting fewer of this group than other locally competing schools. Whilst there is some evidence that social segregation has decreased over the period this is likely to be an artefact of using free school meals as a measure of disadvantage.

Measuring segregation

The word segregation often is associated with the consequences of social rules, processes and institutions that impact differentially upon various economic, cultural or ethnic groups of people and which lead to geographical outcomes – the isolation or clustering of some groups within some places more than others. It is sometimes further associated with acts of avoidance; of, for example, one group of people choosing to school their children separately from others. In both these uses, segregation is a pejorative term to describe a spatial patterning that is socially divisive and which social policy should seek to remedy.

Though indices of segregation often have arisen from concern especially of racial divisions within the United States, some authors have sought to use the more neutral language of separation and to make the distinction between separations that are involuntary and those that are chosen, perhaps to better enable a person to express or develop their cultural identity, to provide comfort, familiarity and safety or as a response to the daily experience of frustration and disappointment with a system that has failed them (Harris 2011; Merry 2011). In any case, spatial patterns of separation can arise as minority groups within society exercise the same liberty of choice that the majority feel entitled to, albeit that there may be strong social pressures that frame those choices.

Segregation indices are used to measure how various social or ethnic groups of people are distributed across a study region and whether there is evidence they are separated or not. In themselves, the indices are not restricted to any singular view of the processes that led to the separations or to whether those separations should necessarily be prevented. Their application tends to be cross-sectional not longitudinal, a descriptive measure at any point of time rather than a process model of, for example, diffusion or concentration across the study region. Though not an exhaustive typology, the majority of indices fall into one of two types. The first measures and summarises the differences between each individual observation and some average or expected value for the study region. The second summarises the product of the observed and expected values.

Equation 1 is a general expression of the first type of index:

$$\text{Index value} = k\sum_{n}\left|p_{\text{obs}} - p_{\text{exp}}\right| \quad [1]$$

For example, when measuring social segregation between schools, where eligibility to receive a free school meal (FSM) is used to indicate a lower income household, p_{obs} is the proportion of the FSM eligible pupils that are within the school, p_{exp} is the contrast group, the summation is across all *n* schools within the local education authority (LEA) or some other zone, and *k* is a scaling constant, usually equal to 0.5. The definition of p_{EXP} can be, *inter alia*, the proportion of all pupils within the LEA that are FSM eligible, the proportion of pupils within the school that are not FSM eligible or the proportion of all pupils in the LEA that attend the school. These formulations produce a measure of within LEA variation, respectively an index of dissimilarity (Duncan & Duncan 1955; Duncan & Lieberson 1959) and the index used by Gorard (e.g. Gorard et al. 2003) (for a useful summary, see Johnston & Jones 2010).

The second type of index is similar, having the form:

$$\text{Index value} = k\sum_{n} p_{\text{obs}}\,p_{\text{exp}} \quad [2]$$

The index of isolation (Bell 1954; Shevky 1949) is one such measure, which, if used to measure social segregation between schools, would have as the observed value the proportion of all FSM eligible pupils within the LEA that are in each school and, for the expected value, the number of FSM pupils as a proportion of all pupils in the school. It can be interpreted as the joint probability of selecting a FSM eligible pupil at random from any one of the schools in the LEA, then selecting another FSM eligible pupil at random from all pupils who attend that school. Hence, whereas the first type of index is comparative, the second is probabilistic.

Critically, the statistical properties of the index are affected by the definition of the observed and expected values, and whether they are differenced or multiplied (Allen & Vignoles 2007). There has been considerable debate about which indices best capture various theories and aspects of segregation but with no consensus. This is inevitable: segregation is a multi-faceted phenomena meaning different things to different people and arising as a result of any number of social process and/or individual choices. It seems unlikely that any measure of segregation could ever be definitive.

What is more certain is that segregation is a result of spatial processes that have spatial manifestations. Yet neither of the two types of index is spatial in the sense of producing a statistic that functionally is dependent on the location of the observations vis-à-vis the location of other observations within the study region. Any two schools could be proximate or entirely independent of each other within an LEA but that dis-/connection is irrelevant to the measure of social segregation.

Local indicators of segregation

Local index of dissimilarity

A local and spatial index of segregation is one where (a) each zone or place in the study region is considered with respect to all others with which it interacts, is proximate to, shares a border and/or with which there is an interdependency or connection; and (b) where a separate index value is calculated for every zone or place within the study region (as opposed to having one summary average for them all).

The defining characteristic of the index is the use of a weights matrix to define the connections between places within the study region. It is the weights matrix that permits the characteristics of one place to be compared with the (weighted) average for the places with which it is connected. Consider, for example, a local index of difference or of dissimilarity (LID) that compares some characteristic of a particular location with the characteristics of locations around it. Here, measuring social segregation between schools, the index will summarise the difference between the proportion of FSM eligible pupils in one school vis-à-vis the proportions in competing schools (defined below). That is,

$$\mathrm{LID}_i = p_i - \sum_{j=1}^{n-1} w_{ij} p_j \qquad -1 \le \mathrm{LID}_i \le 1, j \ne i, 0 \le w_{ij} \le 1, \sum w_{ij} = 1 \qquad [3]$$

where p_i is the proportion of FSM eligible pupils within one school, and $\sum_{j=1}^{n-1} w_{ij} p_j$ is the weighted average proportion for the competing schools. The index will range from -1 (no pupils within school *i* are FSM eligible, whereas all pupils in surrounding schools are), through 0 (the proportion of FSM eligible pupils in *i* is the same as the average for surrounding schools) to 1 (all pupils in *i* are FSM eligible; none in surrounding schools is).

