

# ***Using multi-level modelling to understand the determinants of happiness***

**Dimitris Ballas**

*Social and Spatial Inequalities Group,*

*Department of Geography, University of Sheffield*

<http://sasi.group.shef.ac.uk/>



**RES-163-27-1013**



# Outline

- Measuring happiness and well-being
- Individual-level and contextual factors that may be affecting subjective happiness
- Geography of happiness in Britain
- Happy People or Happy Places? – a multilevel problem
- Concluding comments

# ***What is happiness?***

- Buddhist philosophies
- Greece, circa 500 BC
- Socrates, Plato →

**Aristotle (384-322 BC)**

***Nicomachean Ethics (350 BC)***

<http://classics.mit.edu/Aristotle/nicomachaen.html>

England, 18<sup>th</sup> century

**Jeremy Bentham (1748 – 1832), the principle of Utility**

**John Stuart Mill (1806 – 1873) – Utilitarianism**

<http://www.utilitarianism.com/>

# ***Can happiness be measured and modelled?***

A person who has had a life of misfortune, with very little opportunities, and rather little hope, may be more easily reconciled to deprivations than others reared in more fortunate and affluent circumstances. **The metric of happiness may, therefore, distort the extent of deprivation in a specific and biased way.**

(Sen, 1987: 45, my emphasis)

Andrew Oswald and colleagues: statistical regression models of happiness measuring the impact of different factors and life events upon human well being

World Database of Happiness (Ruut Veenhoven)

# General Health Questionnaire (1)

## Have you recently:

- Been able to concentrate on whatever you are doing?
- Lost much sleep over worry?
- Felt that you are playing a useful part in things?
- Felt capable of making decisions about things?
- Felt constantly under strain?
- Felt you could not overcome your difficulties?

# General Health Questionnaire (2)

## Have you recently:

- Been able to enjoy your normal day-to-day activities?
- Been able to face up to your problems?
- Been feeling unhappy or depressed?
- Been losing confidence in yourself?
- Been thinking of yourself as a worthless person?
- Been feeling reasonably happy all things considered?

## **Subjective happiness measure: HLGHQ1**

This measure converts valid answers to questions wGHQA to wGHQL to a single scale by recoding so that the scale for individual variables runs from 0 to 3 instead of 1 to 4, and then summing, giving a scale running from 0 (the least distressed) to 36 (the most distressed). See Cox, B.D *et al*, *The Health and Lifestyle Survey*. (London: Health Promotion Research Trust, 1987).

# **Factors and variables linked to subjective happiness (individual level studies)**

- Age
- Education
- Social Class
- Income
- Marital status/relationships
- Employment
- Leisure
- Religion
- Health
- Life events and activities



# Happiness and social comparisons

“A house may be large or small; as long as the surrounding houses are equally small it satisfies all social demands for a dwelling. But if a palace arises beside the little house, the little house shrinks to a hovel... [and]... the dweller will feel more and more uncomfortable, dissatisfied and cramped within its four walls.”

(Marx, 1847)

# Geographies of happiness in Britain

Region / Metropolitan Area \* GHQ: general happiness Crosstabulation

% within Region / Metropolitan Area

		GHQ: general happiness						Total
		Missing or wild	Proxy respondent	More than usual	Same as usual	Less so	Much less	
Region / Metropolitan Area	Inner London	4.5%	4.3%	14.4%	66.7%	7.7%	2.4%	100.0%
	Outer London	2.8%	5.7%	10.6%	68.6%	10.2%	2.1%	100.0%
	R. of South East	2.2%	5.0%	11.9%	70.2%	9.1%	1.6%	100.0%
	South West	1.7%	3.5%	11.3%	74.1%	8.0%	1.4%	100.0%
	East Anglia	2.1%	1.3%	10.0%	77.4%	8.5%	.8%	100.0%
	East Midlands	2.2%	1.4%	10.9%	76.0%	8.3%	1.3%	100.0%
	West Midlands							
	Conurbation	6.6%	4.6%	11.5%	66.0%	9.9%	1.3%	100.0%
	R. of West Midlands	.8%	2.2%	10.7%	73.7%	10.7%	2.0%	100.0%
	Greater Manchester	1.0%	2.6%	11.1%	75.2%	7.7%	2.4%	100.0%
	Merseyside	.4%	4.7%	9.9%	75.5%	8.6%	.9%	100.0%
	R. of North West	1.3%	4.0%	14.5%	70.7%	8.1%	1.3%	100.0%
	South Yorkshire	1.0%	1.7%	11.3%	71.0%	13.3%	1.7%	100.0%
	West Yorkshire	2.7%	2.7%	10.7%	73.9%	8.5%	1.4%	100.0%
	R. of Yorks & Humberside	1.2%	5.5%	10.1%	76.5%	5.5%	1.2%	100.0%
	Tyne & Wear	.4%	3.8%	14.0%	72.7%	6.8%	2.3%	100.0%
	R. of North	1.8%	2.3%	10.8%	72.3%	11.5%	1.5%	100.0%
Wales	3.9%	1.5%	8.8%	70.9%	12.6%	2.3%	100.0%	
Scotland	1.8%	2.3%	10.8%	74.0%	9.9%	1.3%	100.0%	
Total	2.2%	3.4%	11.3%	72.2%	9.2%	1.6%	100.0%	

Source: The British Household Panel Survey, 1991

# Research questions :

- What are the factors that influence different types of individuals' happiness?
- Is the source of happiness or unhappiness purely personal or do contextual factors matter? (and if they do, to what extent?)
- *If social comparisons are important, what is the spatial scale at which people make their social comparisons?*
- *Happy People or Happy Places?*

# Research methods:

- **Regression modelling**

**single level** analysis to investigate the association between “subjective happiness” and individual level explanatory variables

- **Multi-level modelling**

Assesing variation in happiness at **several levels simultaneously**

# Multilevel Analysis

World → Nation → Region →  
District → Electoral Wards → Neighbourhood  
→ Household → Individual

