Multilevel modelling of happiness: does it make sense?

Mark Tranmer
School of Social Sciences
University of Manchester
UK
Acknowledgements

• This work arose from a request from ESRC for me to be a ‘statistical mentor’ for a mid-career research fellowship by Dr Dimitris Ballas, Dept. Geography, University of Sheffield. (research collaboration between universities)

• Project ‘Geography of Happiness and well-being in the UK’

• Also involves Prof. Danny Dorling
• I would also like to thank Prof. David Steel for inviting me to give this presentation.

• Also worth noting this is my 15th visit to University of Wollongong since 1994.

• Value of international collaborations with repeat visits.

• Develop complementary research, draw on complementary research expertise.
Contents

1. Research questions
2. Data
3. Initial analysis: methods & results
4. Initial dissemination
5. Media coverage
6. Reactions to media coverage
Contents

7. New analysis
8. Latest results
9. Conclusions: does it make sense?
Research Questions

- Do self-reported measures of happiness and well-being vary by person, households or geographical areas?
- Can these variations be explained by individual characteristics?
- Do the relationships between individual characteristics and happiness/well-being vary in different areas?
- Is there any remaining unexplained variation at the household or area level?
Data

- British Household Panel Survey (BHPS)
- 1991 and 2003 waves
- Self reported happiness and well-being measures
- Individual, household and district levels
- District is a fairly large area: e.g. Manchester, Sheffield, Slough, Edinburgh.
Data: BHPS sample

- BHPS: annual survey - nationally representative sample of 5,500 households (hh) recruited in 1991; total of 10,000 interviewed individuals

- Sample: stratified clustered design from postcode address file: all residents present at addresses in first wave designated as panel members.

- Same individuals interviewed each successive year

- If split from original hh to form new hh, are followed and all new household members also interviewed.
Outcome: Happiness

- Happiness outcome
- Have you:

  ‘Been feeling reasonably happy all things considered?’

  - More than usual
  - Same as usual
  - Less than usual
  - Much less than usual
Outcome: Well-being

- well-being outcome is sum of 12 4-point scores, coded 0-3 for each of the 12 items on next 2 slides.

- Higher score means worse feeling of well being

- First categorical PCA component of 12 items explains 83% of overall variation - all items have similar, positive loadings.

- this well-being measure used in previous research

- Seems to have validity as outcome measure
Outcome: Well-being

1. Been able to concentrate on whatever you are doing?
2. Lost much sleep over worry?
3. Felt that you are playing a useful part in things?
4. Felt capable of making decisions about things?
5. Felt constantly under strain?
6. Felt you could not overcome your difficulties?
Outcome: well-being

7. Been able to enjoy your normal day-to-day activities?
8. Been able to face up to your problems?
9. Been feeling unhappy or depressed?
10. Been losing confidence in yourself?
11. Been thinking of yourself as a worthless person?
12. Been feeling reasonably happy all things considered?
Methods: Multilevel models

Level 2: Household

Level 3: District

Level 1: Individual
Modelling strategy

- Null models: extent of variation at each level
- Add individual level BHPS variables
- Combine with 1991 area level census data
- Interactions - social comparisons
- Proxies for local scales
### Combining Census and BHPS data

<table>
<thead>
<tr>
<th>1991 Census of UK population:</th>
<th>BHPS</th>
</tr>
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<tbody>
<tr>
<td>100% coverage</td>
<td>sample size: more than 5,000 households</td>
</tr>
<tr>
<td>fine geographical detail</td>
<td>annual surveys since 1991</td>
</tr>
<tr>
<td>small area data available only in tabular format with limited variables to preserve confidentiality</td>
<td>individual data</td>
</tr>
<tr>
<td></td>
<td>more variables than census</td>
</tr>
<tr>
<td></td>
<td>coarse geography</td>
</tr>
<tr>
<td></td>
<td>household attrition</td>
</tr>
</tbody>
</table>
Explanatory variables

- Demographic characteristics
- Socio-economic
- Self-reported health
- Social context – interaction variables
  - e.g. “unemployed or not” dummy variable x “district unemployment rate” variable
Null model estimates of well-being variation, 1991 BHPS (IGLS estimation).