The weights matrix quantifies the strength of connection between the various places and entails a network view of geographical space, informed by the literature on local indicators of spatial association (LISAs) and on spatial econometrics (Anselin 1995; LeSage & Pace 2008). It can be determined in various ways, including by the inverse of the distance between schools which gives greatest weight to schools that are least far apart. Here, following Harris (2011), w_{ij} defines the level of spatial competition between secondary schools, where competing secondary schools are defined as those recruiting pupils from one or more of the same primary schools as each other. Specifically, the weight is equal to the proportion of secondary school *i*'s intake that is drawn from the primary schools shared with school *j*, multiplied by the proportion of secondary school j's intake that is drawn from the same. The weights are then scaled (row-standardised) so that the sum of the weights for any school is equal to one.

This is some conceptual overlap with the measures of spatial segregation introduced by Reardon & O'Sullivan (2004) (with parallels in Johnston et al. 2011). Using their notation and terminology, the index measures spatial evenness where,

$$\mathrm{LID}_i = \pi_{pm} - \tilde{\pi}_{pm}, \quad [4]$$

π_{pm} is the proportion in group m at point *p*, $\tilde{\pi}_{pm}$ is the proportion in group *m* in the local environment of point *p* (but here excluding *p* itself), and where the weights matrix is equivalent to the spatial function $\phi(p,q)$ defining the spatial proximity of locations *p* and *q* (but without the constraint $\phi(p,q) = \phi(q,p)$, i.e. that $w_{ij} = w_{ji}$).

However, Reardon's and O'Sullivan's purpose is somewhat different in that they are seeking to address the situation of forming segregation indices from individual data that must first be aggregated into some sort of spatially meaningful areal 'containers' in order that differences in the prevalence of group *m* across the region can be summarised. Here the point locations – the schools – already permit prevalence to be measured (they already represent aggregations of pupils and their characteristics at that location) and the aim is to assess how the differences between one place and those to which it is connected vary across the study region. Preserving the distribution of the LID values across the study region is as important as calculating a summary measure.

Local indices of isolation and of concentration

A local index of isolation may be formed as the probability of selecting a person with a particular characteristic at one location and then selecting a second person *without* that characteristic from surrounding locations. It is a measure of spatial exposure under Reardon's and O'Sullivan's nomenclature and is calculated as:

$$\text{LII}_i = p_i \sum_{j=1}^{n-1} w_{ij}\left(1 - p_j\right) \qquad 0 \le \text{LII}_i \le 1, j \ne i, 0 \le w_{ij} \le 1, \sum w_{ij} = 1 \qquad [5]$$

Applied to schools, this index will range from zero when there are no FSM eligible pupils in school *i*, to one when all the pupils in school *i* are FSM eligible but none of the pupils in the surrounding schools is. The index measures the prevalence of FSM eligible pupils in one school with respect to its competitors; of how concentrated FSM eligible pupils are within the one school.

The index is not, however, composition invariant. As the proportion eligible for free school meals increases so, too, does the index.

An example is given in Table 1. It imagines a simplified case where there are two schools in each of six observed LEAs and in each case school *j* is competing with school *i*. Working across the rows of the table, the LII scores for observations 1 to 3 act intuitively: as the proportion of FSM eligible pupils in school *i* decreases relative to those in school *j*, the index value decrease too.

Imagine, however, that observations 4 to 6 represent a part of the study region subject to some exogenous shock, for example the closure of a local manufacturing plant. Alternatively, consider that observations 4 to 6 represent the same LEAs as 1 to 3 but at a different time period and during an economic recession. In either case, the context doubles the proportion of FSM eligible pupils within each LEA and within each school. The result is a rise in the index of isolation even when the proportion of FSM pupils remains equal for the two schools (compare observation 5 with observation 2).

As Table 1 also shows, the local index of difference (LID) has some compositional invariance but only at the point of equality, when the one school has the same proportion of FSM eligible pupils as its competitor. In this case, the index will always be zero. A third index does, however, display full compositional invariance (in Table 1). This is the index of concentration (LIC), which allows for the differences between competing schools, the LID values, to be considered in respect to the local rate of FSM eligibility within those schools. Specifically, the local index of concentration is calculated as:

$$\mathrm{LID}_i = \frac{p_i - \sum_{j=1}^{n-1} w_{ij} p_j}{p_i + \sum_{j=1}^{n-1} w_{ij} p_j} \qquad -1 \le \mathrm{LIC}_i \le 1,\ j \ne i,\ 0 \le w_{ij} \le 1 \qquad [6]$$

For the rest of this paper, all three indices (LID, LII and LIC) will be used in tandem and on the basis that none is inherently superior to the others. In practice, they are strongly correlated, as Table 2 shows.

