People, place and change. A longitudinal study of individual, cohort and contextual effects on levels of belonging to neighbourhoods and interaction with neighbours, England 1998-2008

A thesis submitted to the University of Manchester for the degree of Doctor of Philosophy in the Faculty of Humanities

2014

Brian Kelly

School of Social Sciences

Contents

Word count: 71,621 words (excluding appendices)

List of tables

List of figures

List of abbreviations

AIC	Akaike information criterion
BHPS	British Household Panel Survey
BIC	Bayesian information criterion
BME	Black and minority ethnic
DIC	Deviance information criteria
ESRC	Economic and Social Research Council
IGLS	Iterative generalised least squares
MAUP	Modifiable areal unit problem
MCMC	Markov chain Monte Carlo
ODPM	Office for the Deputy Prime Minister
OECD	The Organisation for Economic Co-operation and Development
ONS	Office for National Statistics
UK	United Kingdom

List of appendices

Abstract

September 2014

The University of Manchester
Brian Kelly
Thesis submitted for the degree of Doctor of Philosophy, Faculty of Humanities

People, place and change. A longitudinal study of individual, cohort and contextual effects on levels of belonging to neighbourhoods and interaction with neighbours, England 1998-2008

Abstract

In recent decades there has been a rekindling of academic interest in place, and with the way in which processes associated with modernity, globalisation and individualisation may have diminished place based communities, and weakened the attachment between individuals and the neighbourhoods in which they live. There are also debates about the importance of neighbourhood context, particularly whether neighbourhood level material deprivation and increased ethnic diversity act to reduce individual belonging to neighbourhoods and interactions between neighbours.

This thesis aims to contribute towards an understanding of the ways in which individual belonging to neighbourhoods, and interaction with neighbours, may have changed over time, in relation to individual and neighbourhood context. Data from the British Household Panel Survey, for England, for the period 1998 to 2008, measuring the outcomes of individual level belonging to neighbourhoods and the likelihood of talking to neighbours, are combined with neighbourhood level Census data. Longitudinal models are used to test for age and cohort effects, and then extended to consider neighbourhood level context. Specific attention is given to the relationship between the outcomes under study and neighbourhood material deprivation, neighbourhood ethnic diversity, household income and individual mobility between neighbourhoods.

Some evidence was found for cohort effects, with younger cohorts, particularly those in higher income households, being less likely to talk to neighbours. There were no apparent cohort effects for the outcome of belonging to the neighbourhood, which is found to be associated with age (generally increasing as individuals get older), and neighbourhood context. In materially deprived neighbourhoods levels of belonging are lower, but only for individuals in households with low incomes. Similarly any effect of individual mobility was found to be conditional on household income and neighbourhood level material deprivation. In general, high or increasing neighbourhood level ethnic diversity was not associated with reduced individual belonging to neighbourhoods or likelihood of talking to neighbours once other contextual variables were considered. Also, increased ethnic diversity had a small positive effect on the outcomes under study for individuals living in neighbourhoods with high levels of material deprivation.

Declaration

No portion of the work referred to in the thesis has been submitted in support of an application for another degree or qualification of this or any other university or other institute of learning.

Copyright statement

Acknowledgements

I am very grateful to my supervisors Dr Mark Tranmer and Professor Tarani Chandola for their helpful and thoughtful guidance, and for their invaluable encouragement and support. I would also like to thank Professor Ian Plewis and Professor Natalie Shlomo for their important and insightful contributions.

I am grateful to the Economic and Social Research Council, for the generous funding and the opportunity to undertake this PhD, and to the UK Data Service for enabling access to data.

Thanks to all PhD students in Manchester who I have had the good fortune to meet along the way, the opportunity to present and discuss work has been crucial to the whole process.

This work was supported by the Economic and Social Research Council [ES/J500094/1].

1 Introduction

1.1 Overview

This thesis is concerned with the relationship between individuals and local neighbourhoods, and with the ways in which this may have changed over time.

In recent decades there has been a rekindling of academic interest in the concept of local place and neighbourhood (Agnew 1989, Casey 1997). Partly this arises from concerns with the ways in which processes associated with modernity, globalisation and individualisation may be changing the nature of local place, weakening individual attachments to local neighbourhoods, and undermining 'communities' (Harvey 1982, Bauman 2001, Beck & Beck-Gernsheim 2002). There is also developing interest in the notion that local place has 'agency' (Gieyrn 2000), and that neighbourhood has a separate, independent effect on a range of individual outcomes (Wilson 1987, van Ham et al 2012).

The objective is to examine the individual level outcomes of belonging to the neighbourhood and likelihood of talking to neighbours. The extent of individual belonging to neighbourhoods and likelihood of talking to neighbours are measures that capture key aspects of neighbourhood and community. The overall aim of this thesis is to contribute towards an understanding of the ways in which these outcomes may have changed over time, in relation to differences between individuals, processes of change within individuals, and neighbourhood context.

This thesis, therefore, engages with the concepts of process and neighbourhood context. A definition of neighbourhood is developed which recognises the central importance of the relationship between people and local place (Tuan 1977, Agnew 1987, Low & Altman 1992). Neighbourhood, it is argued, is best understood as a process, essentially open and dynamic, an event that is always under construction (Lefebvre 1991 [1974], Soja 1980, Massey 2005).

1.2 Research questions and hypotheses

The research questions addressed in this thesis are also about process and neighbourhood context. Are the processes associated with modernity, globalisation and individualisation leading to reduced individual belonging to neighbourhoods and likelihood of talking to neighbours? Does neighbourhood context, and change to neighbourhood context, have an independent effect on individual levels of belonging to neighbourhoods and likelihood of talking to neighbours? What role does individual mobility play? Does individual mobility lead to reduced belonging to neighbourhoods and likelihood of talking to neighbours, or are any associations with individual mobility dependent upon individual circumstances and neighbourhood context? Chapter 2 of this thesis reviews the existing theoretical and empirical literature in order to develop specific hypotheses that address gaps, or contested areas, of existing knowledge.

Theoretical work suggests that structural processes associated with modernity, globalisation and individualisation are leading to reduced individual belonging to neighbourhoods and reduced interactions between neighbours (Harvey 1982, Bauman 2001, Beck & Beck-Gernsheim 2002). If this were so then this would represent a generational change, and would be observable as a reduction in belonging to neighbourhoods and talking to neighbours in younger birth cohorts, independent of any effects associated with an individual’s life course.

The vast majority of empirical studies find that older individuals have higher levels of belonging to neighbourhoods and likelihood of talking to neighbours (Trentelman 2009, Lewicka 2011). It has been argued that the higher levels of belonging to neighbourhoods and talking to neighbours observed in older people results from accumulated biographical experience (Gieryn 2000, Trentelman 2009). However, as existing empirical studies are predominantly cross-sectional there is no way to determine whether higher levels of belonging to neighbourhoods and talking to neighbours amongst older individuals reflect changes that occur within individuals over their life course, or whether these observations reflect generational change (Lewicka 2011, Scannell & Gifford 2014).

Therefore this thesis looks to test hypothesis 1: that younger cohorts will have lower levels of belonging to neighbourhoods and talking to neighbours, independent of any individual age related effects associated with life stage. In other words, the positive association between older age groups and both higher levels of belonging to the neighbourhood, and increased likelihood of talking to neighbours, that have been observed in cross-sectional studies to date, are partly a result of cohort differences, reflecting decreasing levels of belonging to neighbourhoods and talking to neighbours in younger generations.

There are strong arguments to suggest that, if successive generations belong to neighbourhoods less and talk to neighbours less as a result of processes associated with globalisation and individualisation, then any such change is conditional on individual income. It may be that the affluent have become increasingly detached from local neighbourhoods and neighbours, while the poor have remained more localised (Massey 1991, Bauman 1998a, Castells: 1996, 1997, 1998). Therefore poorer individuals may have higher levels of belonging to neighbourhoods and likelihood of talking to neighbourhoods. The empirical evidence is mixed (Sampson 1988, Brown et al 2003, Lewicka 2011). There is often an implicit assumption that individual poverty leads to more negative outcomes for individuals, leading to less interaction between individuals within neighbourhoods and reduced community cohesion (Wilson: 1987, 2013, Walker & Walker 1997, Madanipour et al 1998, Oliver and Wong 2003, Li et al 2005). However, some studies suggest that poorer individuals require extended networks and connections in their local neighbourhoods in order to deal with the realities of everyday life (Guest & Wierzbicki 1999, Forrest and Kearns 2001).

Again, most existing studies are cross-sectional and do not engage with processes of change. Based on the literature reviewed in this thesis it is expected that poorer groups have remained more localised, as the affluent have transcended local neighbourhoods. Therefore this thesis will look to test hypothesis 2: that any reduction in levels of belonging to the neighbourhood and likelihood of talking to neighbours in younger cohorts, as a result of generational change, is greater for high income groups. It is expected that lower income groups will have higher levels of belonging to the neighbourhood and likelihood of talking to neighbours. Also that, over time, more affluent groups will experience greater reductions in levels of belonging and interaction with neighbours as a result of generational change.

While hypothesis 2 contends that low income groups may have higher levels of belonging to neighbourhoods and likelihood of talking to neighbours, most conceptual and empirical work suggests that high levels of neighbourhood deprivation are associated with more negative individual outcomes. If this were the case then this would present a potential paradox, which perhaps can only be understood in the context of individual mobility, or lack of mobility, between neighbourhoods.

Within the field of 'neighbourhood effects' there is emerging concern over the issue of selection bias (Small & Feldman 2012, Hedman & Galster 2013). Selection bias arises from the non-random distribution of individuals across different types of neighbourhood, resulting in an 'endogenous group membership problem' (Hedman & van Ham 2012, van Ham et all 2013, Wilson 2013). This has been seen as a threat to inferences made about the causal mechanisms operating within neighbourhood effects (Galster 2012). More recently interest has focussed on the selection processes in operation that lead to the clustering of certain types of individuals within certain types of neighbourhood. It has been suggested that neighbourhoods are best understood as flows (Bailey et al 2013), rather than as static entities. That there is a 'demographic conveyor belt', whereby many young people move into deprived neighbourhoods and move out again shortly afterwards (van Ham et al 2013). There is also evidence that poorer individuals are more constrained to neighbourhoods with higher levels of material deprivation throughout their life course (Kelly 2013). Cross-sectional studies only provide a snapshot of neighbourhoods at a given point in time, and so reveal little about underlying processes. It may be that the processes that constrain poorer groups to more deprived neighbourhoods through their life course and the processes that enable others to pass through deprived neighbourhoods are not just issues of bias in estimating neighbourhood effects. Rather, it may be that selection bias, the selection mechanisms that give rise to the clustering of similar individuals within neighbourhoods, are equivalent to observed neighbourhood effects. In other words, it may be that being constrained to more deprived neighbourhoods throughout an individual's life course acts to reduce individual level belonging to neighbourhoods and likelihood of talking to neighbours. Therefore this thesis will look to test the hypothesis 3: that remaining in materially deprived neighbourhoods, or moving into materially deprived neighbourhoods, will act to reduce levels of belonging to neighbourhoods and talking to neighbours for low income groups.

The final hypothesis that this thesis looks to test, hypothesis 4, also relates to notions of neighbourhood effects. It has been suggested that high, or increasing, levels of ethnic diversity within neighbourhoods leads to individuals withdrawing from the neighbourhood and from contact with others within the neighbourhood (Putnam 2007). Empirical studies addressing this proposition have produced conflicting results, often due to differences in, and limitations of, methodological approaches (Laurence & Heath 2008, Letki 2008, Fieldhouse & Cutts 2010, Sturgis & Smith 2010, Twigg et al 2010, Becares et al 2011, Laurence 2011, Sturgis et al 2011). These conflicting results also reflect longstanding debates about attitudes to ethnic diversity and difference. Conflict theories (Blumer 1958, Blalock 1967, Tajfel 1982), and suggestions that ethnic diversity leads to social disorganisation (LeVine & Campbell 1972, Sampson 1988, Keith 2005), are based on bounded, exclusive, competitive notions of identity and community. In contrast, contact theory suggests that interaction between different ethnic groups leads to better understandings and relationships between groups (Allport 1954). Also neighbourhood and community can be understood as essentially open, dynamic processes, consisting of hybrids of those living in any given neighbourhood at any given point in time (Massey 1991, Lippard 1997). It has been argued that as long as local identity is not exclusive, or based on involuntary segregation, then belonging to place is not only possible but an essential part of human well-being (van Leeuwen 2013). Also, that all identities can be considered as inevitably 'hybridised', new forms created by the coming together of difference (Bhabha 1990, Rose: 1995, 1999), without the 'politics of polarity' (Hall & Jefferson 1976, Gilroy: 1987, 2004, Young 1990). Diverse neighbourhoods can be thought of as a 'difference making machine' (Isin 2002). Difference, therefore may be an essential part of the process of neighbourhood, and may lead to stronger relationships between individuals and neighbourhood, and between individuals living within neighbourhoods.

Therefore this thesis looks to test hypothesis 4: that, after controlling for other neighbourhood level variables, higher levels of, or increases in, neighbourhood ethnic diversity are associated with higher levels of individual belonging to neighbourhoods and talking to neighbours, when compared to individuals in neighbourhoods that are not ethnically diverse, or do not experience an increase in neighbourhood ethnic diversity.

It is important to address this question. Despite the academic debate being unresolved, governments in the UK have developed policies based on exclusive notions of belonging and neighbourhoods, presenting ethnic diversity as a threat to cohesion (Yuval-Davis et al 2005, Kundnani 2007). It has been argued that values and accepted community norms have now become 'governmental' (Cheong et al 2007, Back et al 2002). It has also been argued that the community cohesion agenda, and attacks on multiculturalism may be counterproductive as these policies create and manufacture the problem of the 'other', while doing nothing to address material disadvantage and discrimination (Amin & Parkinson 2002, Ben-Tovim 2002, Yuval-Davis et al 2005, Kalra & Kapoor 2009, Ratcliffe 2012, van Leeuwen 2013).