<table>
<thead>
<tr>
<th>Level</th>
<th>Variance</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>District</td>
<td>.009</td>
<td>1</td>
</tr>
<tr>
<td>Household</td>
<td>.141</td>
<td>15</td>
</tr>
<tr>
<td>Individual</td>
<td>.814</td>
<td>84</td>
</tr>
</tbody>
</table>
Significant explanatory variables:

- lower well-being / happiness, + higher well-being / happiness

<table>
<thead>
<tr>
<th>Variable</th>
<th>Happiness</th>
<th>Well-being</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Female</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>health cf. excellent</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>unemp. cf. employed</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>At current address &gt; 5 yrs</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>private rent cf. owner occupier</td>
<td></td>
<td>+</td>
</tr>
<tr>
<td>unemp status * unemp rate</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>
Proxies for local scale

- District is a coarse geographical scale, so we tried proxies for local scale: e.g. the coefficient of variation of the ED level unemployment rate and coefficient of variation of % renting in each ED.

- We wondered if more variability of these in districts associated with different levels of happiness and well being.

- Not significant - but not sure how good a proxy this is in practice. Any comments?
Higher level variance components

• When the explanatory variables were added to the model, district level variation was estimated at close to, but not exactly, zero.

• Significant between-household and between-individual variation remained.
2003 analysis

• The analysis based on BHPS variables only was repeated for 2003 data.

• There are more areas (districts) in the 2003 dataset because people have moved etc.

• The results were presented at a Royal Geographical Society Conference
2003 Analysis

• The results were similar to those for 1991.

• Most variation is at the individual level, then the household, and a tiny amount at the district level.

• From multilevel model these tiny but non-zero differences in district levels of well-being can be calculated and ranked: both for the null model and the complete model
Ranks

- Ranks hide differences.
- $100,000 (1) and $50,000 (2)
- $100,001 (1) and $100,000 (2)
- but ranks *seem important*
Perception of ranks

• Journalists were present at the RGS talk and were very excited by the ranks, despite being told the differences from place to place were not statistically significant.

• The *Independent* newspaper ran a list of all places in the 2003 BHPS and provided ranks for each one in terms of ‘happiness’.
Media coverage

- news.bbc.co.uk ran a page on the topic with a photo of Edinburgh castle at the top and some text saying Edinburgh was ranked as ‘the least cheerful place in Britain’.

- Manchester was ranked second ‘most cheerful’!

- Half way through the article the BBC said ‘the differences are not statistically significant’.

- ‘Have your say’ comments invited for the web page - there were 473! - let’s look at a few:
Some comments

“Britain’s happiest place is in my head!!”, R, Exeter.

“The only good thing about Edinburgh is the train to Glasgow!”, L, Somewhere

“I fail to see how Manchester made it to 2nd. The last time I went to that god forsaken dump I found the locals overbearing, nosey and insincere...

....Didsbury [an area of south Manchester] must be down near the bottom with the rest of the miserable sods.” Dallas, Didsbury.
A couple more ...

“You can be happy wherever you live: important things include good services, friendly people, litter-free streets ...” C, London.

“Well there certainly seem to be a lot of people posting comments here whose idea of happiness is whinging about other people whinging. Plus of course the standard accusation that all Have Your Say commentators are - insert one the following - right-wing, daily mail readers or worse still critics of the government.” A, London.
Current analysis

• In the light of these experiences and some comments on the approaches by academics, we went back to the analysis, and I’d now like to present some current work we have been doing.
Current analysis

- Focused on the 1991 and 2003 well-being scores, and changed the focus to well-being

- 4-point happiness score a strange question in the first place and I was unconvinced the multilevel models were running correctly anyway.

- So I abandoned this outcome and just looked at well-being: a composite that at least contains the happiness item.
Modelling approaches

- Null models
- Comparable explanatory variables from 1991 and 2003 BHPS
- \( \log(\text{well being score + 1}) \) is outcome - normally distributed.
- Higher score means lower feeling of well-being
- IGLS, WIGLS and MCMC estimation
Results.

• Similar results to before: but need to make sure the results presented in a meaningful way. Began by fitting null models for:

  • single level,
  • individual+household level,
  • individual+household+district level models
  • used three different estimation approaches
results

• Carried out likelihood ratio tests and obtained DIC statistics for each model - to test statistical significance of variance components.