	(1) p_{FSM} = 0.20			(2) p_{FSM} = 0.20			(3) p_{FSM} = 0.20		
	FSM_i	FSM_j	$!FSM_j$	FSM_i	FSM_j	$!FSM_j$	FSM_i	FSM_j	$!FSM_j$
n	30	10	90	20	20	80	5	35	65
N	100	100		100	100		100	100	
p	0.30	0.10	0.90	0.20	0.20	0.80	0.05	0.35	0.65
LII_i	0.27 = 0.30 × 0.90			0.16			0.03		
LID_i	0.20 = 0.30 - 0.10			0.00			-0.30		
LIC_i	0.50 = 0.20 / (0.30 + 0.10)			0.00			-0.75		
	(4) p_{FSM} = 0.40			(5) p_{FSM} = 0.40			(6) p_{FSM} = 0.40		
	FSM_i	FSM_j	$!FSM_j$	FSM_i	FSM_j	$!FSM_j$	FSM_i	FSM_j	$!FSM_j$
n	60	20	80	40	40	60	10	70	30
N	100	100		100	100		100	100	
p	0.60	0.20	0.80	0.40	0.40	0.60	0.10	0.70	0.30
LII	0.48			0.24			0.03		
LID	0.40			0.00			-0.60		
LIC	0.50			0.00			-0.75		

Table 1. Showing the calculation and value of the three local indices of segregation for a simplified case of two schools in each LEA (see text for detail).

	LID	LII	LIC
LID	1.000	0.766	0.812
LII	0.766	1.000	0.764
LIC	0.812	0.764	1.000

Table 2. Pearson correlations, *r*, between the three local indices of segregation, calculated for pupils entering each of 366 secondary schools in London in 2008

A case study of London secondary schools

The Geography of social segregation between schools

Figure 1 maps the local index of dissimilarity (LID) scores based on pupils entering each of 366 state-funded secondary schools in London in 2008 (hence the school year 2008-9), where the information about those schools has been obtained from the pupils known to attend them, as recorded in the PLASC/NPD data (http://www.bris.ac.uk/cmpo/plug/). It is a cartogram (Dorling 1996): the radius of each circle is proportional to the absolute score: the larger the difference in the proportions of FSM-eligible pupils of one school compared to its competitors, the larger the symbol.

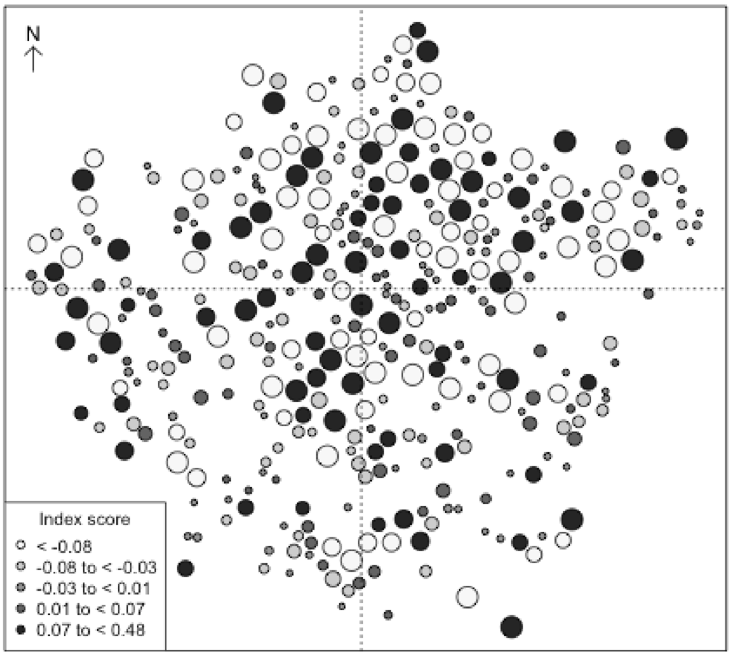

Figure 1. Showing the local index of dissimilarity (LID) scores for London secondary schools in 2008. The size of the circles is proportional to the absolute value. Note that it is not possible to read the values for specific schools from their location on the map (see text for detail).

To preserve the anonymity of schools the position of the symbols on the maps do not correspond directly to the true locations of schools. Some symbols have been moved slightly to prevent overlapping and a random selection of index values has been swapped with other nearby schools. Consequently, though the map preserves the broad geography of the schools and the spatial distribution of the index values, it is not possible to obtain the index scores for specific schools from their apparent location on the map.

Across the region the index ranges from -0.295 (where the school recruits 29.5 percentage points less FSM eligible pupils that its average competitor) to 0.478 (it recruits 47.8 percentage points more). The interquartile range is -0.069 to 0.054. The mean is, of course, approximately zero because the study region is a closed system where all pupils attend a school somewhere. Hence, those schools with low proportion of FSM eligible pupils balance those with high proportions. Because of this, a more usefil average is the mean of the absolute value, |LID|. This is 0.078. it shows that the average difference between a school and its average competitor is 7.8 percentage points in regard to the percentage of FSM eligible pupils they recruit. This is not inconsiderable given the percentage of pupils eligible for FSM that year was 26.8 per cent.

Looking at Figure 1, there is evidence of a checkerboard effect, where some schools have a disproportionately high number of FSM-eligible pupils whereas surrounding schools have a disproportionately low number. The patterns are summarised by Table 3. This gives the mean of |LID| for each LEA. The table also includes the range and interquartile range of the LID values per LEA. Additionally, the LEA average proportion of FSM eligible pupils per school is included in the table, together with the standard deviation around that mean. Finally, LEAs where less than five schools are present in the data are excluded. Specifically, these are Harrow, and Kensington and Chelsea.