Chapter 2 provides an in-depth review of the literature and details the development of the specific hypotheses that this thesis looks to test.

1.3 Methodological approach

As the research questions and specific hypotheses are related to process and neighbourhood context, then it is fitting that the methods employed are able to engage with these concepts. To that end longitudinal and multilevel methods are employed in the course of the analysis.

This thesis uses longitudinal data, for England, from the British Household Panel Survey (BHPS), carried out by the ESRC UK Longitudinal Studies Centre, for three survey waves (1998, 2003 and 2008) where questions regarding individual belonging to the neighbourhood and likelihood of talking to neighbours were asked. The sample at each cross-sectional survey wave varied between 6,601 and 8,864 individuals, and the longitudinal sample, those responding across survey waves, consisted of 9,949 individuals. The survey collects a range of individual and household level variables, and geographical information that can be used to identify the neighbourhood of residence for each respondent at each survey wave. Census data are used to construct neighbourhood level measures of material deprivation, ethnic diversity, population turnover and population density, using standard ward geographies to represent neighbourhood. These ward level measures of neighbourhood context were then attached to individual sample respondents.

Longitudinal growth trajectory models, which are capable of distinguishing between cohort and age effects, were developed first. The defining feature of such models is their ability to determine variation within individuals over time, as well as variation between individuals. These models allow for random differences between individuals, and for each individual to have variation in their trajectory of change over time. By partitioning the variance in this way it is possible to determine the exact nature of change within individuals over time, and so determine whether there are cohort effects in operation. By introducing a measure of household income, and investigating the interaction between individual change over time and household income, it is possible to determine whether any cohort changes to individual levels of belonging to neighbourhoods and likelihood of talking to neighbours are conditional, dependent upon levels of household income.

Next, neighbourhood context was considered, beginning with descriptive analysis which looked at measures of ward level material deprivation, ethnic diversity, gross migration rates and population density for the entire population of England wards. Particular attention was given to the ways that measures of neighbourhood context change over the three Census periods of 1991, 2001 and 2011, and to the relationships between measures of neighbourhood context. Ward level measures were estimated for the intra Census years corresponding to the survey waves of 1998, 2003 and 2008. The relationship between neighbourhood context and the individual level outcomes of belonging to the neighbourhood and talking to neighbours was explored and cross-sectional multilevel models, treating individuals as nested within neighbourhoods, were developed. These multilevel models are able to partition the variance in the outcomes under study into variance between neighbourhoods and variance between individuals within neighbourhoods. Therefore the extent of clustering, of similar individuals within certain neighbourhoods, can be measured. The cross-sectional multilevel models enable an initial analysis of neighbourhood contextual effects, in isolation and when controlling for other individual, household and contextual neighbourhood variables.

Finally models are developed that are capable of incorporating both longitudinal change over time and neighbourhood context. This presents some challenges. Individual mobility between neighbourhoods during the study period results in an imperfect hierarchy, with individuals having the potential to be in different neighbourhoods at different measurement occasions. In order to deal with this imperfect hierarchy cross-classified longitudinal multilevel models are developed that allow for individuals to be nested within different neighbourhoods at different time points. These models not only accommodate the imperfect hierarchy within the data, they also enable a consideration of the effects of moving between neighbourhoods. Therefore it is possible to model the association between individual mobility and the outcomes of belonging to the neighbourhood and likelihood of talking to neighbours, relative to neighbourhood context and individual circumstances. Also the cross-classified longitudinal multilevel models are able to consider any effects associated with a change in neighbourhood level context over time, whether this change arises from individuals changing neighbourhood or from changes to pre-existing neighbourhood context. The methodological approach is set out in detail in chapter 3.

1.4 Summary of findings

1.4.1 Results for hypothesis 1

Older individuals were found to have higher levels of belonging to the neighbourhood and were more likely to talk to neighbours, confirming the associations found in existing empirical work. This thesis looks to extend the understanding of this association. Specifically this thesis aims to determine whether older individuals have higher levels of belonging to the neighbourhood and likelihood of talking to neighbours because these outcomes increase within individuals as they get older, or because older cohorts belong more to neighbourhoods and talk more to neighbours, compared to younger cohorts, as a result of generational change.

Results were mixed. For the outcome of talking to neighbours there were observable cohort effects. Older individuals talk more to neighbours, but the likelihood of talking to neighbours does not increase within individuals as they age. Individuals do not change their level of talking to neighbours over time, the differences between older and younger individuals appears to be as a result of generational change. In contrast, it was found that all individuals increase their levels of belonging to the neighbourhood as they get older. The differences between older and younger individuals can be explained by this change within individuals over time. Therefore, while there is evidence to support hypothesis 1 for the outcome of talking to neighbours, there is no support for this hypothesis for the outcome of belonging to the neighbourhood.

These results were observed in two level longitudinal growth trajectory models, using different metrics of time to distinguish between age and cohort effects. These findings are set out in chapter 4. The results remained unchanged once neighbourhood context was also considered in three level cross-classified models, as set out in chapter 6.

1.4.2 Results for hypothesis 2

Hypothesis 2 looks to provide evidence in support of arguments that suggest not all individuals have 'transcended' local place; that the affluent have become increasingly detached from local place while poorer groups remain more localised. There was evidence to support hypothesis 2 for the outcome of talking to neighbours. While younger individuals talk less to neighbours than older individuals, as a result of generational change, this difference is greatest for high income groups. Low income groups experience less change in the likelihood of talking to neighbours, with a smaller decrease between successive cohorts compared to high income groups. For the outcome of belonging to the neighbourhood there were no observable cohort effects to begin with. This outcome is associated with age effects, and, on average, these age related effects do not depend on household income levels.

The findings from two level longitudinal models are presented in chapter 4, and remained unchanged once neighbourhood context was also considered in three level cross-classified models presented in chapter 6.

1.4.3 Results for hypothesis 3

Individuals in households with higher incomes were found to belong more to their neighbourhood but to talk less to neighbours. However when neighbourhood level context is considered higher levels of neighbourhood material deprivation were found to be associated with lower levels of individual belonging to the neighbourhood and lower levels of talking to neighbours. The relationship between neighbourhood level material deprivation and household income was explored, first in cross-sectional multilevel models, presented in chapter 5, and then, along with individual mobility, in cross-classified longitudinal models, presented in chapter 6.

There was a significant interaction between neighbourhood level material deprivation and household income. Individuals in households with low incomes had lower levels of belonging to the neighbourhood, but only in neighbourhoods with high levels of material deprivation. Individuals in households with high incomes had higher levels of belonging to the neighbourhood, regardless of levels of neighbourhood deprivation. For the outcome of talking to neighbours ward context mattered less.

Any effects of moving neighbourhood were found to be conditional, dependent upon neighbourhood level material deprivation and household income. Moving between neighbourhoods has little effect on levels of belonging for high income groups, regardless of neighbourhood material deprivation, or any resulting changes to neighbourhood material deprivation. In contrast moving between neighbourhoods can have a relatively large effect for low income groups, but this depends upon any change in neighbourhood level material deprivation associated with that mobility. Individuals in low income households have lower levels of belonging if they remain in neighbourhoods with high deprivation or move between neighbourhoods with high deprivation. However a move to neighbourhoods with lower levels of material deprivation results in a large increase in belonging to the neighbourhood, just as a move to neighbourhoods with higher levels of material deprivation results in a decrease in belonging. For the outcome of talking to neighbours the effects of moving neighbourhood and the effects of neighbourhood level material deprivation are substantively very small.

1.4.4 Results for hypothesis 4

When neighbourhood ethnic diversity was considered alone, in two level multilevel models, in chapter 4, and three level cross-classified longitudinal multilevel models, in chapter 6, individuals in neighbourhoods with higher levels of ethnic diversity were found to have lower levels of belonging to the neighbourhood and talking to neighbours. However, once neighbourhood level material deprivation and other contextual variables are taken into account the relationship between neighbourhood level ethnic diversity and both outcomes becomes very small and non-significant. This suggests that any observed associations between neighbourhood level ethnic diversity and the outcomes under study are spurious, as a result of the association between neighbourhood ethnic diversity and other neighbourhood level contextual variables, particularly material deprivation.

However, when an interaction between neighbourhood level ethnic diversity and material deprivation was considered, there was a small positive effect of increased neighbourhood ethnic diversity, but only in wards with higher levels of material deprivation. However, it should be noted that the differences are relatively small. The main difference in individual belonging remains associated with levels of neighbourhood material deprivation.

1.5 Substantive conclusions, contribution to knowledge and implications for future research

This thesis addressed the fundamental question of generational change. Despite the longstanding concerns about the ways in which structural processes may have changed individual relationships with neighbourhood, weakening individual belonging to neighbourhoods and diminishing communities (Relph 1976, Harvey 1982, Bauman 2001, Beck & Beck-Gernsheim 2002) there is little empirical evidence to support such theories. Largely this is due to a lack of longitudinal studies able to quantify population level change over time, and examine the nature of change within individuals.

Evidence was found to support the existence of generational change, conditional on income, for the outcome of talking to neighbours, but not the outcome of belonging to the neighbourhood. Perhaps this suggests that any structural changes associated with globalisation and individualisation impact more on behaviour, and less on attitudes or emotions. This is an interesting question that would benefit from further research. Particularly there is more work that could be done to identify the impact of individualisation on individual behaviour, and on notions of community; making use of other longitudinal and cohort studies, and investigating longer time periods.

Also the findings suggest that empirical studies investigating measures relating to neighbourhood or community should be careful about inferences made regarding associations with age. Unless longitudinal methods are employed there is no way to distinguish age and cohort effects.

This thesis also makes a contribution to the study of neighbourhood effects. Within the field of neighbourhood effects there is a recognised need for more longitudinal studies (Hedman & van Ham 2012, Small & Feldman 2012, Hedman & Galster 2013, van Ham et al 2013, Wilson 2013). The three level cross-classified models developed in this thesis offer potential for future longitudinal studies into neighbourhood effects, as they accommodate the imperfect hierarchies that arise due to individual mobility, and enable the modelling of these mobility processes.

Within the neighbourhood effects literature there has been recent interest in the nature of the selection mechanisms that lead to individuals living in particular neighbourhoods (Hedman & van Ham 2012, Small & Feldman 2012, Bailey et al 2013, Hedman & Galster 2013, van Ham et al 2013, Wilson 2013). The findings from this thesis suggest that the neighbourhood effect for belonging to the neighbourhood may be equivalent to the selection mechanisms in operation, and related to processes of geographical constraint. There is a need for further longitudinal research into the ways that processes of constraint to deprived neighbours, throughout a life course, impact on individual outcomes.

Finally, the results add to the weight of evidence which contests the idea that increasing levels of neighbourhood ethnic diversity cause individuals to withdraw from others in the neighbourhood. The findings from this thesis suggest that current UK policy is misdirected, and would be better focussing on, and tackling, issues of individual and spatial inequalities.

1.6 Structure of thesis

Chapter 2 reviews the relevant literature, considering theoretical perspectives, current debates and empirical evidence. This chapter considers the ways in which this thesis can contribute to current understandings, and develops a number of specific hypotheses to be tested in subsequent chapters.

Having set out the research question and specific research hypotheses, Chapter 3 then outlines the data and methods used to test these hypotheses. Conceptual and practical issues are considered. Longitudinal and multilevel models, that enable the testing of research hypotheses, are developed and evaluated.

Chapter 4 employs two level longitudinal growth trajectory models that are able to distinguish between age and cohort effects, and to consider differences in the outcomes between individuals and within individuals over time. These models are employed to test hypotheses 1 and 2, to identify whether cohort effects exist, and whether any such effects are conditional on household income.

Chapter 5 focuses on contextual, neighbourhood level, measures, specifically neighbourhood level material deprivation, neighbourhood ethnic diversity, neighbourhood population turnover and density, and change in neighbourhood context over time. The associations between neighbourhood measures, and the associations with individual characteristics and the outcomes under study are explored. This chapter then considers two level multilevel models, individuals nested within neighbourhoods, for each cross-sectional wave. This provides initial analysis of neighbourhood context in relation to hypotheses 3 and 4.

Chapter 6 brings the longitudinal and multilevel aspects together in three level cross-classified models. These models are able to accommodate the imperfect hierarchy that arises as a result of individuals moving between neighbourhoods over time. Moreover, these models allow for processes of individual mobility, and lack of mobility, to be considered alongside neighbourhood context, and change in neighbourhood context. The cross-classified models were able to fully test hypothesis 3 and 4. Also they considered whether any observed cohort effects, in relation to hypotheses 1 and 2, were modified by neighbourhood context. At the end of chapter 6, evidence for each hypothesis is evaluated in turn.

Chapter 7 presents overall conclusions from this thesis, and reviews the methodological approach taken. The findings arising from this thesis are summarised and contributions to existing knowledge are identified. Finally, wider implications for current and future research are considered.

2 Literature review, research question and hypotheses

2.1 Introduction

The overall aim of this thesis is to contribute towards the understanding of ways in which individual level belonging to neighbourhoods, and interactions between neighbours, may have changed over time, in relation to differences between individuals, change within individuals and neighbourhood context. This chapter will review theoretical perspectives, current debates and empirical evidence, consider how this thesis can contribute to current understandings, and develop a number of specific hypotheses to be tested in subsequent chapters.

The chapter begins by considering some broad concepts. First a definition of neighbourhood is presented, which emphasises the central relationship between people and place. Theories of place are reviewed, and applied in order to develop an overarching theoretical perspective of neighbourhood. The case is made for why the individual outcomes of belonging to neighbourhoods and interaction with neighbours, also why neighbourhoods themselves, should be considered important.

Next, this chapter addresses the question of change. There is an ongoing debate about the impact that processes of modernity, globalisation and individualisation may be having on the very nature of local neighbourhoods, on individual levels of belonging to neighbourhoods and interactions between individuals within neighbourhoods. It has been suggested that individuals have 'transcended' local place. If this were so then this would represent generational change, and be observable as change between successive birth cohorts. This chapter will review the literature, consider the notion of cohort change, and identify limitations of existing empirical studies in their ability to identify cohort change.