Multilevel modelling enables the analysis of data with complex patterns of variability – suitable to explore the variability of happiness at different levels

# Multilevel Analysis

World → Nation → **Region** →  
**District** → Electoral Wards → Neighbourhood  
→ **Household** → **Individual**

Multilevel modelling enables the analysis of data with complex patterns of variability – suitable to explore the variability of happiness at different levels

# Combining Data

**1991 & 2001 Census of UK population:**  
100% coverage  
fine geographical detail  
small area data  
available only in tabular format with limited variables to preserve confidentiality

**British Household Panel Survey:**  
sample size: more than 5,000 households  
annual surveys since 1991  
individual data  
more variables than census  
coarse geography  
household attrition

# Modelling happiness and well-being: single level models

1. Demography
2. Socio-economic
3. Health
4. Social context – interaction variables  
(e.g. “unemployed or not” dummy variable x “district unemployment rate” variable)



	<b>B</b>	<b>Std. Error</b>	<b>Sig.</b>
<b>Dependent variable: "unhappiness"</b>			
Constant	-0.886	0.123	0.000
Age	0.033	0.006	0.000
Agesq	0.000	0.000	0.000
Female	0.195	0.024	0.000
<b>Individual level LLTI</b>			
University degree	0.024	0.040	0.549
<b>Unemployed (reference group = "employed or self employed")</b>	<b>0.891</b>	<b>0.234</b>	<b>0.000</b>
Retired (reference group = "employed or self employed")	0.019	0.345	0.957
Family care (reference group = "employed or self employed")	0.273	0.223	0.220
Student (reference group = "employed or self employed")	-0.054	0.081	0.505
Sick/disabled (reference group = "employed or self employed")	-0.657	0.589	0.265
<b>On maternity leave (reference group = "employed or self employed")</b>	<b>-0.474</b>	<b>0.312</b>	<b>0.129</b>
On a government scheme (reference group = "employed or self employed")	-0.307	0.185	0.098
Other job status (reference group = "employed or self employed")	0.242	0.448	0.590
<b>Household income</b>			
<b>Couple no child (reference = "single")</b>	<b>-0.089</b>	<b>0.050</b>	<b>0.078</b>
Couple with dependent children (reference = "single")	-0.025	0.050	0.619
Couple with no dependent children (reference = "single")	-0.063	0.056	0.262
<b>Lone parent (reference = "single")</b>	<b>0.157</b>	<b>0.082</b>	<b>0.054</b>
Lone parent non dependent children (reference = "single")	0.077	0.073	0.295
Other household type (reference = "single")	-0.025	0.074	0.732
Renting (reference = "owner occupier")	0.015	0.047	0.753
Local authority housing (reference = "owner occupier")	0.058	0.040	0.150
One car (reference = "no car")	0.049	0.040	0.218
Two cars (reference = "no car")	0.062	0.044	0.161
Three or more cars (reference = "no car")	0.038	0.056	0.497

## Dependent variable: "unhappiness"

	<b>B</b>	<b>Std. Error</b>	<b>Sig.</b>
Constant	-0.886	0.123	0.000

## District rates

Unemployment rate	0.016	0.039	0.692
Lone parent	0.010	0.028	0.710
Social housing	0.035	0.034	0.296
Sick/disabled	0.014	0.021	0.500
% "affluent"	0.060	0.040	0.132
% "poor"	0.013	0.026	0.630
% "households with one car"	0.002	0.026	0.926
% "households with two cars"	0.012	0.075	0.874
% "households with three cars"	-0.007	0.067	0.914

## Interaction variables

<b>unemployment</b>	<b>-0.846</b>	<b>0.235</b>	<b>0.000</b>
no car	-0.031	0.033	0.353
students	-0.056	0.073	0.440
<b>social housing</b>	<b>-0.070</b>	<b>0.042</b>	<b>0.093</b>
private renting	-0.032	0.029	0.275
owner occupier	0.028	0.032	0.381
age 20-24	0.065	0.036	0.068
aged over 75	-0.127	0.251	0.612
"affluent"	-0.007	0.033	0.841
"middle"	-0.007	0.027	0.785
<b>"poor"</b>	<b>0.001</b>	<b>0.026</b>	<b>0.963</b>
sick/disabled	0.163	0.295	0.580

# Multi-level modelling (4-levels: region, district, household, individual): “null model”

$$\text{UNHAPPINESSSTD}_{ijkl} \sim N(XB, \Omega)$$

$$\text{UNHAPPINESSSTD}_{ijkl} = \beta_{0ijkl} \text{cons}$$

$$\beta_{0ijkl} = -0.034(0.017) + f_{0l} + v_{0kl} + u_{0jkl} + e_{0ijkl}$$

$$[f_{0l}] \sim N(0, \Omega_f) : \Omega_f = [0.002(0.002)]$$

$$[v_{0kl}] \sim N(0, \Omega_v) : \Omega_v = [0.007(0.003)]$$

$$[u_{0jkl}] \sim N(0, \Omega_u) : \Omega_u = [0.141(0.014)]$$

$$[e_{0ijkl}] \sim N(0, \Omega_e) : \Omega_e = [0.814(0.017)]$$

$-2 * \log\text{likelihood(IGLS Deviance)} = 26755.820(9602 \text{ of } 9912 \text{ cases in use})$

## Multi-level modelling (4-levels: region, district, household, individual): “null model”

<b>Level</b>	<b>Variance</b>	<b>Variance (%)</b>	<b>SE</b>
Region	0.002	0.21	0.002
District	0.007	0.73	0.003
Household	0.141	14.63	0.014
Individual	0.814	84.44	0.017

# **Modelling happiness and well-being: multilevel (Ballas and Tranmer, 2007)**

- 1. “Null model” – extent of variation**
- 2. Socio-economic variables and health – random intercepts**
- 3. Social context – interaction variables**