Looking at the mean |LID| values, the LEA mean difference between a school and its average competitor ranges from 3.3 to 14.6 percentage points. However, that average conceals instances of much greater difference within LEAs. For example, one school in Barking and Dagenham has a percentage of FSM eligible pupils that is 47.8 points higher than its average competitor. This suggests that there are at least instances when the LEA is not a sensible scale to measure segregation – it is too coarse and conceals so-called ‘postcode poverty’.

LEA	n	|LID| mean	LID min.	LID Q1	LID Q3	LID max.	FSM mean	FSM sd
Barking & Dagenham	8	0.146	-0.230	-0.156	0.002	0.478	0.321	0.199
Hammersmith & Fulham	7	0.125	-0.240	-0.093	0.103	0.196	0.360	0.256
Lambeth	11	0.123	-0.189	-0.098	0.053	0.385	0.357	0.194
Hillingdon	16	0.110	-0.207	-0.108	0.073	0.287	0.216	0.146
Barnet*	19	0.104	-0.161	-0.117	0.039	0.240	0.213	0.158
Redbridge*	17	0.097	-0.175	-0.095	0.078	0.271	0.202	0.122
Brent	13	0.096	-0.191	-0.079	0.019	0.219	0.292	0.139
Camden	9	0.095	-0.118	-0.067	0.028	0.251	0.443	0.143
Haringey	10	0.095	-0.171	-0.115	0.089	0.132	0.385	0.155
Waltham Forest	15	0.092	-0.152	-0.084	0.076	0.218	0.332	0.127
Hackney	6	0.087	-0.152	-0.078	0.084	0.112	0.452	0.122
Newham	15	0.081	-0.147	-0.084	0.031	0.332	0.432	0.127
Enfield*	17	0.077	-0.179	-0.085	0.007	0.245	0.269	0.155
Greenwich	11	0.077	-0.145	-0.034	0.065	0.251	0.357	0.154
Wandsworth	10	0.075	-0.161	-0.054	0.067	0.148	0.310	0.120
Ealing	12	0.069	-0.139	-0.021	0.087	0.139	0.289	0.088
Croydon	18	0.068	-0.120	-0.065	0.067	0.134	0.225	0.131
Richmond upon Thames	8	0.068	-0.090	-0.069	0.066	0.114	0.185	0.083
Bromley	17	0.067	-0.295	-0.023	0.039	0.233	0.129	0.100
Havering	18	0.065	-0.186	-0.080	0.023	0.184	0.129	0.100
Tower Hamlets	15	0.063	-0.132	-0.023	0.069	0.140	0.544	0.103
Westminster	6	0.062	-0.114	-0.028	0.030	0.158	0.368	0.128
Southwark	7	0.062	-0.139	-0.022	0.059	0.082	0.263	0.059
Lewisham	10	0.060	-0.143	-0.045	0.038	0.114	0.309	0.103
Sutton*	14	0.053	-0.126	-0.074	0.002	0.054	0.088	0.082
Bexley*	13	0.052	-0.120	-0.065	0.013	0.098	0.082	0.070
Hounslow	14	0.050	-0.095	-0.039	0.053	0.086	0.236	0.086
Kingston upon Thames*	10	0.050	-0.126	-0.034	0.018	0.085	0.111	0.068
Islington	8	0.038	-0.053	-0.016	0.051	0.086	0.485	0.057
Merton	6	0.033	-0.041	-0.028	0.020	0.079	0.172	0.068

*LEAs with academically selective schools

Table 3. The mean, median, upper quartile and maximum |LID| values per LEA (London 2008).

The lack of social homogeneity across some LEAs more than others also is revealed by the standard deviation of the FSM variable that is greatest for Hammersmith and Fulham (0.256) and least for Islington (0.057). This, in turn, reveals why these two LEAs can have a very similar proportion of FSM eligible pupils on average and yet strongly differing mean |LID| values. The greater social heterogeneity in Hammersmith and Fulham is reflected in greater differences between schools as measured by the segregation index. Indeed, the Pearson correlation between the mean |LID| score and the standard deviation of the FSM variable per LEA is $r = 0.878$ ($p < 0.001$).

The mean |LID| score also is related to the mean proportion of FSM pupils per LEA but that relationship is curvilinear – Figure 2. This is because the proportions are bounded by zero and one. Put simply, there is greater room for variation between schools at the centre of the distribution of FSM values than at the limits. Nevertheless, the first five LEAs in Table 3 still display the greatest differences between schools even allowing for the rate of FSM eligibility. These are the LEAs that are furthest above the regression function in Figure 2.