Attention then turns to debates about the impact of individual and neighbourhood context on levels of belonging to neighbourhoods and interactions between neighbours. There are strong arguments to suggest that any changes to individual belonging to neighbourhoods and levels of interaction between individuals within neighbourhoods are dependent on individual socio-economic status, that the affluent have transcended local neighbourhoods while poorer individuals remain more localised. At the same time empirical studies suggest that neighbourhood level material deprivation is associated with lower levels of individual belonging to neighbourhoods and interactions between neighbours. The relationship between neighbourhood level material deprivation and household income is discussed, and gaps in existing knowledge are identified. This chapter then considers individual mobility between wards. Empirical evidence in relation to individual mobility and neighbourhood level population turnover is examined and consideration is given to the way this may impact on individual belonging to neighbourhoods and interactions between neighbours.

This chapter then considers arguments that suggest changes to neighbourhood level ethnic diversity have led to reduced individual belonging to neighbourhoods and interaction between neighbours. The empirical evidence and conceptual issues are reviewed. The concept of neighbourhood developed in this chapter stands at odds with fixed, bounded notions evident in arguments contesting that neighbourhood level ethnic diversity reduces individual belonging to neighbourhoods and interaction between neighbours.

Finally the arguments developed in the course of this chapter are drawn together, the key questions that this thesis can address are identified, and specific hypothesis are developed for testing.

2.2 Understanding neighbourhood

Neighbourhood is an ambiguous concept. In empirical studies it has been operationalised at different scales and often, through necessity, bounded by the shape of official geographies. Most empirical studies use relatively small geographic areas when operationalising neighbourhood, though a range of approaches are taken in practice. The finer points of methodological and operational detail are discussed in chapter three. However it is helpful to begin with a discussion of how neighbourhood relates to local place, notions of community and processes of change.

Neighbourhood can be understood, in the broadest sense, as local place. And local place, in turn, understood as a relationship between people and geographical space. The distinguished geographer John Agnew defines place as comprising of three aspects: location, the actual where; locale, the form that where takes; and sense of place, consisting of subjective experience and emotional attachment. (Agnew 1987). This third aspect, subjective experience and emotional attachment, distinguishes place from geographical space. It has been argued that physical space becomes a place when personal, group, or cultural processes have been given meaning through it, (Low & Altman 1992). This suggests place is not static, limited to a given point of space, rather it can be seen as both the product of human activity and the site of human experience (Tuan 1977, Relph 1976, Agnew 1989, Malpas 1999, Gieryn 2000). Much of the renewed academic interest in place has developed in reaction to notions, inherent within modernism, of place as fixed, and thus devoid of meaning (Foucault 1980, Soja 1980, Jameson 1991), where place is regarded as a subordinate concept in comparison to time, and as ‘regressive' or 'trivial' (Casey 1997).

Doreen Massey, from Geography, has argued that space and time should be considered as ‘inextricably interwoven’, as in modern theories in physics (Massey 1992: 1999). Local place can be thought of as an "articulated moment, (the) constellation of social relations, meetings and weaving together at a particular locus" (Massey 1991, p28), local place is therefore not static but generative, an expression of space-time being made, always under construction, always in the process of "being made" (Massey 2005, p39). This reflects similar perspectives from earlier works from philosophy and sociology. The French philosopher Giles Deleuze proposed that time and space should be thought of as together in a single flowing process of time-space (Deleuze 1997 [1975]). Henri Lefebvre also developed an understanding of place as process, from a Marxist perspective, building on dialectical materialism and promoting the importance of place in the theory of spatial dialectics (Lefebvre: 1976 [1973], 1991 [1974]). Dialectical materialism understands the world not as a complex of ready made up things but as a complex of processes, of constant change and the production of the new (Cornforth 1968).

2.3 Neighbourhood and community

If neighbourhood, like local place, can be thought of as a fluid hybrid, consisting of those living there at a given point in time, (Lippard 1997) then what does this mean for the understanding of the notion of community?

It is probably unhelpful to simply conflate notions of neighbourhood and community as there are unlikely to be single, homogonous groups in any given neighbourhood (Massey: 1991, 2004, Agnew 1989). Also community as a concept is often bounded, linked with a nostalgic, static sense of ownership and a negative attitude to outsiders (Entriken 1991, Vaisey 2007). The nostalgic view of 'community lost' is prevalent in early sociology. Influenced by the views of Tonnies, Wirth believed that three aspects of modern urban life population size; population density and population heterogeneity were each acting to reduce the bonds between members of the community (Wirth 1938). This has been challenged (Kasarda & Janowitz 1974), and though the debate has continued (Gans 1968, Fischer 1973, Buttel et al 1979, Wasserman 1982), it is generally agreed that community, or more precisely the relationships between individuals within neighbourhoods, survived the processes of early modernity.

More recently the concept of community has been the subject of renewed interest with the prominence of particular theories of social capital (Putnam 2000). Such theories mirror early sociological concerns with the negative effects of heterogeneity (Putnam 2007), tend to hark back to notions of ‘community lost’ (Putnam 1995) and conflate neighbourhood with community (Putnam: 2000, 2007). Despite this, the definition of social capital as the networks and bonds between individuals actually helps identify that the concepts of neighbourhood and community are separate entities. This thesis therefore engages with the notion of community, not as a definition of neighbourhood, but as a process that may, or may not, occur within neighbourhoods. Rather than neighbourhood being conflated with the notion of a single community, it is probably more accurate to consider the extent and nature of interactions and relationships between individuals within neighbourhoods as an expression of community. Such interactions and relationships within neighbourhoods may be numerous and multifaceted, or may be non-existent, but they are a fluid and dynamic expression of process not a fixed nostalgic entity.

Drawing on these theoretical perspectives, it is argued that neighbourhoods can best be understood as local place and therefore can be considered as a process, as an event that is always under construction, given meaning by, and through, human activity. Community is not reducible to a shared geographic space, rather place based 'communities' can be seen as an expression of the multifaceted interactions and relationships between individuals within neighbourhoods and therefore also as a dynamic process. This dynamic understanding of neighbourhood is central to the development of the research questions addressed in this thesis.

2.4 Why the outcomes of interest are important

A brief case needs to be made for why individual level belonging to neighbourhoods and interaction between neighbours are important outcomes, worthy of academic attention.

Early humanistic geographers, influenced by the idea that belonging is a basic human need (Maslow 1954), suggested that people-place bonds were important for individual psychological well-being (Fried 1963, Tuan 1977, Giuliani & Feldman 1993). It has also been argued that belonging to place is central to the formation of individual identity (Stedman 2002). While some have stressed the shared, collective nature of these processes (Anant 1966), others suggest a more antagonistic scenario of individuals jostling for territory

(Savage 2010). Similarly belonging, or attachment, to neighbourhoods has been suggested as contributing towards individual quality of life (Low & Altman 1992, Rollero & DePiccoli 2010). It has also been suggested that the interaction between individuals within neighbourhoods, or sense of community, is beneficial for individual well-being (Davidson & Cotter 1991, Raphael et al 2001, Theodori 2001). Such views lend some support to the belief that individuals possess a communal essence and that individuals can only achieve their full potential, their realisation as a 'species being' through communal activity and associations with others Marx (1977) [1844].

It has been argued that social capital, as measured by the strength of networks and ties between individuals, including within neighbourhoods, leads to more positive individual outcomes for physical health and subjective well–being (Putnam 2000, Helliwell & Putnam 2004). In addition to the individual level outcomes, it has been claimed that increased social capital leads to reduced levels of crime, better functioning democracies and even increased macro level economic prosperity (Putnam et al 1993, Putnam 2000). It will be necessary, as this chapter progresses, to take a critical look at the social capital theory as advanced by Putnam, suffice to say at this point that, while it may be useful shorthand for positive aspects of sociability some of the claims for the benefits of social capital may be exaggerated (Portes 1998).

Recent government policies suggest that a lack of individual belonging to neighbourhoods leads to less community cohesion (Cameron 2011). However such policies promote an exclusive notion of belonging based on fixed, shared values (Kundnani 2007) which may be counterproductive in the attempt to build cohesive neighbourhoods (Ben-Tovim 2002, Yuval-Davis et al 2005). The question of whether individual belonging to neighbourhoods is inherently an inclusive or exclusive process and the debates around community cohesion are addressed in some detail later in this chapter.

Of all potential individual and societal benefits associated with the higher levels of individual belonging to neighbourhoods and interaction with neighbours, the most compelling may be those that highlight the relationship with human well-being and the expression of human essence.

2.5 Why neighbourhoods are important

Having established a definition of neighbourhood and considered the importance of the outcomes of individual belonging to neighbourhoods and interaction between neighbours, it is also worth considering why it is that the neighbourhood itself should be worthy of academic focus.

The first reason is that neighbourhoods represent a spatial expression of current economic and structural inequalities, indeed there is a longstanding interest in spatial inequalities and spatial justice within geography and sociology (Harvey: 1973, 1996, Castells 1977, Soja 2010). If local place is the site of lived experience (Relph 1976, Tuan 1977), then it is, in essence, an unequal experience. And over the last decades there has been a marked rise in the degree of individual income inequality in the UK (Palmer et al 2008, Evans & Williams 2009, Cribb et al 2012) as well as the US and other western counties (Wilkinson & Pickett 2010). This increasing inequality has a spatial expression, it has been argued that the increasing geographic concentration of affluence and poverty throughout the world, is creating a radical change in human society (Massey 1996, Danziger 1996). In the UK there is certainly evidence of increasing spatial segregation based on income (Dorling et al 2007, Dorling & Ballas 2008). The recent programme of austerity and cuts pursued by UK government since 2010 is likely to lead to further inequality (Dorling 2011, Brewer et al 2011, Dickens 2011) and income segregation (Hammet 2010).

It has been argued that rising inequalities are a direct result of contemporary neo-liberal politics (Irvin 2008, Brady 2009, Hacker & Pierson 2010). These politics are also redrawing the relationship between neighbourhoods and the state. Current policies are moving away from area based regeneration, abandoning existing programmes (Audit Commission 2011) and placing responsibility onto 'communities' (Communities and Local government 2011), leaving deprived neighbourhoods cut adrift to deal with their own inequalities with increasingly fewer resources (Brewer et al 2011, Dickens 2011). As governments have withdrawn from commitment to tackle material inequality, they have moved into the arena of culture and values (Kalra & Kapoor 2009, Ratcliffe 2012) emphasising individual responsibility (Norman 2010). As part of this process, the community cohesion agenda in the UK marks a distinct shift away from addressing material disadvantage towards cultural explanations for lack of individual belonging and cohesion in neighbourhoods (Kymlicka 1999, Joppke 2004, Zetter et all 2006, Perry 2008, Pilkington 2008).

Another reason why neighbourhoods may be important is the suggestion that they, as an 'agentic' entity (Gieryn 2000), have separate, independent effects on individual outcomes, over and above individual circumstances. This is the main premise of the emerging field of 'neighbourhood effects' which has developed since the study of concentrated poverty in Chicago by the American sociologist Julius Wilson (Wilson 1987). There has been a dramatic increase in the literature on neighbourhood effects since then (van Ham et al 2012), however empirical evidence for independent effects remains relatively thin (Cheshire 2012). The most pressing issues are the identification of causal mechanisms and the understanding of selection bias (van Ham et al 2013). A number of causal mechanisms have been proposed, which can be characterised as either structural, for example labour market mismatches, or cultural (Small & Newman 2001, Galster 2012). Cultural explanations predominate and propose that poor neighbourhoods weaken social order, which is spread through ‘contagion’ effects producing ‘oppositional’ or ‘deviant’ subcultures (Jencks & Mayer, 1990).

However, the largest randomised experiment addressing the effects of area level poverty in the USA, the ‘moving to opportunity’ study, designed to test these cultural effects, failed to find any conclusive results (Ludwig et al 2008, Small & Feldman 2012). There were design and implementation problems with the study (Clampet-Lundquist & Massey 2008) but another potential reason for the lack of conclusive results may be that the study was looking to test cultural explanations of neighbourhood effects, which may not exist if the causes were structural. Indeed, the overt focus on individualistic explanations for neighbourhood effects, linked with concepts of the underclass and the culture of poverty, have drawn criticism (Bauder 2002, Wacquant 2008, Slater 2013). While the identification of causal mechanisms remains illusive (Galster 2012, van Ham et al 2012), a linked, but separate, challenge within neighbourhood effects is the selection bias that arises from the non-random nature of mechanisms that lead to certain groups of individuals living in certain areas (Joshi 2001, Hedman & Galster 2013, van Ham et al 2013). The issue of selection bias is central to an understanding of the relationship between individuals and neighbourhoods in general, and specifically to the identification of neighbourhood effects.

A final reason why neighbourhoods may be important is that, if neighbourhood, like local place can be considered as a process, an event always under construction, then neighbourhoods also represents the potential for change. This idea is central to Lefebvre's spatial dialectics (Lefebvre 1991 [1974]). What Lefebvre offers is the potential of place, an open conceptualisation of what place can be, a "dialectical use of utopianism" (Lefebvre 1995 [1962], p357). Recently prominent sociologists have echoed such thinking, making the case that, given increasing inequalities, utopian thinking is required now, more than ever, and recognising the role of local place in building alternatives (Jameson 2004, Wright: 2010, 2012). Such alternatives are only possible if individuals collectively inhabit 'lived space' (Lefebvre 1991 [1974]).

To summarise, neighbourhoods may be considered an important concept for a number of reasons. First because they represent a spatial expression of inequalities and there is evidence of growing inequalities impacting on neighbourhoods leading to more unequal individual experiences. Linked to this is a changing political landscape that has seen a disengagement from addressing material inequality, replaced with a focus on cultural norms. This important development, and the link with certain academic studies, is discussed in more detail later in this chapter. Also it has been argued that neighbourhoods have a separate, independent effect on individual outcomes, over and above individual characteristics. Finally neighbourhoods are important as they remain the site of potential new forms of culture, alternative futures, and opposition to structural inequalities.