# Multi-level modelling (4-levels: region, district, household, individual): “null model”

$$\text{UNHAPPINESSSTD}_{ijkl} \sim N(XB, \Omega)$$

$$\text{UNHAPPINESSSTD}_{ijkl} = \beta_{0ijkl} \text{cons}$$

$$\beta_{0ijkl} = -0.034(0.017) + f_{0l} + v_{0kl} + u_{0jkl} + e_{0ijkl}$$

$$[f_{0l}] \sim N(0, \Omega_f) : \Omega_f = [0.002(0.002)]$$

$$[v_{0kl}] \sim N(0, \Omega_v) : \Omega_v = [0.007(0.003)]$$

$$[u_{0jkl}] \sim N(0, \Omega_u) : \Omega_u = [0.141(0.014)]$$

$$[e_{0ijkl}] \sim N(0, \Omega_e) : \Omega_e = [0.814(0.017)]$$

$-2 * \log \text{likelihood(IGLS Deviance)} = 26755.820(9602 \text{ of } 9912 \text{ cases in use})$

# Model 1 variance component estimates

<b>Level</b>	<b>Variance</b>	<b>Variance (%)</b>	<b>SE</b>
Region	0.002	0.21	0.002
District	0.007	0.73	0.003
Household	0.141	14.63	0.014
Individual	0.814	84.44	0.017

# All variables – random intercepts

$$\text{UNHAPPINESSSTD}_{ijk} \sim N(XB, \Omega)$$

$$\begin{aligned} \text{UNHAPPINESSSTD}_{ijk} = & \beta_{0ijk} \text{cons} + 0.015(0.003)\text{AGE}_{ijk} + 0.000(0.000)\text{AGESQ}_{ijk} + 0.167(0.019)\text{FEMALE}_{ijk} + \\ & 0.201(0.022)\text{indhealthGood}_{ijk} + 0.507(0.028)\text{indhealthFair}_{ijk} + 0.963(0.043)\text{indhealthPoor}_{ijk} + \\ & 1.467(0.073)\text{indhealthVeryPoor}_{ijk} + 0.050(0.037)\text{INDFIRSTDE}_{ijk} + 0.438(0.043)\text{INDUNEMPLO}_{ijk} + \\ & -0.045(0.040)\text{INDRETIRED}_{ijk} + 0.119(0.034)\text{INDFAMILYC}_{ijk} + -0.087(0.053)\text{INDSTUDENT}_{ijk} + \\ & 0.443(0.063)\text{INDSICKDIS}_{ijk} + 0.005(0.258)\text{INDMATLEAV}_{ijk} + 0.019(0.153)\text{INDGVTSCH}_{ijk} + \\ & -0.092(0.161)\text{INDOTHERJS}_{ijk} + -0.024(0.013)\text{AFIHHMN}_{jk} + 0.009(0.016)\text{ANCARS}_{jk} + \\ & -0.122(0.033)\text{INDCOUPLENOCHILD}_{jk} + 0.007(0.037)\text{INDCOUPLEDEPCHILD}_{jk} + \\ & -0.079(0.044)\text{INDCOUPLECHILDNONDEP}_{jk} + 0.274(0.058)\text{INDLONEPARENT}_{jk} + \\ & 0.015(0.059)\text{INDLONEPARENTNONDEPC}_{jk} + -0.088(0.061)\text{INDOTHERHTYPE}_{jk} + \\ & 0.076(0.037)\text{INDTENURERENT}_{jk} + 0.076(0.028)\text{INDTENURESOCI}_{jk} \end{aligned}$$

$$\beta_{0ijk} = -0.763(0.076) + v_{0ik} + u_{0ijk} + e_{0ijk}$$

$$[v_{0ik}] \sim N(0, \Omega_v) : \Omega_v = [0.003(0.002)]$$

$$[u_{0ijk}] \sim N(0, \Omega_u) : \Omega_u = [0.100(0.012)]$$

$$[e_{0ijk}] \sim N(0, \Omega_e) : \Omega_e = [0.709(0.015)]$$

-2\*loglikelihood(IGLS Deviance) = 25017.280(9547 of 9912 cases in use)



# All variables and interaction variables – random intercepts

$$\text{UNHAPPINESSSTD}_{ijk} \sim N(XB, \Omega)$$

$$\begin{aligned} \text{UNHAPPINESSSTD}_{ijk} = & \beta_{0ijk} \text{cons} + 0.034(0.006)\text{AGE}_{ijk} + 0.000(0.000)\text{AGESQ}_{ijk} + 0.192(0.022)\text{FEMALE}_{ijk} + 0.209(0.025)\text{indhealthGood}_{ijk} + \\ & 0.502(0.035)\text{indhealthFair}_{ijk} + 0.724(0.062)\text{indhealthPoor}_{ijk} + 0.833(0.145)\text{indhealthVeryPoor}_{ijk} + 0.048(0.039)\text{INDFIRSTDE}_{ijk} + \\ & 0.862(0.234)\text{INDUNEMPLO}_{ijk} + 0.142(0.346)\text{INDRETIRED}_{ijk} + 0.190(0.217)\text{INDFAMILYC}_{ijk} + 0.000(0.081)\text{INDSTUDENT}_{ijk} + \\ & -0.729(0.554)\text{INDSICKDIS}_{ijk} + -0.290(0.280)\text{INDMATLEAV}_{ijk} + -0.295(0.181)\text{INDGVTSCH}_{ijk} + 0.302(0.484)\text{INDOTHERJS}_{ijk} + \\ & -0.035(0.014)\text{AFIHHMN}_{jk} + 0.023(0.018)\text{ANCARS}_{jk} + -0.050(0.047)\text{INDCOUPLENOCHILD}_{jk} + \\ & -0.003(0.047)\text{INDCOUPLEDEPCHILD}_{jk} + -0.063(0.054)\text{INDCOUPLECHILDNONDEP}_{jk} + 0.210(0.076)\text{INDLONEPARENT}_{jk} + \\ & 0.116(0.074)\text{INDLONEPARENTNONDEPC}_{jk} + -0.044(0.076)\text{INDOTHERHTYPE}_{jk} + 0.007(0.046)\text{INDTENURERENT}_{jk} + \\ & 0.032(0.040)\text{INDTENURESOCI}_{jk} + -0.841(0.235)\text{unem\_int}_{ijk} + -0.022(0.032)\text{NOCAR\_INT}_{jk} + -0.021(0.032)\text{socialhousing\_int}_{jk} + \\ & 0.139(0.285)\text{sickdis\_int}_{ijk} + 0.029(0.025)\text{affluent\_int}_{ijk} + -0.032(0.019)\text{middle\_int}_{ijk} + -0.017(0.019)\text{poor\_int}_{ijk} + \\ & -0.101(0.253)\text{age75plus\_int}_{ijk} + -0.021(0.016)\text{ownocc\_int}_{jk} + -0.013(0.029)\text{privaterent\_int}_{jk} + -0.026(0.074)\text{students\_int}_{ijk} \end{aligned}$$