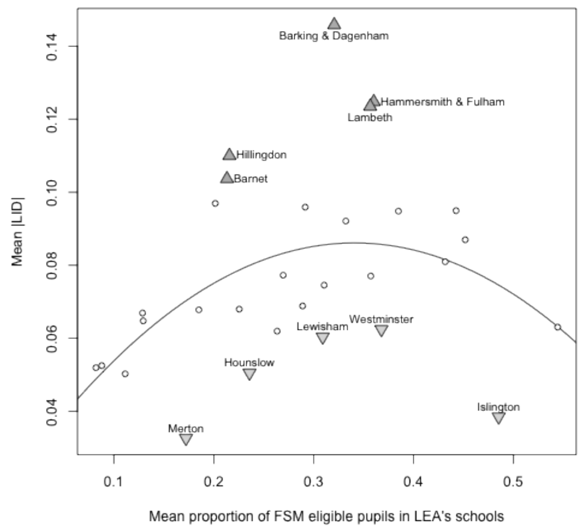

Figure 2. Showing the relationship between the mean |LID| score per LEA and the mean proportion of FSM eligible pupils in its schools. The five LEAs shown with upward pointing triangles are the LEAs with greatest social segregation in Table 3.

Social segregation by school type

An enduring arena of debate is whether schools that select by academic attainment or by requiring practising faith amongst their admissions criteria act to propagate social exclusion, albeit unintentionally (Allen 2007; Sutton Trust 2008).

Figure 3 groups the proportion of FSM eligible pupils per school and also the index scores by school type, showing their centre and range as boxplots. Selective schools, defined as academically selecting (they set an entry examination) admit a much lower proportion of FSM eligible pupils than other types of school: the median is less than p = 0.028, approximately one tenth of the median for all other schools, p = 0.269, and the variation around the average is little. To some extent this is to be expected as FSM eligible pupils do not, on average, reach the same level of attainment as other pupils and so are less likely to take or to pass the entry examination for selective schools. Evidence of this is that the median attainment score for the standardised tests taken by all pupils in state-funded primary schools in their final year at the school was, for FSM-eligible pupils in London in 2008, 27 with an interquartile range from 25 to 29, lower than the median for ineligible pupils which was 29 with an IQR from 27 to 31.

Faith schools, too, tend to have lower proportions of FSM eligible pupils, on average. Unlike selective schools, this cannot be a consequence of an entry examination because the category excludes the few faith schools that are also academically selective (those schools are within the selective group). It also cannot be due to location – the possibility the schools are located in areas of low eligibility – because they under-recruit FSM eligible pupils when compared to their local competitors. Instead, it is more a consequence of who is able or willing to demonstrate some sort of commitment to or practice of the faith. It is notable that voluntary aided (VA) Church of England (CoE) and Roman Catholic (RC) schools – ones that set their own admissions criteria and can include commitment to the religious group or denomination amongst them – under-recruit FSM eligible pupils, on average and relative to their competitors, whereas voluntary controlled (VC) schools, which use the LEA admissions criteria, actually slightly over-recruit on average. Of course, we should be wary of generalisations and observe the variation around these averages. It is one of the mistakes in the debates about faith schools to treat them as a homogenous group when there are, for example, historical and intentional differences between schools whose first purpose is to serve a community of faith (and may recruit adherents form across large catchment areas) and those that have a history of serving their local community as a response to faith (schools that offered education to ‘the poor’ prior to the establishment of a national education system in the late nineteenth and early twentieth centuries).