2.6 Are the levels of individual belonging to neighbourhoods and interaction between neighbours changing?

It has been argued that recent social and structural processes associated with globalisation have led to changes in the fundamental relationship between individuals and neighbourhoods; that modernity and globalisation have led to a homogenisation, a reduction in diversity of place (Relph 1976, Harvey 1982, Beatley 2004) to the point that local place is being obliterated by global space (Taylor 1982). It is also suggested that in late modernity there has been a 'transcendence of place' (Coleman 1993), a shift in human consciousness from being centred, part of place and period, to being decentred, transcending the here and now (Nagel 1986, Entriken 1991, Auge 1995, Szerszynski & Urry 2006). This is seen by some as a capitalist strategy to create 'places without place', reflecting a consumer society characterised by increasing 'banality and shallowness' (Bauman: 1998b, 2000).

In addition there are processes of individualisation associated with late modernity and the rise of neo-liberal politics that may constitute a new relationship between the individual and society (Beck 1999, Beck & Beck-Gernsheim 2002). It has been suggested that individualisation has become the greatest threat to society, to notions of shared experience (Bauman 2001), and that the underlying capacity of human cooperation is being undermined in the individualised nature of modern society (Sennett 2012). These processes of individualisation and alienation, that may reduce both the degree of individual belonging to neighbourhoods and the interaction that occurs within neighbourhoods, also have a spatial expression in increasing placelessness and the emergence of non-places (Relph 1976, Auge 1995). From a Marxist perspective, processes of individualisation are central to the ideology of late capitalism, where "the atomisation of society into private individuals" is part of the alienation of everyday life (Lefebvre 1991 [1974], p233). Influenced by Situationist thinking, that the defining nature of everyday life was the reification and abstraction of individuals from directly lived experience (Debord 1994 [1967]), Lefebvre's theory of spatial dialectics argues that the alienation of individuals in modern capitalism is no longer just confined to the process of production, but extends to the role of local place. While Lefebvre recognises the open possibilities of 'lived space', where individuals can become total humans, or l'homme totale, this is seen as under threat from the 'perceived' and 'conceived' space of modern capitalism, where 'perceived' and 'conceived' space have become 'the location and source of abstractions' (Lefebvre 1991 [1974]). It has been argued that modern capitalism, particularly in the US, has created places that are no longer 'real', but rather belong to the 'hyper-real order', the 'order of simulation' (Baudrillard 1994 [1981]). Certainly different types of neighbourhood may promote or constrain the amount of social interaction that occurs. For example US suburbs with privatised gardens, no public space, public transport or even pavements (Lippard 1997), and the rise in the number of 'gated communities' which appropriate and regulate public space (Low 2006, Low & Smith 2006, Cunningham 2004).

This thesis is concerned with the impact that such structural changes may have had on individual belonging to neighbourhoods and interaction with neighbours. Of all structural changes presented, the process of individualisation may have had the greatest impact. The process of individualisation erodes the possibility of collective experience and undermines the existence of 'communities' and dynamic neighbourhoods. Alienated individuals may share the same geographical space without much interaction. Also, the weakening of 'community' and of dynamic neighbourhoods may mean that there is less of an event that individuals can belong to.

Robert Putnam's theory of social capital argues that since 1965, in the US, there has been a fundamental decline in political and civic engagement, informal social ties and trust (Putnam 1995, Putnam 2000). In this early work the reasons for this decline are rather underdeveloped and are presented in a 'guestimated explanation' in a pie chart (Putnam 2000, p 284) as, in descending order of size, generational change, TV, work, urban sprawl and one category called 'other'. The greatest effect, generational change, is linked to the passing of the 'world war two generation', those born in the first third of the last century. Putnam's version of social capital has been criticised as lacking in conceptual clarity (Portes 1998), for ignoring social inequalities and the effects of neo-liberal globalisation (McLean et al 2002) and for ignoring the negative effects that can arise from strong exclusionary networks (Portes 1998, Trigilia, 2001, Browning et al 2004). However, in this context, the biggest conceptual deficit is that this work does not address the issue of individualisation which is not even listed in the subject index of 'Bowling Alone' (Putnam 2000), despite the fact that many of the subjects discussed in the book could be best described as individualisation (Fischer 2005).

If it is the case that processes of globalisation, individualisation and privatisation of place have had an impact on individual levels of belonging and interaction with neighbours, then there should be observable generational, cohort, changes, over and above changes associated with individual aging processes. Analysis presented by Putnam using repeated cross-sectional data is not clear (Putnam 1995) and subsequent studies repeating the analysis, using the same data, have suggested the presence of both age and cohort effects (Robinson & Jackson 2001). While identifying cohort changes does not explain why these changes occur (Fischer 2005), the concept of generational change, change between successive cohorts, is important in understanding the process of social change (Ryder 1965, Glenn 1976).

Conceptually, cohort effects can be considered as distinct from age and period effects. Age effects refer to the changes that affect all individuals as a result of life cycle changes, while cohort effects can be thought of as independent of the effects of aging, this can be the unique experience of one birth cohort or systematic generational change. Period effects are differences related to a particular era, an effect that applies to all individuals in a given era independent of age or birth cohort (Schaie 1965, Firebaugh 1997).

It has been argued that individual belonging to neighbourhoods is a result of accumulated biographical experience (Gieryn 2000), and many empirical studies focussing on individual explanations for these outcomes identify a positive association with individual age and length of time in the neighbourhood (Berry & Kasarda 1977, Shumaker & Taylor 1983, Sampson 1988, Cuba & Hummon 1993, Trentelman 2009, Lewicka 2011). Within this literature there is a debate about the relative effects of age and time lived in the neighbourhood, as older people tend to move less, these variables are related. It is important to separate these effects in any analysis and this is considered in more detail when discussing individual mobility later in this chapter.

However it has to be noted that previous empirical studies that consider the outcomes of belonging to the neighbourhood or interaction between neighbours have been predominantly cross-sectional (Trentelman 2009, Lewicka 2011). Despite the concern with processes there is a lack of longitudinal studies (Hernandez et al 2014, Scannell & Gifford 2014). This is problematic as cross-sectional studies cannot separate age and cohort effects (Firebaugh 1997) and in cross-sectional analysis the difference in outcomes by age group are often assumed to be age effects when they may in fact be cohort differences (Palmore 1978). Therefore, while individual age is universally observed to be associated with the outcomes of belonging to neighbourhoods and interaction with neighbours, it is not known how much this is due to individual developmental changes and how much to generational differences.

2.7 Income and levels of individual belonging to neighbourhoods and interaction with neighbours

2.7.1Are changing levels of individual belonging to neighbourhoods and interaction with neighbours conditional on individual income?

The phrase time-space compression has been used to describe the increased ability for movement and communications and the stretching out of personal relationships over larger geographies (Harvey 1990). However, there are strong arguments to suggest that everyone does not experience time-space compression in the same way. It has been argued that experience is dictated by an individual's position in the global social hierarchy, that there is a "power geometry of time-space compression", with some in charge of new movement and some imprisoned by it (Massey 1991, p25-26). The processes associated with globalisation may amount to a complex spatial restructuring, a polarisation of spatial based inequalities, rather than a transcendence of place (Bauman

1998a), and that in the new 'network society', it is the poor who remain localised (Castells: 1996, 1997, 1998). This suggests that poorer individuals may have stronger relationships with neighbourhoods, having higher levels of belonging and interaction with neighbours.

The results from empirical studies that address the effects of individual income, or socio-economic status, on belonging to neighbourhoods and interaction with neighbours are mixed, partly due to differences in methodology (Lewicka 2011). Some studies have identified that affluent individuals are less attached to their neighbourhood (Gerson et al, 1977, Sampson 1988), while others report no effects (Hidalgo & Hernandez 2001, Brown et al 2003). A recent study in the UK, using a large representative sample and multilevel modelling, identified relatively strong effects of socio-economic status on the outcome of belonging to the neighbourhood (Finney and Jivraj 2013), however this was not the main focus of this study. In the literature there is often an implicit view that poor individuals lack the resources for interaction and cohesion and that this leads to 'unsuccessful' neighbourhoods (Forrest & Kearns 2001). This notion, that individual level poverty leads to less interaction, and particularly cohesion in neighbourhoods, has been advanced by a number of authors (Wilson: 1987, 2013, Walker & Walker 1997, Madanipour et al 1998, Li et al 2005, Oliver and Wong 2003, Laurence & Heath 2008).

While there may be implicit assumptions about the negative effects of poverty on individual levels of belonging to neighbourhoods and talking to neighbours, it has also been shown that poorer individuals require extended networks and connections in order to deal with everyday life (Stack 1974), that relationships with neighbours may be more important for poorer individuals (Guest & Wierzbicki 1999), and that poor people spend more time in their neighbourhood (Forrest & Kearns 2001). Consequently more affluent individuals may have more spatially diffuse relationships and may not anticipate or practice much social interaction within their neighbourhoods (Forrest & Kearns, 1999). Also most empirical studies are, again, cross-sectional and there are no studies considering whether generational, cohort, changes to individual belonging to neighbourhoods and interaction with neighbours are conditional on individual income. Based on the literature reviewed it would be expected that the poor have remained more localised as the affluent have transcended place. This is an area that remains under studied and deserving of further investigation.

2.7.2 Individual income and the neighbourhood effect paradox

It has been suggested that concentrated neighbourhood level material deprivation reduces individual level relationships with neighbourhoods (Small & Newman 2001, Hickman et al 2012, Wilson 2013). High neighbourhood level material deprivation has been consistently shown to be associated with lower levels of individual belonging (Bailey et al 2012) and levels of individual interaction within neighbourhoods (Sampson 1988). There have been a number of empirical studies employing multilevel models and using large representative samples from the UK that have addressed the association with neighbourhood level material deprivation. These studies tend to find that there are negative effects of neighbourhood level material deprivation on individual relationships with neighbourhoods (Laurence & Heath 2008, Letki, 2008, Becares et al 2011), though there are some results that find the association non significant (Finney & Jivraj 2013). While multilevel models are more suited, than single level studies, in determining contextual effects all multilevel studies so far have also been cross-sectional and so cannot say much about process.

Within neighbourhood effects studies it is largely assumed that concentrated neighbourhood poverty has a negative effect because of 'contagion' effects operating at the individual level (Wilson 1987, Small & Newman 2001, Galster 2012). However if this were the case, then individual level and neighbourhood level effects would be in the same direction. In other words, if poor people had lower levels of belonging and talking to neighbours and then transmitted this to other individuals in the neighbourhood then this would explain the contextual effects. But if poor people have greater levels of belonging and interaction with others in the neighbourhood, it cannot be that contagion effects are the causal mechanism if the neighbourhood level effects of material deprivation are negative. This remains an interesting paradox that has not been directly addressed in the literature to date. It may be that this paradox can only be fully understood when considering individual mobility, or lack of mobility, and that lack of mobility for poorer individuals in areas of concentrated poverty may have a suppressor effect on levels of belonging to neighbourhoods and interaction with neighbours. In other words that being constrained to more materially deprived wards will reduce levels of belonging to that neighbourhood and reduce likelihood of talking to neighbours. Combining multilevel and longitudinal models would offer further possibilities for determining these contextual effects. This, and the importance of incorporating individual geographical mobility, is addressed in subsequent sections of this review.

2.8 Geographical mobility and individual belonging to neighbourhoods and interaction with neighbours

2.8.1 Individual geographical mobility

Empirical studies tend to argue that increased geographical mobility has led to individual relationships being spread over wider geographies which weakens levels of belonging to the neighbourhood (Wellman 1988, Wellman & Leighton 1979, David et al 2010). A recent study in the Netherlands proposed that individual mobility had a negative effect on the relationships between people within neighbourhoods, however when tested with a large random sample, using multilevel models, it was found that there were no such negative effects (Nieuwenhuis et al 2013). Conversely it has been suggested that mobility can facilitate attachments to new places and that these attachments can occur quickly, that it is possible for an individual to feel that they belong to a neighbourhood very soon after arriving (Lewicka 2014). Also there is some evidence that geographical mobility leads to individuals seeking to make new social connections in the neighbourhoods they move into (Oishi et al 2013). Also recent longitudinal research using the British Household Panel Survey has suggested that individual life satisfaction improved after geographical mobility (Findlay & Nowok 2012, Nowok et al 2013).

It should be noted that Putnam rejected increased geographical mobility as a reason for the decline in social capital as mobility rates in the US were relatively constant in the period 1965 to 2000 (Putnam 2000). Indeed, geographical mobility rates in the US have remained fairly constant since the 1940's (Rossi 1980) and it has been convincingly argued that geographical mobility can regarded as a normal activity that most people engage with during their lives (Rossi & Shlay 1982). Certainly mobility is not a new phenomenon. Historical evidence would suggest that geographical mobility can be seen as a human habit running through the full extent of history (Manning 2012). An interesting example is that of the tin trade of Cornwall in the UK that linked with the Eastern Mediterranean as far back as the bronze age (Hawkins 1811). There have been large population movements across America and Europe in more recent history, in the nineteenth and early twentieth century around fifty million Europeans migrated from their home country, mostly to American and other 'new world' destinations (Hatton & Williamson 1994, Manning 2012). Also, even before the industrial revolution, internal migration in the UK was common, with migratory craftsmen and seasonal labourers contributing to mixed populations (Hawsbawn 1991, Emsley et al 2013).

So while it seems an implicit assumption, in much of the literature, that individual mobility has negative effects on levels of belonging to neighbourhoods and talking to neighbours, there is reason to doubt that should always be the case. There is good empirical evidence, from longitudinal data, that mobility can increase individual quality of life and some emerging results, from small scale studies and studies outside the UK, that suggest that mobility between neighbourhoods may not have a negative effect on individual belonging to neighbourhoods and interaction with neighbours.