$$\beta_{0ijk} = -1.123(0.115) + v_{0k} + u_{0jk} + e_{0ijk}$$

$$\begin{bmatrix} v_{0k} \end{bmatrix} \sim N(0, \Omega_v) : \Omega_v = \begin{bmatrix} 0.002(0.002) \end{bmatrix}$$

$$\begin{bmatrix} u_{0jk} \end{bmatrix} \sim N(0, \Omega_u) : \Omega_u = \begin{bmatrix} 0.068(0.014) \end{bmatrix}$$

$$\begin{bmatrix} e_{0ijk} \end{bmatrix} \sim N(0, \Omega_e) : \Omega_e = \begin{bmatrix} 0.635(0.017) \end{bmatrix}$$

-2\*loglikelihood(IGLS Deviance) = 14365.850(5784 of 9912 cases in use)

# All variables and interaction coefficient of variation variables

$$\text{UNHAPPINESSSTD}_{ijk} \sim N(XB, \Omega)$$

$$\begin{aligned} \text{UNHAPPINESSSTD}_{ijk} = & \beta_{0ijk} \text{cons} + 0.002(0.001)\text{AGE}_{ijk} + 0.173(0.019)\text{FEMALE}_{ijk} + 0.198(0.022)\text{indhealthGood}_{ijk} + 0.504(0.028)\text{indhealthFair}_{ijk} + \\ & 0.963(0.044)\text{indhealthPoor}_{ijk} + 1.470(0.073)\text{indhealthVeryPoor}_{ijk} + 0.051(0.038)\text{INDFIRSTDE}_{ijk} + 0.441(0.044)\text{INDUNEMPLO}_{ijk} + \\ & -0.110(0.037)\text{INDRETIRED}_{ijk} + 0.101(0.034)\text{INDFAMILYC}_{ijk} + -0.151(0.051)\text{INDSTUDENT}_{ijk} + 0.456(0.063)\text{INDSICKDIS}_{ijk} + \\ & -0.003(0.259)\text{INDMATLEAV}_{ijk} + -0.016(0.153)\text{INDGVTSCHE}_{ijk} + -0.103(0.161)\text{INDOTHERJS}_{ijk} + -0.023(0.013)\text{AFIHHMN}_{ijk} + \\ & 0.012(0.016)\text{ANCARS}_{jk} + -0.098(0.033)\text{INDCOUPLENOCHILD}_{jk} + 0.040(0.037)\text{INDCOUPLEDEPCHILD}_{jk} + \\ & -0.060(0.044)\text{INDCOUPLECHILDNONDEP}_{jk} + 0.309(0.058)\text{INDLONEPARENT}_{jk} + \\ & 0.029(0.059)\text{INDLONEPARENTNONDEPC}_{jk} + -0.073(0.061)\text{INDOTHERHTYPE}_{jk} + 0.082(0.038)\text{INDTENURERENT}_{jk} + \\ & 0.081(0.029)\text{INDTENURESOCI}_{jk} + -0.008(0.032)\text{TTW40}_{ijk} + 0.055(0.044)\text{TTW60}_{ijk} + 0.109(0.072)\text{TTW60PLUS}_{ijk} + \\ & -0.084(0.042)\text{UN\_COV\_STD\_int}_{ijk} + 0.008(0.013)\text{owncov\_STD\_int}_{jk} + 0.053(0.037)\text{rentcov\_STD\_int}_{jk} + \\ & 0.021(0.023)\text{socialcov\_STD\_int}_{jk} \end{aligned}$$

$$\beta_{0ijk} = -0.555(0.056) + v_{0k} + u_{0jk} + e_{0ijk}$$

$$\begin{bmatrix} v_{0k} \end{bmatrix} \sim N(0, \Omega_v) : \Omega_v = \begin{bmatrix} 0.002(0.002) \end{bmatrix}$$

$$\begin{bmatrix} u_{0jk} \end{bmatrix} \sim N(0, \Omega_u) : \Omega_u = \begin{bmatrix} 0.098(0.012) \end{bmatrix}$$

$$\begin{bmatrix} e_{0ijk} \end{bmatrix} \sim N(0, \Omega_e) : \Omega_e = \begin{bmatrix} 0.712(0.015) \end{bmatrix}$$

-2\*loglikelihood(IGLS Deviance) = 24939.030(9510 of 9912 cases in use)