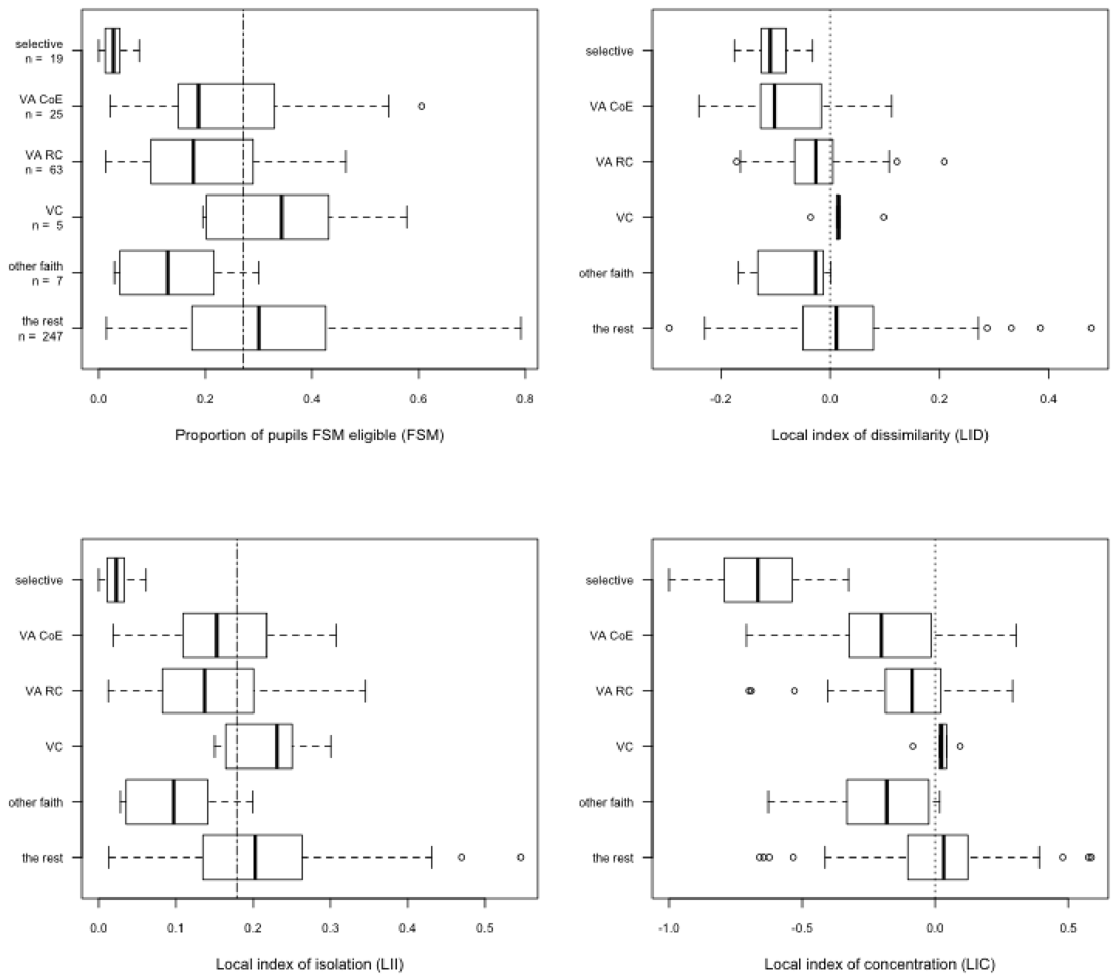

Figure 3. Boxplots showing the distribution by school type of proportions of pupils that are FSM eligible, the LID scores, the LII scores and the LIC scores.

Longitudinal analysis

The key question informing social debate about policies of greater school choice is ‘do the policies lead to increased segregation?’ How they might is described by Weekes-Bernard (2007, p.1) who outlines the problems of choice as follows:

> [F]irst, it assumes the ability (and willingness) of all parents to make these choices on an equally informed basis; and, second, it assumes that the field in which they make these choices is an open one. Research on working-class parents has demonstrated that school ‘choice’ is more accurately allied to economic privilege, to the ability to work the system and to entrenched forms of middle-class social and

> cultural capital, while working-class and economically marginalized families are forced to make do with what's left.

However, an early and important longitudinal study suggested the opposite conclusion (Gorard et al. 2003). Focusing on secondary schools and using a measure of unevenness, its broad conclusion was segregation fell nationally and in most LEAs between 1989–95, with the overall percentage of pupils eligible for free school meals that would have to change school to create evenness dropping from about 35 to 30. It rose thereafter to 33 per cent in 2001 but not back to the level found in 1989. In other words, it appeared unlikely education policies were having the adverse impacts predicted.

Unfortunately, interpretation of the empirical evidence is complicated by the measure of social disadvantage used, eligibility for free school meals (FSM). Eligibility is dependent upon personal circumstances that in some years will apply to more people than in others. It is not a consistent measure of pupils from the poorest fifth or so of households. One explanation that can be given for the fall of segregation that Gorard et al. find especially from 1991 is macroeconomics: the UK recession of the late 1980s and early 1990s, creating 'equality of poverty' – the idea that as the proportion of FSM eligible pupils rises the group becomes more evenly spread across schools. Allowing a lag period of one to two years, as the economy has improved so social segregation between schools has increased, falling again after 2007 as economic output fell sharply. This trend appears in Cheng and Gorard (2010) though they are more circumspect about linking the changes in the segregation index to economic cycles.

As it happens, the period of this study, 2003 to 2008/9, is one of economic growth, though the proportion of pupils in the PLASC/NPD data that are recorded as FSM eligible rises nevertheless, peaking in 2007 – Figure 4.

Figure 5 reveals the trends in the local indices of segregation over the study period. It shows the mean |LID| (local index of dissimilarity), mean LII (local index of isolation), and the mean |LIC| (local index of concentration) scores as calculated for London secondary schools for each of the years. It is also includes the mean proportion of FSM eligible pupils in the schools each year.

The is no evidence that the |LID| values have either increased or decreased over the time period, especially not once the 95 percent confident intervals around the means are considered. These can be calculated because we have an |LID| value for each school for each year permitting the variance of the values and thus the standard error of the mean to be estimated.

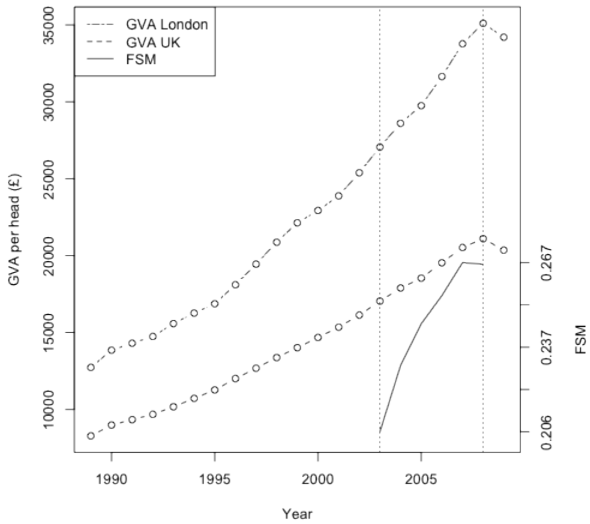

Figure 4. Showing Gross Value Added per person in the UK and in the Greater London region at 2009 prices, and the proportion of secondary school pupils that are FSM-eligible (sources: Office for National Statistics and PLASC/NPD)

On face value, the LII tells a different story, with the mean LII score rising each year, with a significant increase between 2003 and 2008. However, recall that the isolation index is not composition invariant. In fact, the correlation of the mean LII value and mean FSM eligibility is r = 0.999.