2.8.2 Neighbourhood population turnover and selection effects

Perhaps the view that 'modern society is a society on the move' (Lash & Urry 1994) may be too stark a claim, not only because geographical mobility is not a new phenomenon but also because mobilities may be conditional on individual income, with the affluent taking advantage of this increased mobility while impoverished and marginalised social groups become localised due to lack of resources and growing powerlessness (Bauman 1998a). In this way restrictions on mobility may act to reinforce social inequalities (Urry: 2000a, 2000b, 2012). Indeed, while globalisation may have increased the mobility of goods and services, it may also have led to the creation of enclaves, increased political regulation and restrictions on mobility (Turner 2007), to the extent that these new forms of closure, entrapment and containment can be understood as a 'mobility regime' (Shamir 2005). Some have argued that there is an increasingly 'gated globe', where global interconnections and mobility are increasingly stratified and highly regulated (Cunningham 2004). Therefore it is important to recognise that belonging or attachments to neighbourhoods may not always be considered as positive (Trentlelman 2009), as for some there is little choice and restricted ability to move (Gilleard et al 2007).

It has been suggested that there is a residualisation process which concentrates those with least choice into neighbourhoods with the poorest quality physical environment and services (Taylor 1980). Studies using longitudinal data and large representative samples have demonstrated, from a life course perspective, that low income individuals are more constrained to neighbourhoods with high material deprivation, both in the UK (Kelly 2013) and US (Sharkey 2012). It has also been argued that geographical mobility itself does not necessarily lead to negative well-being, but rather low mobility, in conjunction with low levels of personal choice, has a negative effect on well-being (Stokols & Shumaker 1982, Stokols et al. 1983). Therefore, while individual belonging to neighbourhoods has been consistently shown to be positively associated with length of residence (Lewicka 2011), less attention has been paid to the potential negative effects of lack of mobility for those in materially deprived neighbourhoods.

UK government policies tend to regard neighbourhoods with high population turnover as leading to reduced local social cohesion (Lawrence & Heath 2008, Beatty et al 2009). There is some empirical evidence to support this (Sampson et al 1997), but most empirical studies have found no relationship between neighbourhood level population turnover and lower cohesion (Bailey & Livingston; 2007, 2008, Bailey et al; 2012, 2013, Nieuwenhuis et al 2013).

Within the neighbourhood effects literature it is recognised that individuals are not allocated to neighbourhoods in a random manner, this creates an ‘endogenous group membership problem’, which is particularly problematic when the selection bias is related to the outcomes under study (Hedman & van Ham 2012). Most empirical studies into neighbourhood effects have been cross-sectional so cannot address selection bias (van Ham et al 2013), and this limits attempts to identify causal mechanisms, which remains a central concern within neighbourhoods effects (van Ham et al 2012, Wilson 2013). More recently however it has been recognised that an understanding of mobility is central to fully understanding neighbourhood effects (Hedman & van Ham 2012, Small & Feldman 2012, Hedman & Galster 2013, van Ham et al 2013, Wilson 2013).

It has been suggested that neighbourhoods may be best understood as flows, rather than static entities (Bailey et al 2013) and that in poor neighbourhoods there may be a 'demographic conveyor' where many young people move into poor neighbourhoods and then move out again shortly after (van Ham et al 2013). Therefore a cross-sectional study can only illuminate a static snapshot in time, and reveals little about process. One recent study employing longitudinal data from Sweden, develops a more holistic notion of neighbourhood effects, where individual characteristics affect where individuals live and then in turn these neighbourhoods affect individual outcomes, including future moving behaviour (Hedman & Galster 2013). While this is an advance in terms of identifying process as important, there may still be conceptual problems with such an approach. It has been argued earlier in this thesis that there is socio-economic constraint on geographical mobility, a process that leads to poorer individuals constrained to poorer areas during their life course, and these processes can be considered as the selection mechanism in operation. A 'holistic' view (Hedman & Galster 2013) is important but this may be drawing false distinctions, perhaps the most holistic approach would be to consider whether neighbourhood effects are the selection mechanisms in operation (Tienda 1991).

It has been argued recently that the main proposition of neighbourhoods effects theory, that 'where you live affects your life chances', could actually be understood as 'your life chances affect where you live' (Slater 2013). Therefore it may be that neighbourhood effects are a reflection of these underlying processes of constraint in selection mechanisms, this is particularly an issue with cross-sectional studies. Snapshots in time may suggest independent neighbourhood effects because the selection mechanism, the selection bias, has not been accounted for.

In summary, it has been noted in empirical studies that materially deprived neighbourhoods contain a mix of individuals, with some higher income individuals. Also it has been recognised that many young people pass through deprived neighbourhoods during their life course. It is only possible to observe these processes using longitudinal data, but again there are a lack of such studies and a lack of studies addressing the central issue of constraint on mobility. If individual geographical mobility is shown not to have a negative effect on the outcomes under study, then it may be that there is a negative effect from lack of mobility, from being left behind in materially deprived neighbourhoods. Through their life course, those older individuals who have become 'residualised' in deprived neighbourhoods may become isolated. This could help explain the apparent contradiction between individual level and neighbourhood level poverty. Remaining immobile in deprived wards may have a suppressing effect on individual belonging to neighbourhoods and interaction with neighbours.

2.9 Neighbourhood level ethnic diversity

2.9.1 'Hunkering down', a review of the evidence

Robert Putnam argues that ethnic diversity leads to anomie and social isolation of individuals in neighbourhoods. That individuals in ethnically diverse neighbourhoods appear to "hunker down... to pull in like a turtle” (Putnam 2007, p149). This claim is based on empirical work from a sample of around 27,000 individuals, clustered in 41 areas of varying size, together with a random US wide sample of around 3,000 individuals, and combined with Census data at the census tract level. The first part of the analysis presents correlations, for the 41 areas, of aggregate scores of trust and the mean census tract level of ethnic homogeneity of the area. From these simple ecological correlations Putnam draws inference to support his causal argument, though in the second part of the paper it is acknowledged that methodological criticisms could be made, regarding the unit of analysis and the absence of other explanatory variables. So the paper then presents a single level linear regression analysis of trust in neighbours, explanatory variables were the census tract ethnic homogeneity along with other census tract and individual level variables. The inference from this regression is rather confused, however, as it is presented as follows: ‘In short, we have tried to test every conceivable artificial explanation for our core finding, and yet the pattern persists. Many Americans today are uncomfortable with diversity” (Putnam 2007, p158).

In effect the paper suggests that because the coefficient for ethnic homogeneity of an area remains significant in the regression model that this is evidence to support the causal claims made from the ecological associations. However, an inspection of the model demonstrates that the effect size for census tract homogeneity is very small, half the effect size for the census tract poverty rate and equal to the effect size for census tract density. These three variables will be related but the model is presented solely to claim that homogeneity remains significant and so the inference regarding ethnic diversity remains valid. Another reading would be that the model explains only 26% of the total variation in the outcome and that within this model area level ethnic homogeneity accounts for very small, substantially insignificant, amount of that explained variation. Also it is not clear how the clustering of individuals within areas is accounted for, Putnam reports that multilevel analysis was carried out, however the results from this are not given, just the comment that the coefficient for ethnic homogeneity remained ‘highly significant’ although ‘slightly lower’. The paper recognises the conclusions as "provocative", (Putnam 2007, p151), perhaps the real concern is that the inference is invalid, that there is flimsy evidence presented for the causal inference made.

Prior to Putnam (2007) others in the United States had reported negative associations between neighbourhood level ethnic diversity and a range of negative social capital outcomes (Alesina & LaFerrara: 2000, 2002, Alisina et al 2003, Costa & Khan 2003, Halpern 2006). Empirical studies in the UK since 2007 have produced mixed results but largely seem to suggest that, once neighbourhood level variables of economic deprivation and individual characteristics such as age and ethnicity are accounted for, the relationship between neighbourhood level ethnic diversity and trust is conditional or not significant (Laurence & Heath 2008, Letki 2008, Fieldhouse & Cutts 2010, Sturgis & Smith 2010, Twigg et al 2010, Becares et al 2011, Laurence 2011, Sturgis et al 2011).

Although much of the work in the US is focussed solely on the outcomes of trust, the inference drawn is to the withdrawal of individuals from relationships with others in neighbourhoods and individual detachment from neighbourhoods, to 'hunkering down' (Putnam 2007). Similarly in the UK studies tend to focus on outcomes of social capital, involving outcomes of trust or group membership. In some studies measures of belonging to the neighbourhood and attitudes towards the neighbourhood and neighbours are included but they tend to be as part of a factor score claiming to represent social capital (Fieldhouse & Cutts 2010). Qualitative work in the US has argued that Putnam presents a 'bleak picture' of dislocation between individuals in ethnically diverse neighbourhoods that bears little resemblance to the views of individuals in such neighbourhoods where difference is accommodated (Hickman et al 2012).

There are actually very few quantitative studies that look to measure the association between neighbourhood ethnic diversity and individual belonging to neighbourhoods, or individual interactions within neighbourhoods directly and these have produced contradictory results (Greif 2009). In the US one study reported that individuals living in ethnically mixed, heterogeneous, neighbourhoods have lower levels of belonging (Taylor et al 1985), while another found that neighbourhood ethnic diversity did not have a significant impact on individual level neighbourhood belonging (Greif 2009). Another study suggests that while ethnic diversity improves the relationships between people from different ethnic groups it reduces the levels of individual belonging to the neighbourhood (Oliver 2010). These contradictory results may be partly due to the fact that all of these studies were based on small samples of specific geographical areas. Also in the UK there has not been much empirical work looking directly at the effect of neighbourhood level ethnic diversity on individual level belonging. However, one recent study employs a large representative cross-sectional sample, from the Citizenship Survey, and multilevel analysis to test the hypothesis that neighbourhood level ethnic diversity 'erodes' individual belonging, especially in deprived neighbourhoods and reports that 'contrary to expectations' neighbourhood level ethnic diversity did not have any effect on individual levels of belonging (Bailey et al 2012). Another recent study looks more at the impact of population change on levels of individual belonging to the neighbourhood, using the same cross-sectional data, and also employing multilevel models. It was found that neighbourhoods with in-migration and population growth had positive effects on individual level belonging, whether the in-migration was ethnically diverse or not (Finney & Jivraj 2013). Therefore there remains a need for more empirical studies, particularly studies employing longitudinal data, which look to test the nature of the association between neighbourhood level ethnic diversity and the specific outcomes of individual belonging to neighbourhoods and interaction with neighbours in the UK. Before framing the research question that this thesis will address, it is important to briefly consider a number of conceptual questions and consider the way in which UK government policy has engaged with the debate.

2.9.2 Conceptual issues

While the term super-diversity has been used to suggest a level and kind of complexity surpassing anything previously experienced in Western counties (Vertovec: 2006, 2007), characterised by multiple dimensions of differentiation, social patterns and conditions (Berkeley et al. 2005, Kyambi 2005, Robinson & Reeve 2005), it is important to recognise that diversity is not a 'new' phenomenon. For example, Ackroyd describes tenth century London as a city "populated by Cymric Brythons and Belgae, by remnants of the Gaulish legions, by East Saxons and Mercians, by Danes, Norwegians and Swedes, by Franks and Jutes and Angles, all mingled and mingling together to form a distinct tribe of Londoners" (Ackroyd 2000, p702). Also while Putnam acknowledges that “the ancestors of most African-Americans have been in the United States longer than the ancestors of most white Americans” (Putnam 2007, p140) the importance of this fact is not accounted for in the inference made. Indeed, a brief look at US history demonstrates that while the slave trade began in 1690 the main wave of European immigration did not start until around 1820 (Hatton & Williamson 1994). US Census data shows the percentage of the population that were white was 80.3% in 1790, rising to the highest level recorded level of 89.5% in 1960 and falling again to 80.3% in 1990. In 1790 there were 760,000 Black people in the US, the vast majority were slaves, amounting to 19.3% of the population and there were around 4,500,000 Black people by 1860, just before the final abolition of slavery. In the South Black people made up over 35% of the population between 1790 and 1860 (Gibson and Jung 2002). The proportion of the US population that was born outside the US continued to be very high, peaking around 1910 (Gibson and Lennon 1999), when Putnam's lost 'civic' generation were born.

A related conceptual issue is the way that immigration and ethnic diversity are often conflated. For example Putnam states that diversity is on the increase in most advanced countries and that this is being driven mostly by immigration, while acknowledging that immigration and diversity are not the same thing, they are still clearly conflated in the objective to show "how diversity (and by implication, immigration) affects social capital” (Putnam 2007, p144). In the UK the issues of immigration and ethnic diversity are also often conflated, however the rise in ethnic diversity is not simply as a result of migration, it is also due to younger age populations and consequently higher birth rates amongst ethnic minority populations (Finney & Simpson 2009). The 2011 Census shows that many individuals from ethnic minorities in England were born in England, for example 79% of 'mixed' groups, 60% of Black Caribbean and 56% of Pakistani people, compared to 27% of White Irish people (ONS, Census 2012).

Given that the US has always been ethnically diverse, then the key issue is not neighbourhood level diversity but segregation. Indeed the measure of ethnic diversity used in the Putnam analysis, the Herfindahl index, is actually a measure of segregation, the likelihood that any two randomly chosen individuals in a given neighbourhood are from the same ethnic group (Putnam 2007). Therefore the analysis is actually suggesting that neighbourhoods with higher levels of segregation have better outcomes. This confused picture is replicated in the UK where it is claimed, from cross-sectional analysis, that increased ethnic diversity negatively affects social connectivity (Laurence 2013). This study uses the Simpson index, essentially symmetric to the Herfindahl index, again this measures the likelihood that two individuals are from the same ethnic group. But it should be recognised that neighbourhood level ethnic diversity and segregation are opposites (Peach 1996, Uslaner 2012). This is an important issue as, given an ethnically diverse population, the use of such measures leads to the inference that segregation is positive.