• the MCMC estimates of the district and household components were a bit larger than IGLS

• District level estimate for null model tiny but statistically significant.
Results

• Produced a ‘caterpillar plot’ as shown on the next slide, which ranks the districts and gives the district level estimates of well being and error bars which are $1.4 \times \text{SE of estimate}$ (Goldstein and Healy, JRSS(A), 1995).
Areas with statistically significantly different well-being scores: null model, MCMC; 1991

Lowest well-being:
1. Wakefield (Yorkshire)
2. Slough
3. Alyn and Deeside, Delyn and Wrexham Maelor (Wales)

Highest well-being:
1. Wycombe
How big are these differences?

- On the original scale, the overall mean is 9.92
- 10.46 in Wakefield
- 10.45 in Slough
- 10.43 in Wrexham, etc.
- 9.48 in Wycombe.
2003 analysis

- The null models for 2003 had even lower estimates of between district variance component, higher between household variance than 1991 and higher between individual variance than 2003, whilst the overall mean score was almost identical 2.391 [or 9.92 on original scale].
Household and individual level components: well-being; null models; standard deviations.

<table>
<thead>
<tr>
<th></th>
<th>1991</th>
<th>2003</th>
</tr>
</thead>
<tbody>
<tr>
<td>HH</td>
<td>.13</td>
<td>.16</td>
</tr>
<tr>
<td>Indiv.</td>
<td>.37</td>
<td>.43</td>
</tr>
</tbody>
</table>
2003 analysis

• Are there greater social divides between people in terms of well-being in 2003 compared with 1991?
• likelihood ratio test and DIC measures suggested borderline significance of the district level variance component for 2003 well-being in the null model.
• Here is the caterpillar plot for 2003 ...
2003 null model

- No districts are significantly different from any other with respect to this well being measure, despite the fact that the DIC was slightly smaller for the model with district level included than that for the model without.
Selected coefficients from comparable models for 1991 and 2003; MCMC estimation.

<table>
<thead>
<tr>
<th></th>
<th>1991</th>
<th>2003</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
<td>.001 *</td>
<td>.002 *</td>
</tr>
<tr>
<td><strong>Female</strong></td>
<td>.008 *</td>
<td>.009 *</td>
</tr>
<tr>
<td><strong>Health excellent</strong></td>
<td>ref.</td>
<td>ref.</td>
</tr>
<tr>
<td><strong>Health good</strong></td>
<td>.095 *</td>
<td>.149 *</td>
</tr>
<tr>
<td><strong>Health fair</strong></td>
<td>.216 *</td>
<td>.308 *</td>
</tr>
<tr>
<td><strong>Health poor</strong></td>
<td>.368 *</td>
<td>.461 *</td>
</tr>
<tr>
<td><strong>Health very poor</strong></td>
<td>.494 *</td>
<td>.713 *</td>
</tr>
<tr>
<td><strong>Unemployed</strong></td>
<td>.165 *</td>
<td>.054 *</td>
</tr>
<tr>
<td><strong>Family income</strong></td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td><strong>Lone parent</strong></td>
<td>.118 *</td>
<td>.032 NS</td>
</tr>
</tbody>
</table>
1991 Full model district level residuals: MCMC
2003 Full model district level residuals: MCMC
### Remaining household and individual level variation, full models

<table>
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<th>2003</th>
</tr>
</thead>
<tbody>
<tr>
<td>HH</td>
<td>0.11</td>
<td>0.14</td>
</tr>
<tr>
<td>Indiv.</td>
<td>0.35</td>
<td>0.40</td>
</tr>
</tbody>
</table>
Conclusions 1

• Happiness is a difficult thing to measure.

• If we have a measure of happiness that we are prepared to use then I think it makes sense to do some multilevel modelling of this outcome as a part of a wider analysis.

• In our case we opted for a composite measure of well-being that may contain some element of happiness - a well-being score.
Conclusions 2

• presentation of the results must be done with care: ranks are dangerous!

• however, our earlier experiences were interesting in terms of the comments on the results, and maybe suggest that the multilevel modelling could be followed up with a qualitative study based on the results of the models.
Conclusions 3

• Based on the characteristics we found important in models we can identify population to study qualitatively: mixed methods approach.

• this may enable us to investigate individual and hh variations in more detail.

• May also be scope for longitudinal modelling of well being or other happiness measures.

• Also would like to look at finer geography if data permitted.
the end.
	hank you!