## Model 2: socio-economic / health characteristics (1)

<b>Model 2 Variables, variance component estimates and coefficients (standard error in brackets)</b>	<b>Subjective well-being</b>	<b>General Happiness</b>
Intercept	0.766 (0.074)	0.607 (0.084)
<i>Individual-level variables:</i>		
Age	<b>-0.016 (0.003)</b>	<b>-0.022 (0.003)</b>
Female	<b>-0.177 (0.021)</b>	<b>-0.068 (0.023)</b>
Individual income	-0.012 (0.013)	0.007 (0.015)
Health good (reference = health excellent)	<b>-0.200 (0.022)</b>	<b>-0.085 (0.024)</b>
Health fair (reference = health excellent)	<b>-0.510 (0.028)</b>	<b>-0.249 (0.031)</b>
Health poor (reference = health excellent)	<b>-0.963 (0.043)</b>	<b>-0.465 (0.047)</b>
Health very poor (reference = health excellent)	<b>-1.471 (0.073)</b>	<b>-0.790 (0.078)</b>
University degree	-0.030 (0.038)	0.079 (0.040)
Employment status: unemployed (reference = employed or self employed)	<b>-0.451 (0.043)</b>	<b>-0.384 (0.047)</b>
Employment status: retired (reference = employed or self employed)	0.038 (0.041)	0.030 (0.044)
Employment status: family care (reference = employed or self employed)	<b>-0.126 (0.035)</b>	<b>-0.078 (0.038)</b>

## Model 2: socio-economic / health characteristics (2)

Model 2 Variables, variance component estimates and coefficients (standard error in brackets)	Subjective well-being	General Happiness
Employment status: student (reference = employed or self employed)	0.048 (0.054)	0.022(0.059)
Employment status: sick/disabled (reference = employed or self employed)	<b>-0.458 (0.063)</b>	<b>-0.158 (0.069)</b>
Employment status: on maternity leave (reference = employed or self employed)	0.023 (0.258)	0.492 (0.281)
Employment status: on a government scheme (reference = employed or self employed)	-0.045 (0.153)	-0.274 (0.167)
Employment status: other job status (reference = employed or self employed)	0.082 (0.161)	0.163 (0.176)
Commuting time: up to 40 minutes	0.012 (0.032)	0.040 (0.034)
Commuting time: between 40 – 60 minutes	-0.048 (0.044)	0.024 (0.047)
Commuting time: over an hour	-0.087 (0.072)	-0.051(0.078)
Has lived at current address for between 1-5 years (reference = lived at current address for less than 1 year)	0.027(0.032)	-0.010(0.034)
Has lived at current address for more than 5 years (reference = lived at current address for less than 1 year)	<b>0.120(0.031)</b>	0.030(0.033)

## Model 2: socio-economic / health characteristics (3)

Model 2 Variables, variance component estimates and coefficients (standard error in brackets)	Subjective well-being	General Happiness
<i>Household level variables:</i>		
Household type: couple no children (reference = single)	<b>0.117 (0.034)</b>	<b>0.144 (0.036)</b>
Household type: couple with dependent children (reference = single)	-0.030 (0.034)	0.047 (0.041)
Household type: couple with children but not dependent (reference = single)	0.037 (0.046)	0.078 (0.049)
Household type: lone parent with dependent child(ren)	<b>-0.281 (0.058)</b>	-0.092 (0.062)
Household type: lone parent with non dependent child(ren)	-0.051(0.060)	0.067(0.063)
Household type: other	0.098 (0.059)	<b>0.176 (0.064)</b>
Household tenure: private renting (reference = owner occupier)	-0.054 (0.038)	0.055(0.040)
Household tenure: LA/HA renting (reference = owner occupier)	<b>-0.068 (0.028)</b>	-0.011(0.029)
Number of cars	-0.010 (0.016)	0.003 (0.016)
Household income	0.028(0.015)	0.002(0.016)

### Model 3: socio-economic / health and interaction (1)

Model 3 Variables, variance component estimates and coefficients (standard error in brackets)	Subjective well-being	General Happiness
Intercept	1.097 (0.117)	0.781 (0.133)
<i>Individual-level variables:</i>		
Age	<b>-0.034 (0.006)</b>	<b>-0.032 (0.006)</b>
Female	<b>-0.195 (0.024)</b>	<b>-0.086 (0.028)</b>
Individual income	-0.002 (0.015)	0.000 (0.017)
Health good (reference = health excellent)	<b>-0.208(0.025)</b>	<b>-0.081 (0.028)</b>
Health fair (reference = health excellent)	<b>-0.506 (0.035)</b>	<b>-0.275 (0.040)</b>
Health poor (reference = health excellent)	<b>-0.725 (0.062)</b>	<b>-0.426 (0.071)</b>
Health very poor (reference = health excellent)	<b>-0.846 (0.144)</b>	<b>-0.642 (0.162)</b>
University degree	-0.033 (0.039)	0.094 (0.044)
Employment status: unemployed (reference = employed or self employed)	<b>-0.882 (0.234)</b>	<b>-0.690 (0.268)</b>
Employment status: retired (reference = employed or self employed)	-0.148 (0.345)	-0.135 (0.369)
Employment status: family care (reference = employed or self employed)	-0.198 (0.217)	-0.334 (0.249)
Employment status: on maternity leave (reference = employed or self employed)	0.312 (0.280)	<b>0.736 (0.321)</b>

### Model 3: socio-economic / health and interaction (2)

Model 3 Variables, variance component estimates and coefficients (standard error in brackets)	Subjective well-being	General Happiness
Employment status: student (reference = employed or self employed)	-0.022 (0.081)	0.066(0.093)
Employment status: sick/disabled (reference = employed or self employed)	0.601 (0.487)	0.493 (0.558)
Employment status: on maternity leave (reference = employed or self employed)	0.312 (0.280)	<b>0.736 (0.321)</b>
Employment status: on a government scheme (reference = employed or self employed)	0.289 (0.181)	0.056 (0.207)
Employment status: other job status (reference = employed or self employed)	-0.295 (0.484)	<b>-1.256(0.554)</b>
Commuting time: up to 40 minutes	0.006 (0.030)	0.034 (0.034)
Commuting time: between 40 – 60 minutes	-0.049 (0.041)	0.019 (0.047)
Commuting time: over an hour	-0.084 (0.068)	-0.056(0.077)
Has lived at current address for between 1-5 years (reference = lived at current address for less than 1 year)	0.037(0.036)	0.017(0.041)
Has lived at current address for more than 5 years (reference = lived at current address for less than 1 year)	<b>0.100(0.036)</b>	0.047(0.040)