The final conceptual issue relates to notions of the 'other'. It has been argued that experiences of ethnic diversity leads to social disorganisation (Sampson 1988, Keith 2005), and that the 'cultural familiarity of place' can be disrupted by neighbourhood level change in ethnic diversity (Watt 2010). Such views present a very static vision of neighbourhood premised on notions of the 'other', the outsider as a threat. Such a perspective suggests that people who are more similar to each other are more likely to want to interact, and that interactions with others who are different are avoided (Homans 1974). Similarly conflict theories suggest that individuals gain their identity by group formation that excludes others not like them (Blumer 1958, Blalock 1967, Tajfel 1982), and through competition for resources thus creating negative attitudes towards 'outsiders '(LeVine & Campbell 1972). There are alternative theories that argue inter group contact reduces prejudice and leads to more positive attitudes to, and relationships between, groups (Allport 1954).

Also it has been argued that as long as local identity is not exclusive, or based on involuntary segregation, then belonging to place is not only possible but an essential part of human well-being (Van Leeuwen 2013), that all identities can be considered as inevitably 'hybridised' new forms created by the coming together of difference (Bhabha 1990, Rose: 1995, 1999) and it is entirely possible that neighbourhoods evolve without the 'politics of polarity' (Young 1990). It has been noted that new and alternative cultures form from the coming together of individuals from different groups (Hall & Jefferson 1976, Gilroy 1987), and that such processes gave rise to multiculturalism in UK cities, through the constants of congeniality and contact (Gilroy 2004). Such diverse neighbourhoods can be thought of as a 'difference making machine' (Isin 2002, p49) and this perspective fits well with the idea of neighbourhoods as local place, as a process, an event always under construction, as outlined earlier in this chapter.

2.9.3 Policy implications in the UK

These conceptual issues are important to consider as the findings from some empirical work in this area have been highly influential in recent UK government policies. The Community Cohesion Review Team, set up in response to the disturbances in northern English towns in 2001, focused on segregated communities and the notion of ‘parallel lives’ (Cantle 2001). Although there is a history of academic concern with segregation, mostly in the USA (Peach 1996), this was new to political discourse in the U.K. (Phillips 2005). It has been argued that the community cohesion agenda marks a distinctive change in government policies, away from a broad acceptance of diversity (Kymlicka 1999, Joppke 2004, Zetter et all 2006, Perry 2008, Pilkington 2008). For example, the Home Office stated the need to develop a ‘sense of common belonging’ in ethnically diverse areas (Home Office 2004) and the sustainable community strategy identified ‘a sense of community identity and belonging as one of the requirements needed for a ‘sustainable community’ (ODPM 2005).

The Commission on Integration and Cohesion produced its final report in 2007 which emphasised the role of shared values and explicitly identified diversity as a challenge to community cohesion (Commission on Integration and

Cohesion 2007). The notion of ethnic minorities leading 'separate lives' in the UK was given support by claims from Trevor Phillips, the then Director of the Commission for Racial Equality, that Britain was ‘sleepwalking to segregation' (Phillips 2005). This was based on findings from newly developed segregation measures (Poulson 2005, Poulson & Johnston 2006) that have been criticised for manufacturing, rather than discovering, ghettos (Simpson 2007, Peach 2008). Using standard measures of segregation, it has been shown that levels of ethnic segregation have been decreasing between 1991 and 2011 (Simpson 2007, Catney 2013). Indeed ethnic minorities actually live in the most mixed neighbourhoods and it is white people that are by far the most isolated group in Britain (Finney & Simpson 2009). As noted above, spatial segregation and neighbourhood level ethnic diversity are opposites, so as segregation decreases this leads to increased neighbourhood level ethnic diversity.

Now the political discourse has come to challenge the concept of multiculturalism, though this can be viewed as an extension of the community cohesion agenda. In a speech in Munich at a conference about international security, in 2011, the UK prime minister stated that under the doctrine of state multiculturalism, we have encouraged different cultures to live separate lives and announced the end of multiculturalism as official state policy in the UK (Cameron 2011). This declaration, then, amounts to the imposition of state approved monoculture, to a set of normative values pronounced upon by Government ministers. To be allowed to 'belong' to the neighbourhoods that people already live in, they are required to subscribe to these fixed values (Yuval-Davis et al 2005, Kundnani 2007). It has been argued that values and accepted community norms have now become 'governmental' (Cheong et al 2007, Back et al 2002). It has also been argued that the community cohesion agenda, and attacks on multiculturalism are counterproductive, as these policies create and manufacture the problem of the 'other', while doing nothing to address material disadvantage and discrimination (Amin & Parkinson 2002, Ben-Tovim 2002, Yuval-Davis et al 2005, Kalra & Kapoor 2009, Ratcliffe 2012, van Leeuwen 2013).

Therefore this thesis looks to test for positive effects of neighbourhood ethnic diversity, as opposed to the arguments put forward by Putnam and others (Alesina & LaFerrara: 2000, 2002, Alisina et al 2003, Costa & Khan 2003, Halpern 2006, Putnam 2007). As noted, current government policy has shifted from tackling inequalities to promoting fixed shared values, in the belief that multiculturalism is a threat to notion of community cohesion. The work of Putnam and others provides an academic prop for this shift in policy. This thesis looks to provide empirical evidence to challenge the notion that ethnic diversity undermines neighbourhood cohesion. If such evidence is found then there are also political implications, as this would challenge the direction of current government policies.

2.9.4 Concluding remarks on neighbourhood ethnic diversity

Despite the claims of causal relationships between neighbourhood level ethnic diversity and negative individual relationships with neighbourhoods the evidence is contradictory. Because government policies in the UK have adopted the findings of some empirical work to develop potentially counterproductive policies it is important to test these claims using appropriate methodology and careful considering the conceptual issues involved. If ethnic diversity did reduce levels of belonging to neighbourhoods and interactions between neighbours then individuals in neighbourhoods that do not experience ethnic diversity, or an increase in ethnic diversity, would have more positive outcomes than individuals in neighbourhoods that do.

However, the argument that this thesis has developed is that neighbourhoods are open and dynamic processes, not nostalgic entities. The community cohesion, and anti-multiculturalism agenda, promote fixed notions of community and belonging that are at odds with the dynamic view of neighbourhoods. From this position, this thesis argues that fixed, nostalgic, prescribed views of neighbourhoods are unhelpful, and if promoted by governments, amount to a form of state control on the possibilities of neighbourhoods to be dynamic. If dynamic neighbourhoods can be viewed as a 'difference making machine', then attempts to suppress difference and the potential for change simply reinforce the current neoliberal agenda. Neighbourhoods retain the potential for change and the production of the new but only if they remain open and dynamic, rather than closed and fixed.

Put simply, the argument developed in this thesis is that diversity is positive for the individual outcomes of belonging to neighbourhoods and interactions with neighbours, because lack of diversity, lack of change and static fixed notions of neighbourhood are the greater threat to these outcomes. Based on the theories reviewed that reject the notion of the 'other' and recognise that difference is important to dynamic relationships between individuals and neighbourhoods, it could be argued that individuals in neighbourhoods that experience ethnic diversity, or increases in ethnic diversity, will have higher levels of belonging to neighbourhoods and interaction with neighbours compared to those that do not. As most of the neighbourhoods that have high levels of ethnic diversity are also areas of concentrated poverty then the theoretical perspective would be that ethnic diversity positively moderates the negative effects of concentrated poverty.

2.10 Conclusions and hypotheses

The central research question that this thesis looks to address is whether individual belonging to neighbourhoods and interaction between neighbours have changed over time and, if so, how and why. This chapter has presented a definition of neighbourhood as local place, and therefore as a dynamic process, an event that is always under construction. It is suggested that while community and neighbourhood should not be conflated, community can be seen as an expression of relationships between individuals in neighbourhoods. Community can then also be considered as a process, dynamic rather than fixed and nostalgic, and it is recognised that these processes may or may not exist within neighbourhoods. The review has also made the case for the importance of the outcomes under study and for the concept of neighbourhood.

The preceding review has also considered the ways in which individual relationships with neighbourhoods are changing. It has been suggested that processes of globalisation have led to individuals becoming less attached to neighbourhoods. In addition associated processes of individualisation and privatisation of local place have reduced interactions between individuals within neighbourhoods. While empirical studies have consistently found that older age groups have higher levels of belonging to neighbourhoods and interaction between neighbours, these studies are mostly cross-sectional and therefore not able to distinguish between age and cohort effects. Therefore the relative effect of cohort changes, independent of effects of individual aging, remains unknown. This gives rise to the first hypothesis that this thesis will look to test:

Hypothesis 1: that younger cohorts will have lower levels of belonging to neighbourhoods and talking to neighbours, independent of any individual age related effects associated with life stage. In other words, the positive association between older age groups and both higher levels of belonging to the neighbourhood, and increased likelihood of talking to neighbours, that have been observed in cross-sectional studies to date, are partly a result of cohort differences, reflecting decreasing levels of belonging to neighbourhoods and talking to neighbours in younger generations.

There are strong arguments to suggest that, if there have been cohort changes to individual relationships with and within neighbourhoods as a result of processes of globalisation and individualisation, then these are conditional on individual income, as the poor have remained more localised. It may be that poorer individuals have higher levels of belonging to neighbourhoods and talking to neighbours, but there is often an implicit assumption that individual poverty restricts these relationships. The empirical evidence is mixed and there is a clear need for more longitudinal studies. Therefore the second hypothesis that this thesis will look to test is:

Hypothesis 2: that any reduction in levels of belonging to the neighbourhood and likelihood of talking to neighbours in younger cohorts, as a result of generational change, is greater for high income groups. So it is expected that lower income groups will have higher levels of belonging to the neighbourhood and likelihood of talking to neighbours. Also that, over time, more affluent groups will experience greater reductions in levels of belonging and interaction with neighbours as a result of generational change. This hypothesis is therefore testing whether any reduction in levels of belonging to neighbourhoods or talking to neighbours, as a result of generation change, is conditional, dependent on levels of income.

Hypothesis 2 contends that low income groups would have higher levels of belonging to the neighbourhood and interactions with neighbours. However, the empirical evidence generally finds that neighbourhood material deprivation is associated with lower levels of belonging to the neighbourhood and interactions with neighbours. If this were the case then this would present a paradox, one which would cast doubt on the notion of 'contagion' mechanisms in neighbourhood effects. Perhaps this paradox can only be understood by considering individual mobility, or lack of mobility, between neighbourhoods.

While it is often implicitly assumed that geographical mobility is negatively associated with belonging to neighbourhoods or talking to neighbours, empirical studies have found mixed results. It may be that mixed results are partly due to the conditional effects of individual mobility between neighbourhoods, dependent upon the level of neighbourhood material deprivation. This chapter has argued that individual mobility cannot be considered as a new phenomenon. It may be that the affluent have been able to take advantage of new mobilities and connections while the poor are less mobile, perhaps increasingly so.

Within the neighbourhood effects literature there has been recent interest in the issue of selection bias. Generally this is seen a source of potential bias in estimating casual effects, though recently there has been interest in the notion of selection processes. This thesis questions whether selection bias, selection processes and neighbourhood effects are essentially equivalent, and that selection processes may lead to the neighbourhood effects observed in cross-sectional studies. Therefore the contention that this thesis develops is that being constrained to neighbourhoods with high levels of material deprivation may act to suppress levels of belonging to the neighbourhood and talking to neighbours. There is evidence to suggest that poorer individuals are more constrained to more materially deprived neighbourhoods during their life course. It may be that being low income in high deprived neighbourhoods will reduce levels of belonging to the neighbourhood and talking to neighbours for low income groups, those least likely to be able to move to less deprived neighbourhoods. Therefore the third hypothesis that this thesis will look to test is:

Hypothesis 3: that remaining in materially deprived neighbourhoods, or moving into materially deprived neighbourhoods, will act to reduce levels of belonging to neighbourhoods and talking to neighbours for low income groups.

This chapter has reviewed arguments that increasing levels of neighbourhood level ethnic diversity have led to individuals 'hunkering down' and withdrawing from others in the neighbourhood. The subsequent academic debate in the US and the UK has produced contradictory and inconclusive findings. There are issues about the construction of outcomes and the inference made, as well as methodological issues related to the predominance of cross-sectional studies. The arguments developed in this chapter suggest that neighbourhood level ethnic diversity, like mobility, should not be considered a 'new' phenomenon. Also that it is incorrect to simply conflate ethnic diversity and migration. This chapter considered views of diversity which stress notions of the 'other', promote exclusive, bounded, notions of belonging and community. In contrast there are positive views of diversity that fit with notions of neighbourhoods as the site of difference making, having the potential for creating new and alternative forms of culture.

Such positive views of diversity are more aligned with the definition of neighbourhood presented in this thesis, as open dynamic processes. Current government policies present fixed, prescribed, nostalgic views of neighbourhood which creates exclusive notions of belonging. The promotion of state sponsored values amounts to a form of state control, preventing the essential dynamic nature of neighbourhood. This can be seen as contributing to the alienation of everyday life, to the replacement of 'lived space' with 'conceived place'. Given this scenario, and the premise that neighbourhoods with higher levels of ethnic diversity are less likely to be exclusive, bounded and homogenous, it could be expected that levels of belonging to the neighbourhood and likelihood of talking to neighbours would be higher in more ethnically diverse neighbourhoods. Therefore hypothesis four is:

Hypothesis 4: that, after controlling for other neighbourhood level variables, higher levels of, or increases in, neighbourhood ethnic diversity are associated with higher levels of individual belonging to neighbourhoods and talking to neighbours, when compared to individuals in neighbourhoods that are not ethnically diverse, or do not experience an increase in neighbourhood ethnic diversity.

Chapter 3 Data and methods

3.1 Introduction

Having set out the research question and specific research hypotheses in the previous chapter, this chapter outlines the data and methods used to test these hypotheses.

First this chapter presents details of the data and the British Household Panel Survey from which the data are drawn. The outcomes of interest are answers to questions asking to what extent respondents belong to their neighbourhood, and talk regularly to neighbours. Details are given for the cross-sectional sample for each survey wave where relevant questions were asked, in 1998, 2003 and 2008, and the longitudinal sample, those that respond at least once over the period. Also the nested nature of the sample, at each wave, is discussed.