Instead, looking at the |LIC| values, there is evidence that social segregation has decreased: between 2003 and 2008 the average difference in the proportion of FSM eligible pupils in one school vis-à-vis its competitors and relative to the (average) proportion of FSM eligible pupils in those schools has declined (a result that Leckie et al. (2010) also find using a multilevel modelling approach).

Over the time period, it appears that the FSM eligible pupils have become less concentrated locally within particular schools. Further evidence to support the finding is found from a Lorenz curve, Figure 6. It shows that in 2003, 10 per cent of all FSM eligible pupils within the data set were found within just 2.4 per cent of all schools; 20 per cent of all such pupils were in 6 per cent of all schools; and 40 per cent were in 16.8 per cent of schools. By 2008 the corresponding figures were 10 per cent of FSM eligible pupils in 3.3 per cent of schools (an increase of 37.5 per cent relative to 2003); 20 per cent of the pupils in 7.7 per cent of schools (an increase of 28 per cent); and 40 per cent in 18.6 per cent of schools (11 per cent). In short, FSM eligible pupils have become more spread out across London schools.

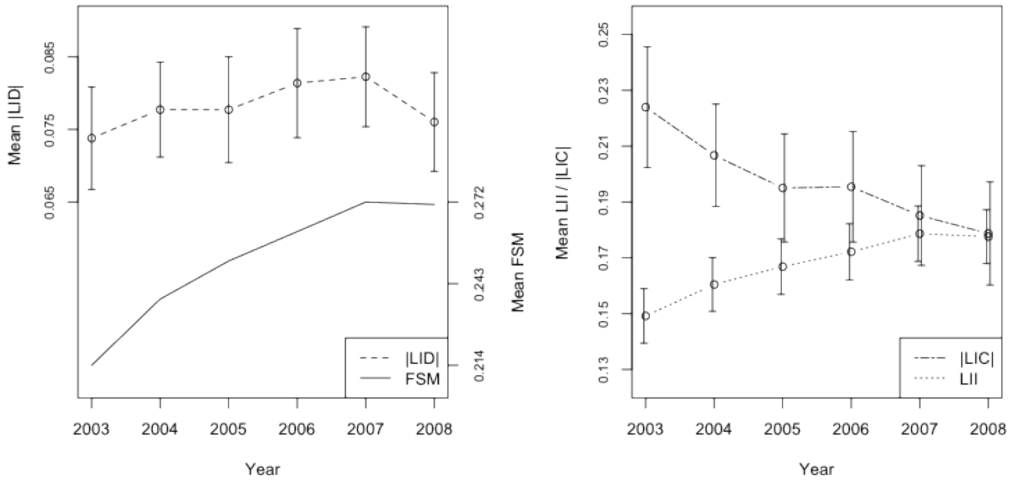

Figure 5. Mean index values for pupils entering state-funded secondary schools in London in each of the years 2002-2008.

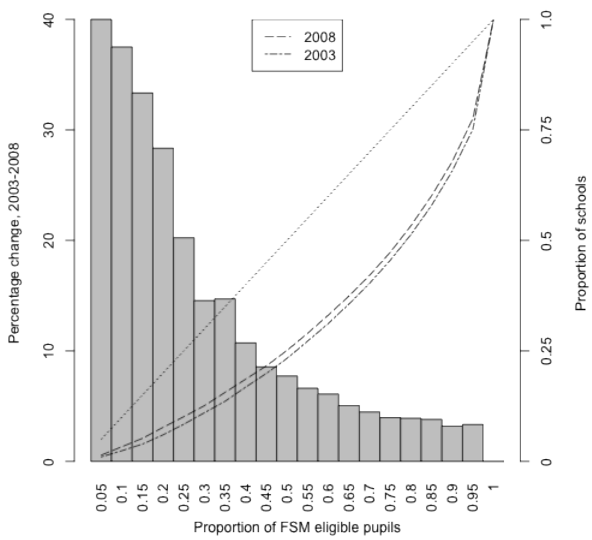

Figure 6. Lorenz curve showing how concentrated FSM eligible pupils are within secondary schools in London and how that concentration has changed (decreased) from 2003 to 2008. See text for detail.

There is, however, an important caveat. Between 2003-2008 the mean proportion of FSM eligible pupils in the London schools rises by 26.6 percent (from 0.214 to 0.271). The mean |LIC| score decreases by 19.6 percent (from 0.228 to 0.184). In other words, eligibility for FSM is rising faster than the index of segregation is decreasing. The suspicion must be that it is not so much that social segregation has decreased but that the group of pupils who met the criteria for FSM eligibility broadened (those criteria are listed at http://tinyurl.com/6jr65r4).

To re-iterate: though it is widely used for school research, eligibility for FSM is not a consistent measure of 'the poor' or socially excluded. In fact, a better indicator, though it ultimately pertains to the area in which a pupil lives as opposed to the pupils themselves, is the Income Deprivation Affecting Children Index (IDACI). This is a fixed estimate of the proportion of children under the age of 16 within the (Lower Super Output) census area the pupil resides in that live in low-income households. From it is possible to calculate the proportion of pupils in each school that is admitted from the upper quartile of low income areas and then calculate the mean |LIC| scores to consider whether differential rates of admission from those areas of highest income deprivation are increasing or decreasing in time.