### Model 3: socio-economic / health and interaction (3)

Model 3 Variables, variance component estimates and coefficients (standard error in brackets)	Subjective well-being	General Happiness
<i>Household level variables:</i>		
Household type: couple no children (reference = single)	0.059 (0.048)	<b>0.121 (0.054)</b>
Household type: couple with dependent children (reference = single)	-0.008 (0.047)	0.061 (0.054)
Household type: couple with children but not dependent (reference = single)	0.046 (0.056)	0.084 (0.064)
Household type: lone parent with dependent child(ren)	<b>-0.213 (0.076)</b>	0.029 (0.087)
Household type: lone parent with non dependent child(ren)	-0.135(0.075)	0.113(0.085)
Household type: other	0.069 (0.077)	0.164 (0.086)
Household tenure: private renting (reference = owner occupier)	0.008 (0.047)	<b>0.126(0.052)</b>
Household tenure: LA/HA renting (reference = owner occupier)	-0.033 (0.040)	-0.004 (0.045)
Number of cars	-0.026 (0.018)	-0.025(0.020)
Household income	0.030(0.017)	0.006(0.019)



### Model 3: socio-economic / health and interaction (4)

Model 3 Variables, variance component estimates and coefficients (standard error in brackets)	Subjective well-being	General Happiness
<i>Interaction (individual/household x district) terms:</i>		
Unemployment status (individual level) x unemployment rate (district level)	<b>0.815 (0.235)</b>	<b>0.548(0.270)</b>
Owner Occupier (household level) x owner occupier households rate (district level)	0.020 (0.016)	-0.009(0.017)
Private renting (household level) x private renting households rate (district level)	0.020(0.029)	0.015(0.032)
Renting from LA/HA x LA/HA renting households rate	0.029(0.030)	-0.038(0.033)
“Affluent” household (household level) x percentage of “affluent” households in the area (district level)	-0.021(0.025)	-0.007(0.29)
“Middle” household (household level) x percentage of “Middle” households in the area (district level)	0.030(0.019)	-0.001(0.21)
“Poor” household (household level) x percentage of “Poor” households in the area (district level)	0.016(0.019)	0.017(0.021)

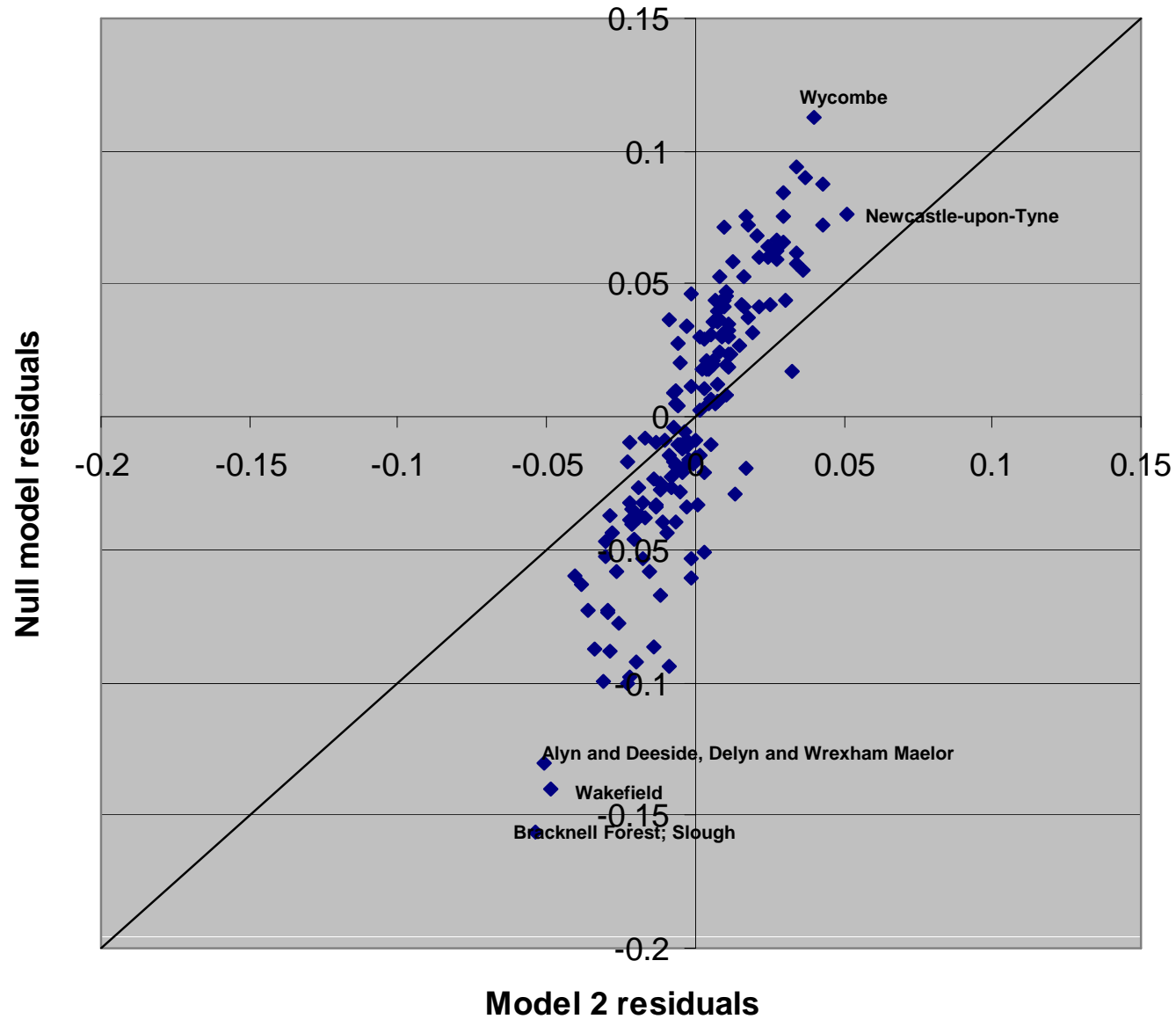
## Model 2 and 3 significant main effects (1)