Next, the outcomes and relevant explanatory variables are considered, including change to the outcome variables over time, and the methods used in the construction of ward level variables are outlined. Then the chapter discusses the methods that will be used to test the research question and hypotheses. The overall approach is to use longitudinal, multilevel models that enable the estimation of variance in and between the nested levels, and the estimation of contextual level effects.

First, longitudinal, two level, models are discussed and presented. These models specifically address questions regarding the nature of individual change over time, and, by using models with different metrics of time, it is possible to distinguish between age and cohort change. Crucially, these models allow for individuals to have different trajectories of change over time, and so it is possible to consider the association between individual level explanatory variables and trajectories of change. These two level longitudinal models will be used to carry out the analysis to test hypotheses 1 and 2, results from this analysis are presented in chapter 4.

Next multilevel models are developed and presented. In addition to the specification of the models, there are a number of conceptual and methodological challenges in defining neighbourhoods, and these are explored. These two level multilevel models, with individual at level one and ward at level two, will be used to test hypotheses 3 and 4, in relation to contextual, ward level, effects. These cross-sectional models, for each survey wave, will consider the relationship between neighbourhood level deprivation, neighbourhood ethnic diversity and household income. The results from these models are presented in chapter 5.

Finally multilevel models that accommodate the occasion, the individual and the ward levels in a single model are discussed and developed. There are some challenges in developing these three level models, as individual mobility between wards during the period leads to an imperfect hierarchy over time. This is discussed and cross-classified models that can accommodate such a data structure are presented. The cross-classified models can consider change in context over time in relation to individual mobility, change in neighbourhood level context over time, and the effects of individual mobility between neighbourhoods. These cross-classified models are used to evaluate evidence for each hypothesis, and results are presented in chapter 6.

At the end of this chapter there are some concluding comments on the methods used, and assumptions inherent in the models employed.

3.2. Data

This thesis uses longitudinal data from the British Household Panel Survey (BHPS), carried out by the ESRC UK Longitudinal Studies Centre, for three survey waves (1998, 2003 and 2008) where questions regarding individual belonging to the neighbourhood and likelihood of talking to neighbours were asked.

The initial BHPS sample, in 1991, was derived from the postcode address file using a multistage clustered design. From a sample of 205 postcode sectors, stratified by socio-economic variables derived from the 1981 Census, an average of 33 addresses were randomly selected within each postcode sector. In 1991 the initial sample, for England, consisted of 8,774 adults, nested within 4,699 households, representing an overall, household levels response rate of 74 percent. All household members, aged 16 or over, were included in the sample. The survey was administered by a combination of face-to-face interviews and self completion questionnaires. For more detail on the initial sample construction see Taylor et al (2010), and also Uhrig (2008) for a discussion on BHPS sample attrition.

Not accounting for new sample members, around 7,292 individuals from the initial 8,744 sample responded in 1998, and 6,464 individuals from the initial 8,744 sample responded in 2008. Over the period of the BHPS the sample grew in a number of ways. If an individual joins a new household all members of that new household are added to the sample, as are children in the household once they reach the age of 16. Also a number of booster samples were included at different points in the period from 1991 to 2008. Because of the mechanisms to add to the sample, as described above the actual total number of full interviews achieved fluctuated from 8,864 in 1998 to 7,202 in 2003 and 6,601 in 2008. For the cross-sectional analysis these achieved full interviews are used, along with the appropriate cross-sectional weights, as the focus of interest here are population estimates at these time points.

For the longitudinal modelling all those individuals with at least once response in the three survey waves of 1998, 2003 and 2008 were included in the analysis. Some of the individuals who were missing from one or two survey waves were identified as missing because they had a zero probability of inclusion in survey waves where their response was missing. Those with missing values, who were missing because of a zero probability of inclusion in any of the survey waves consisted of booster sample members included only in 1998, and so could have not responded in 2003 or in 2008. Also excluded were those who became adult members after 1998 or 2003, who could not have responded to the adult survey in previous waves, and those who died prior to 2003 or 2008. Table 3.1 shows the number of full interviews achieved at each survey wave for the longitudinal sample before and after those missing because of a zero probability of inclusion in any of the survey waves were excluded.

Table 3.1: Longitudinal sample size at each survey wave and sample size excluding individuals with a zero probability of inclusion at any survey wave

Wave (year)	Longitudinal sample with at least one response	Longitudinal sample with at least one response, excluding individuals with a zero probability of inclusion at any survey wave
1998	8,864	8,720
2003	7,202	6,483
2008	6,601	5,555
Total interviews	22,667	20,758

There are a total of 20,758 separate individual interviews in the three survey waves, after excluding those who had a zero probability of inclusion at any survey wave. These responses were given by 9,949 individuals who have responded once, twice, or three times over the period. Table 3.2 breaks down the frequency of the response for these 9,949 individuals. Almost half responded in all three survey waves, although over a third responded in only one survey wave.

Table 3.2: Number of individuals and responses for those with at least one full interview in survey waves 1998, 2003 and 2008, excluding individuals with a zero probability of inclusion at any survey wave

Number of full interviews	Number of Individuals	Number of Responses
One	3,703 37.2%	1 * 3,703 = 3,703
Two	1,683 16.9%	2 * 1,683 = 3,366
Three	4,563 45.9%	3 * 4,563 = 13,689
Total n	9,949 100%	20,758

This thesis is concerned with neighbourhood effects, and so files with geographical information regarding the location of households at each wave were also obtained from the Economic and Social Data Service. These data contained lower level super output area codes, as at 2001, for households at each wave. This was then aggregated to standard wards using the GeoConvert function provided by the Census Dissemination Unit (www.cdu.census.ac.uk). These standard wards are a subset of the Census Area Statistics, and were created by the Office of National Statistics in 2003. There are a total of 7,932 standard wards in England, with an average population of 2,782 households and 6,684 individuals in each. The cross-sectional sample size at each survey wave is shown in figure 3.3, with details of the nested structure. On average there are 1.8 individuals per household in each survey wave and an average of around 4 to 5 individuals per ward, ranging from 1 to between 30 and 40 individuals per ward. As the individual sample size decreases over the time period the number of households also decreases, however the number of wards where these households are located increases, and consequently the number of individuals per ward gets smaller. This is due to mobility, partial or full household moves between wards during the time period. In 1991, in the first year of the survey, the sample was more clustered within specific wards, due to the sample design. But as time progressed a proportion of individuals and full households from that original sample moved, so that in 1991 the sample resided in a total of 510 wards, by 2008 the sample, though smaller, resided in a total of 1,901 wards. As the geographic boundaries of the standard wards are constant over time this change in number of wards is due to residential mobility across ward boundaries rather than a result of changes to ward boundaries.

Table 3.3: Nested nature of the sample at each survey wave

	1998	2003	2008
Individuals	8,864	7,202	6,601
Households	4,944	4,014	3,666
Individuals per household: mean	*1.8*	*1.8*	*1.8*
Individuals per household: mode	*2*	*2*	*2*
Individuals per household: range	*1 to 6*	*1 to 7*	*1 to 6*
Standard wards	1,924	1,848	1,901
Individuals per standard ward: mean	*4.6*	*3.9*	*3.5*
Individuals per standard ward: mode	*2*	*2*	*2*
Individuals per standard ward: range	*1 to 38*	*1 to 32*	*1 to 31*

3.3 Outcome variables

The outcomes at each survey wave are shown in table 3.4 and 3.5, data from each wave has been weighted using the relevant cross-sectional weights. For more details on the construction of these weights see Taylor et al (2010). Most individuals agree that they belong to their neighbourhood and talk regularly to their neighbours, with an average, across the three waves, of 71 percent agreeing or strongly agreeing with these statements. While the average agreement across all three waves is very similar for both outcomes the level of agreement with the outcome of belonging increases slightly over the time period while the outcome of talking to neighbours shows no systematic increase, and a slight decrease between 1998 and 2008.

Table 3.4: Belonging to neighbourhood at each survey wave

Belong to neighbourhood	**1998**	**2003**	**2008**
Strongly agree	15.8%	16.3%	16.1%
Agree	53.5%	54.7%	56.2%
Neither	19.3%	19.9%	19.3%
Disagree	9.1%	7.2%	6.7%
Strongly disagree	2.3%	1.8%	1.8%
Valid n	*8,841*	*7,178*	*6,585*
Missing	*23*	*24*	*16*

Source date: BHPS, waves 1998, 2003 and 2008

Table 3.5: Talk regularly to neighbours at each survey wave

Talk regularly to neighbours	**1998**	**2003**	**2008**
Strongly agree	15.9%	12.9%	13.6%
Agree	56.9%	56.1%	56.8%
Neither	11.8%	13.7%	13.3%
Disagree	11.9%	14.0%	12.8%
Strongly disagree	3.5%	3.3%	3.5%
Valid n	*8,843*	*7,185*	*6,584*
Missing	*21*	*17*	*17*

Source date: BHPS, waves 1998, 2003 and 2008

The outcomes of belonging to the neighbourhood and talking to neighbours are positively associated, those that agree that they belong to their neighbourhood are more likely to agree that they talk to their neighbours, see table 3.6.

Table 3.6: The association between the outcomes at each wave

	1998	2003	2008
Spearman's rho ρ	0.495	0.474	0.489
Chi Squared $\chi^2(16)$	3699.52	2645.56	2840.74

All significant at p <0.001
Source date: BHPS, waves 1998, 2003 and 2008

Table 3.7 shows the change over time for individual belonging to the neighbourhood and talking to neighbours when the outcomes are considered as dichotomous, those that agree or strongly agree, and those that do not. Outcomes are presented as dichotomous in this table for ease of interpretation. Net change is simply the proportion that agree on an occasion minus the proportion that agree on the previous occasion. Net change is small, with a positive net change for belonging to the neighbourhood and negative net change for talking to neighbours between 1998 and 2008. However the percentage of individuals who changed from agreeing to not agreeing (and visa versa) is higher than total net change, with around a quarter of individuals changing between each five year time period. So there is a considerable amount of individual level change, this is reflected in the size of the association between those that agree with the statement in one time period compared to another. It should be noted that the percentage of individuals who change outcome categories is higher when considering the outcomes as five point scales. Between 1998 and 2008 28.4% and 25.9% of individuals change between dichotomous categories for belonging and talking to neighbours respectively compared to 50.5% and 48.6% of individuals changing in the five point scale.

Table 3.7: Change in outcomes over time (as dichotomous outcome)

Outcomes (Those that agree or strongly agree)	**Net change**	**Individuals changed**	**Phi** Φ
Belong to neighbourhood 1998 to 2003	1.6%	25.4%	0.390
Belong to neighbourhood 2003 to 2008	1.3%	23.1%	0.408
Belong to neighbourhood 1998 to 2008	**2.9%**	**28.4%**	**0.298**
Talk to neighbours 1998 to 2003	-3.8%	25.5%	0.369
Talk to neighbours 2003 to 2008	1.4%	24.5%	0.398
Talk to neighbours 1998 to 2008	**-2.4%**	**25.9%**	**0.334**

All Phi significant at p <0.001
Source date: BHPS, waves 1998, 2003 and 2008

3.4 Explanatory variables

3.4.1 Individual age

The age of respondents was recorded at the point of interview in each survey wave, as well as date of birth. The grouped age of the sample at each cross-sectional wave can be seen in table 3.8, the mean age is around 48 years and the range is from 16 to around 100 years. These results have been obtained applying the appropriate cross-sectional weights.

Table 3.8: Age group of sample at each cross-sectional survey wave

Age group	**1998**	**2003**	**2008**
16 to 29	21.4%	19.8%	19.5%
30 to 39	18.9%	17.1%	15.0%
40 to 49	16.1%	17.2%	18.6%
50 to 59	16.1%	16.7%	15.4%
60 to 69	11.6%	12.0%	15.1%
70 plus	16.0%	17.2%	16.4%
Valid n	*8,128*	*7,639*	*7,751*
Mean age	47.2	48.4	48.8
Minimum age	16	16	16
Maximum age	100	97	98

Source date: BHPS, waves 1998, 2003 and 2008

While the cross-sectional sample weighted mean remains similar over the course of the time period, individuals age by 10 years. For the longitudinal sample of 9,949 individuals, the mean age increases at each survey wave from 45 years in 1998 to 51 years in 2008, as does the minimum age from 16 in 1998 to 26 in 2008. This reflects the fact that those who became full sample members by turning 16 in sample households after 1998 had a non zero chance of inclusion in 1998 and so were excluded. This illustrates the difference between the cross-sectional samples, which, with the application of weights, can be used to describe the population, and the longitudinal sample which can be used to study individual change over time.

3.4.2 Individual geographical mobility

The BHPS collects data on individual mobility that can be used, in combination with the geographical data, to determine individual mobility that results in a change of ward. From this it is possible to determine the length of time an individual has lived in their current ward and whether the individual has experienced recent residential mobility that has resulted in a change of ward. The length of time individuals have lived in their current ward at each wave is shown in table 3.9, showing a large range, from less than 1 year to over 60 years.