The general trend is one of increase. The |LIC| scores based on IDACI as a measure of segregation are 0.218, 0.231, 0.245, 0.242, 0.227 and 0.245 for pupils admitted into London state-funded secondary schools in each of the years 2003 – 2008, respectively. However, the confidence intervals (not shown) are too great to attribute statistical significance to these changes.

Conclusion

This paper has followed other researchers and used eligibility for free school meals (FSM) as the basis for measuring segregation between London's state-funded secondary schools. However, it deviates from other studies in developing and applying explicitly local indices of segregation, informed by the assertion that segregation is a spatial outcome of spatial processes and needs therefore to be measured spatially.

The substantive conclusion of the case study is that apparently competing secondary schools do not recruit equal proportions of FSM eligible pupils. The findings lend support to those of Smithers & Robinson (2010) who find that comprehensive schools in England are highly socially segregated. Across London, in 2008, the mean difference between a school and its average competitor was 0.078 (7.8 percentage points) against an overall proportion of 0.268 of pupils eligible for FSM. The patterns of segregation vary geographically and by school type, with schools that select either by faith or by academic ability tending to under recruit FSM eligible pupils relative to their competitors. Whilst there is no evidence that the social segregation has increased over the period 2002 to 2008, the evidence it may have decreased is rendered uncertain by the underlying inconsistency of what FSM eligibility measures at any time period. Indeed, a reasonable conclusion to be drawn from this paper is that FSM eligibility is not suitable for this sort of schools research at all (cf. Croxford 2008) and that a better measure, based on a fixed quantity (such as the IDACI score) is to be preferred.

It is possible, of course, that greater numbers of pupils not eligible for FSM have migrated to schools outside London during the study period, or chosen fee-charging schools instead of the state sector. The data do not allow for analysis of these possibilities nor their effects on the analytical results. Furthermore, the analyses do not resolve the debate about whether the introduction of choice and competition within the education system is socially divisive. The problem is there is no counterfactual: the reforms have been introduced and any speculation about what would have otherwise happened is precisely that – speculation. As the author has noted elsewhere it is difficult to make a social justice argument in favour of insisting pupils must attend their local school even if it is underperforming. That just encourages 'selection by mortgage'. Yet, if choice is to be promoted it should be a real choice with pupils having a reasonable guarantee of attending their preferred school. At the current time, though the overwhelming majority of pupils do attend their first choice school, that choice is constrained by the operation of admissions criteria. Of note is the use of geographical criteria that tend to give priority to those living closest to a school. The reason these exist is because schools are also encouraged to have community roles and functions. There is an awkward tension between this sort of localism agenda and not creating geographical barriers around who is admitted into any school; barriers that will propagate existing social divisions between school (Harris 2011b; Sutherland et al. 2010; see also Andre-Bechely, 2007).

In conclusion, Table 4 (below) summarises the attributes of the indices consider here. Each is defined by two characteristics. First, each incorporates a weights matrix quantifying the amount of interaction, dependency or connection between each zone or place in the study region. Second, each permits a separate – that is, localised – value to be calculated individually for each of those zones of places. None of the indices is definitive; each has its advantages and disadvantages, capturing different facets of what is understood by segregation. Nor is the list of indices exhaustive. Other indices can be developed to meet these criteria (a slightly different specification of the local index of difference is given by Harris 2011a).

In closing, it should be stressed that the indices are not restricted to schools research alone. They can be used in any application where the prevalence of a given attribute can be calculated for a place or institution, where the locations of those places are known, and where a weights matrix can be used to formalise the relationship between places within the study region. Such applications include, for example, the study of differences in the ethnic composition of contiguous census areas.

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Index	Definition	Meaning	Range and interpretation	Compositionally invariant*[1]	Suitable for averaging at a higher level of aggregation?
Local index of difference (LID) (directional version)	Equation 3	Calculates the difference between one place or institution in the study region and its average 'neighbour' in respect to the proportion of their populations that are of a particular group or category.	-1 to 1. A value less than zero means the one the one place has relatively fewer persons belonging to the group than its average neighbour. A value greater than zero means it has more. Zero is the point of equality.	Partially	No, not if the area over which the index is averaged resembles a closed system, whereby higher values necessarily balance lower ones.
Local index of difference (|LID|) (non-directional version)	The absolute value of LID	As above, though which has the greater or less proportion no longer is considered	0 to 1. Any value greater than zero means there is a difference between the one place and its average neighbour.	Partially	Yes

(Continued overleaf)

Index	Definition	Meaning	Range and interpretation	Compositionally invariant*[1]	Suitable for averaging at a higher level of aggregation?
Local index of isolation (LII)	Equation 5	Calculates the probability of selecting a person of a particular group or category from one place but not from the average neighbour.	0 to 1. Zero when no pupils in the place are of the group (so none could be isolated), one when all pupils are of the group but none in surrounding schools is.	No	No
Local index of concentration (LIC) (directional)	Equation 6	Calculates the difference between one place and its average neighbour relative to the local prevalence of the group or attribute of interest.	-1 to 1. The interpretation is the same as for the LID.	Yes	No
Local index of concentration (|LIC|) (non-directional)	The absolute value of LIC	As above	0 to 1	Yes	Yes

Table 4. Summarising the definitions and attributes of the local indices of segregation.