<b>Happiness and well-being determinants</b>	<b>Model 2</b>	<b>Model 3</b>
Age	HLGHQ1(-),GHQL(-)	HLGHQ1(-),GHQL(-)
Female (Reference = Male)	HLGHQ1(-),GHQL(-)	HLGHQ1(-),GHQL(-)
Health good (reference = health excellent)	HLGHQ1(-),GHQL(-)	HLGHQ1(-),GHQL(-)
Health fair (reference = health excellent)	HLGHQ1(-),GHQL(-)	HLGHQ1(-),GHQL(-)
Health poor (reference = health excellent)	HLGHQ1(-),GHQL(-)	HLGHQ1(-),GHQL(-)
Health very poor (reference = health excellent)	HLGHQ1(-),GHQL(-)	HLGHQ1(-),GHQL(-)
Employment status: unemployed (reference = employed or self employed)	HLGHQ1(-),GHQL(-)	HLGHQ1(-),GHQL(-)
Employment status: family care (reference = employed or self employed)	HLGHQ1(-),GHQL(-)	
Employment status: sick/disabled (reference = employed or self employed)	HLGHQ1(-),GHQL(-)	

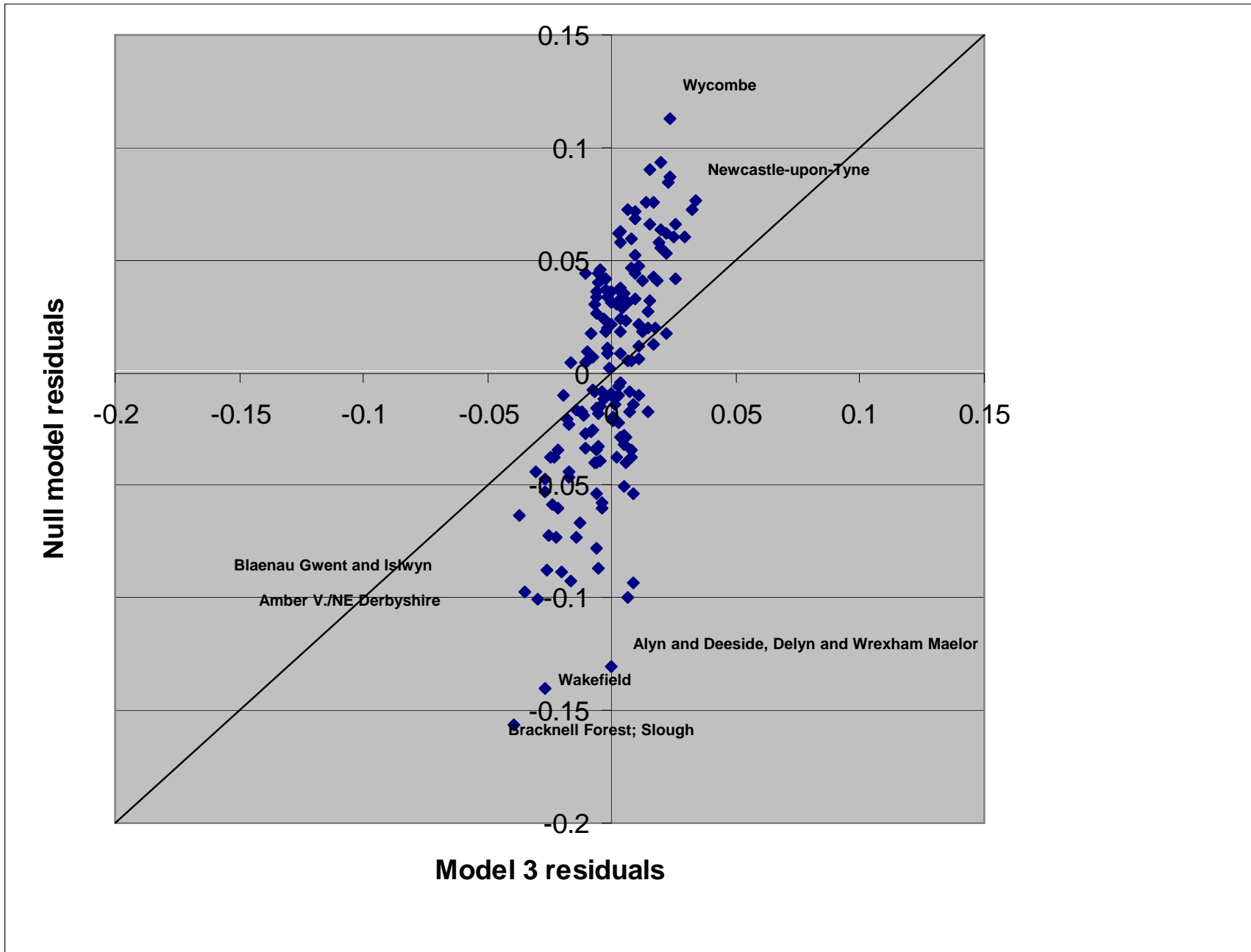
## Model 2 and 3 significant main effects (2)

<b>Happiness and well-being determinants</b>	<b>Model 2</b>	<b>Model 3</b>
Employment status: on maternity leave (reference = employed or self employed)		GHQL(+)
Employment status: on a government scheme (reference = employed or self employed)		GHQL(-)
Employment status: other job status (reference = employed or self employed)		
Has lived at current address for more than 5 years (reference = lived at current address for less than one year)	HLGHQ1(+)	HLGHQ1(+)
Household type: couple no children (reference = single)	HLGHQ1(+),GHQL(+)	GHQL(+)
Household type: lone parent with dependent child(ren) (reference = single)	HLGHQ1(-)	HLGHQ1(-)
Household type: lone parent with non dependent child(ren) (reference = single)		
Household type: other (reference = single)	GHQL(+)	
Household tenure: private renting (reference = owner occupier)		GHQL(+)
Household tenure: LA/HA renting (reference = owner occupier)	HLGHQ1(-)	
Unemployment status (individual level) x unemployment rate (district level)	Not included	HLGHQ1(+),GHQL(+)

# “Null model” vs. Model 2 residuals



# “Null model” vs. Model 3 residuals



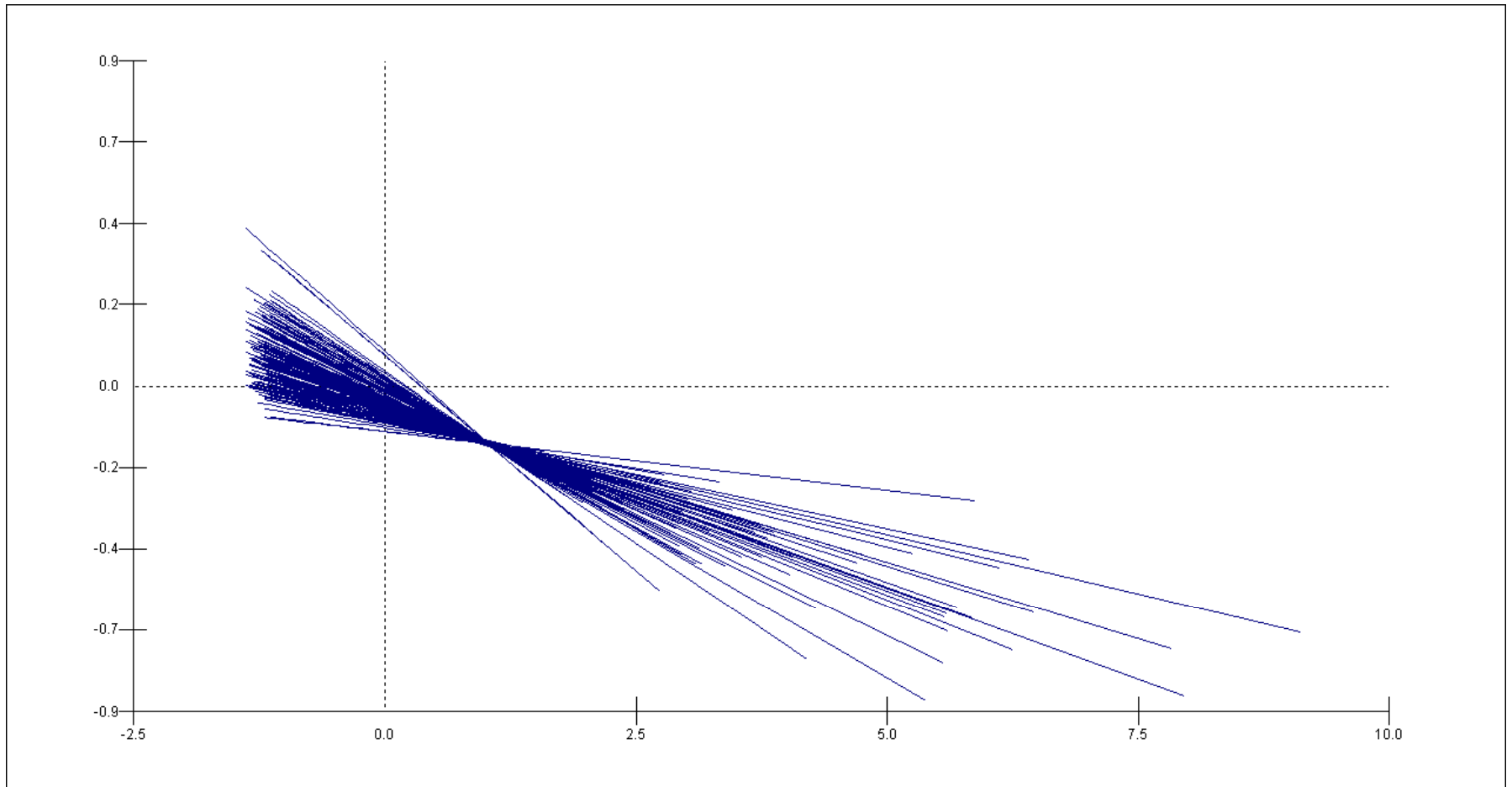
# Happy people or happy places?

- Most of the variation in the measures of “subjective well-being” and “general happiness” is attributable to the individual level
- **However**, some of the variation in both measures is attributable to the household level and a very small proportion of the variation of the “subjective well-being” measure is attributable to the district level

# Happy people or Happy places?

- The variation of “subjective well-being” that is attributable to district and household levels is reduced with the introduction of a number of explanatory and control variables.
- The area with the lowest residual and therefore lowest “well-being” intercept is the district of “**Blacknell Forest; Slough**”. According to both Model 1 and Model 2, individuals living in this district have lower than average “subjective well-being”, **even after controlling for a number of explanatory variables that are thought to be affecting happiness.**
- The district with the **highest positive residual is “Wycombe”**. However, **the inclusion of a number of explanatory variables “drops” Wycombe to the third place and the first place goes to the district of “Newcastle-upon-Tyne”**

# Random coefficients





# Conclusions

- There are individual variations in happiness
- Social context matters
- Can explore additional geographical variations using multilevel modelling techniques
- Some district level variation in happiness does exist, even after accounting for individual and social context
- Need for longitudinal analysis
- Analysis for finer geographical scales (spatial microsimulation and multilevel modelling)