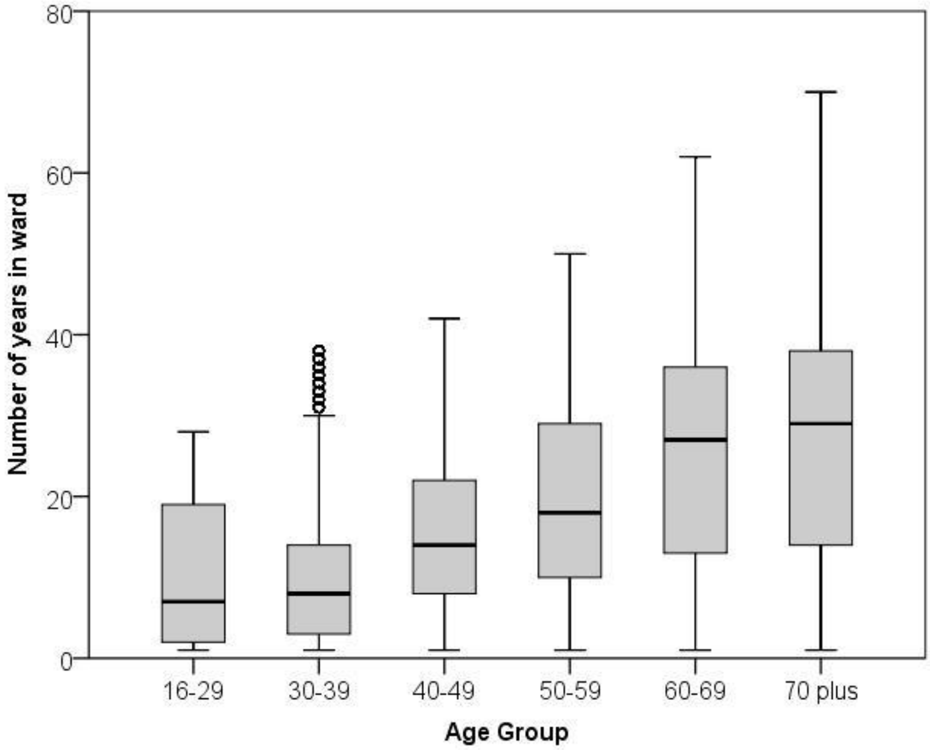
Table 3.9: Length of time individuals have lived in current ward at each survey wave

Time in ward (years)	1998	2003	2008
Less than 2	12.5%	11.8%	12.4%
2 to less than 5	10.6%	13.1%	10.2%
5 to less than 10	13.0%	15.5%	14.5%
10 to less than 20	27.4%	26.9%	24.7%
20 plus	36.6%	32.7%	38.2%
Mean	17.8	16.5	17.7
N	8,864	7,202	6,601

Source date: BHPS, waves 1998, 2003 and 2008

This measure captures individual mobility, however the length of time an individual can have lived in a particular ward is constrained by individual age. Those aged 16 cannot have stayed in the same ward for over 20 years, those aged 70 plus may not have moved in last twenty years but may have moved a lot previously. This can be seen in figure 3.1 which shows the distribution of years individuals have lived in their current ward by age group. All age groups have individuals who have spent a small number of years in their current ward, but the upper limit of the time spent in the ward is dependent on individual age. There are more high value outliers in the 30-39 age group, representing small numbers of this age group that have lived in the same ward all of their lives.

Figure 3.1: The distribution of time in ward by age group. (For survey wave 2003)



Therefore the measure of individual geographical mobility that is used in the analysis is experience of having moved ward in the previous five years. As shown above, time in the ward is partly dependent on age, in that the upper range is bounded by age. All age groups however have individuals who have experienced relatively recent geographical mobility. Table 3.10 shows the percentage of individuals who have moved ward in the previous five years by age group, and while this is still associated with age there are individuals in each age group experiencing a move. Table 3.10 shows the relationship for the survey wave of 2003 for illustration as the relationship is similar in all waves.

Table 3.10: The percentage of individuals who have moved ward in the previous 5 years by age group. (For survey wave 2003)

Age Group	Moved ward in previous 5 years Yes	No	n
16-29	48.1%	51.9%	1,800
30-39	44.7%	55.3%	1,459
40-49	21.1%	78.9%	1,352
50-59	18.2%	81.8%	1,192
60-69	12.0%	88.0%	789
70 plus	10.1%	89.9%	983

Spearman's rho $\rho = 0.320$ ($p < 0.001$)
Source date: BHPS, waves 1998, 2003 and 2008

3.4.3 Individual ethnicity

As this thesis is concerned with ward level associations, including ward level ethnic diversity, it would be good to consider individual ethnicity in the analysis. However there are small numbers in the sample from ethnic minority groups, as shown in table 3.11. Given this, and that ethnic minority groups are particularly under represented in older age groups it is not possible to bring individual ethnicity into the analysis. Unfortunately there are just too few cases.

Table 3.11: Ethnic group of sample at each survey wave

Ethnic Group	1998	2003	2008
White	94.9%	95.4%	94.8%
Black-Caribbean	1.0%	0.7%	0.7%
Black-African	0.6%	0.3%	0.4%
Black-Other	0.3%	0.3%	0.3%
Indian	1.4%	1.5%	1.6%
Pakistani	0.5%	0.6%	0.7%
Bangladeshi	0.2%	0.2%	0.3%
Chinese	0.1%	0.2%	0.2%
Other ethnic group	1.0%	0.8%	1.0%
Missing	66	51	48
Total	8,864	7,202	6,601

Source date: BHPS, waves 1998, 2003 and 2008

3.4.4 Household income

Equivalised household income has been calculated and used rather than individual income as this takes account of differences in household size and composition. The Organisation for Economic Co-operation and Development (OECD) equivalence scale has been used, (Hagenars et al. 1994). This scale attributes a weight to all members of the household, with a weight of 1.0 for the first adult, a weight 0.5 to the second and each subsequent person aged 14 and over and a weight 0.3 to each child aged under 14. The equivalent size is the sum of the weights of all the members of a given household. This measure, rather than individual income, is often used for the calculation of poverty and social exclusion indicators. This has been calculated using household income after housing costs. The range of equivalised household income at each wave is shown in table 3.12.

Table 3.12: Distribution of net equivalised household monthly income at each survey wave

Equivalised household monthly income	**1998**	**2003**	**2008**
Mean	£1,128	£1,405	£1,680
Standard deviation	£957	£1,067	£1,278
Minimum	£0	£0	£0
Percentile: 20	£494	£671	£808
Percentile: 40	£801	£1,013	£1,195
Percentile: 60	£1,120	£1,393	£1,648
Percentile: 80	£1,574	£1,963	£2,347
Maximum	£21,514	£22,775	£24,015
Skewness	7.45	5.28	4.95
Kurtosis	119.98	72.10	60.07

Source date: BHPS, waves 1998, 2003 and 2008. Total n = 8,841 (1998) 7,178 (2003) 6,585 (2008).

It is also worth noting that household income is associated with individual age, with low household income highest in younger and, particularly, older age groups, as shown in table 3.13. Also household income is also associated with individual geographical mobility, as shown in table 3.14. This is a more linear relationship, with individuals in households with lower incomes less likely to have moved ward in the previous five years. Also it is worth remembering that older age groups are less likely to have moved ward in the previous five years, as well as being more likely to have lower household incomes. Therefore in the analysis the modelling will seek to estimate the nature of the associations when controlling for the other variables.

Table 3.13: The relationship between age and household income quintile (averaged for three waves)

Age	1 Highest income	2	3	4	5 Lowest income	Total
16-29	19.8%	24.5%	20.9%	17.0%	17.9%	100%
30-39	24.4%	20.5%	21.2%	17.6%	16.2%	100%
40-49	25.6%	24.5%	21.7%	15.5%	12.6%	100%
50-59	29.2%	23.8%	19.5%	14.5%	13.1%	100%
60-69	14.4%	16.0%	20.1%	26.2%	23.4%	100%
70 plus	5.0%	8.1%	16.1%	32.0%	38.8%	100%

Cramer's V average 0.069. Significant at p< 0.001 at each wave

Table 3.14: The relationship between individual geographical mobility and household income quintile (averaged for three waves)

	Whether moved ward in previous 5 years		
Household income	Yes	No	Total
1 Highest income quintile	28.6%	71.3%	100%
2	24.4%	75.7%	100%
3	23.4%	76.5%	100%
4	20.8%	79.2%	100%
5 Lowest income quintile	20.1%	79.9%	100%

Cramer's V average 0.061. Significant at p< 0.001 at each wave. Source date: BHPS, waves 1998, 2003 and 2008. Total n = 8,841 (1998) 7,178 (2003) 6,585 (2008).

3.4.5 Ward level explanatory variables

Measures of economic deprivation and ethnic diversity were calculated for standard ward geographies using Census data. Standard ward geographies were chosen to overcome the problem of changes to administrative boundaries that have occurred over time and to enable the data to be attached to the British Household Panel Survey sample. The geographical boundaries of wards have changed a number of times between 1991 and 2011, lower super output area (LSOA) boundaries were not introduced until after the 2001 Census (with enumeration districts being the smallest geographical area for 1991). Also local authority boundaries have been subject to a number of changes. In addition the 2011 Census data contains revised LSOA's (around 1% of the first version LSOA's have been modified in the 2011 version, largely being split if the population has grown substantially or merged with neighbouring LSOA's if the population has declined substantially). With this in mind the analysis uses area level measures for consistent geographical boundaries, namely 2003 standard wards.

Data for the 1991 Census was obtained using CASWEB (Census Dissemination Unit). Data are available at enumeration district level for 1991. This was obtained and converted from enumeration districts, first to 2001 LSOA's and then 2003 standard wards, using the GEOCONVERT tool on the Census Dissemination Unit website. The conversion is quite accurate and details of the accuracy are supplied after conversion. (around 0.1% of cases were not matched in the process). Data for the 2001 and 2011 Census was also obtained through CASWEB, and ONS, and converted from LSOA to standard ward using the same procedure as above.

Census data was used to calculate a number of ward level variables for 1991, 2001 and 2011, namely ward level material deprivation, ward level ethnic diversity, ward level population density and ward level gross migration rates.

Ward level material deprivation is measured using the Townsend Index, (Townsend et al 1988), a direct measure of material deprivation, utilising Census data to enable scores to be calculated for any given geography. The index has been used extensively in social research and is generally considered an adequate measure of relative material deprivation (Senior 2002). The Townsend Index is the sum of four equally weighted standardised measures of deprivation, some of which have been log transformed to normalise their distributions, and is calculated as shown in equation 1.

Townsend Index (T) = $z_1 + z_2 + z_3 + z_4$

Where:

$$z_1 = \frac{t_1 - \mu T_1}{\sigma T_1}; \quad z_2 = \frac{t_2 - \mu T_2}{\sigma T_2}; \quad z_3 = \frac{t_3 - \mu T_3}{\sigma T_3}; \quad \text{and } z_4 = \frac{t_4 - \mu T_4}{\sigma T_4}$$

And:

t_1 = the percentage of economically active that are unemployed (log transformed)

t_2 = the percentage households that are overcrowded (log transformed)

t_3 = the percentage households with no car

t_4 = the percentage households not owner occupied (1)

Census data was also used to calculate the total percentage of the ward population from ethnic minorities, in all standard wards. There are other measures of ethnic diversity that could have been used, for example Putnam (2007) uses the Herfindahl Index, which measures the probability that two random individuals in a neighbourhood would be the same ethnicity. Letki 2008 Fieldhouse & Cutts 2010 all use Simpson's Index of Diversity, symmetric to the Herfindahl Index. Both of these indices take account of the number of ethnic groups and the numbers in each ethnic group for any given area.

However these measures describe how a population is dispersed geographically. In a population that is diverse they measure the extent of homogeneity in any given geographical space. These studies, particularly Putnam (2007) and Laurence (2013), report that diversity is negative for the outcomes of trust and interaction between individuals in their neighbourhoods. However, given the measure is of the extent of homogeneity within neighbourhoods for an already diverse population, the conclusion that is being put forward is that greater homogeneity at the neighbourhood level, i.e. greater segregation, leads to better interactions between individuals. Putnam states that "Diversity seems to trigger ... anomie or social isolation ... people living in ethnically diverse settings appear to 'hunker down' – that is, to pull in like a turtle" (Putnam 2007, p149), and talks of "the challenge to social solidarity posed by diversity (Putnam 2007, p165). This appears odd, to suggest that less geographical segregation in a diverse population should challenge social solidarity.

Segregation and diversity indices measure how the population is dispersed geographically. It is possible to have high or low levels of segregation, regardless of the size of the ethnic minority population. The key point appears to be that the percentage of population from ethnic minorities measures the size of the ethnic minority population as a measure of diversity, while diversity indices measure the extent to which a population is distributed spatially. Also, as outlined in the previous paragraph, the use of measures of spatial homogeneity in already diverse populations can lead to some confused inferences about the potential 'benefits; of segregation. As will be detailed in chapter 5, between 1991 and 2011 the proportion of the English population from ethnic minorities has increased from 6.2% to 14.6% in the period 1991 to 2011. At the same time segregation has decreased. Therefore the decision was made to use the percentage of the neighbourhood population that is from ethnic minority groups as the measure of neighbourhood ethnic diversity.

In addition ward level population density and gross migration rates were calculated. Population density, individuals per hectare, was calculated by dividing the standard ward population at each time point by the area in hectares, using shapefiles in GIS for standard ward boundaries, obtained from UKBORDERS (www.edina.ac.uk/ukborders). The gross migration rate for standard wards was calculated using the total inward and outward migration in the year prior to the Census, expressed as a rate per 100 population.

Table 3.15 shows the distribution of ward level scores as calculated for the standard ward geographies at each Census period. As the Townsend scores are standardised measures the distribution is similar at each period, therefore the average over the Census periods is shown. Also the gross migration rates are similar over the period and so the average is given for this as well. The percentage of ward populations from ethnic minorities has increased between 1991 and 2011, with the mean ward BME population having more than doubled in the period. Also ward level population density has increased over the period, but the change is of a lower magnitude than the increases in ward level ethnic diversity.

Table 3.15: Distribution of ward level scores, for the population of all England standard wards at Census years

Population: all standard wards	**Ward Percentage BME**			**Ward Population Density**			**Ward Townsend Index**	**Ward Gross Migration**
	1991	**2001**	**2011**	**1991**	**2001**	**2011**	**Average**	**Average**
Minimum	0.01	0.03	0.08	0.02	0.02	0.03	-6.60	0.86
Mean	3.75	5.64	8.95	19.85	20.92	22.75	0.00	1.78
Maximum	89.45	88.10	93.74	213.79	210.25	264.70	14.35	6.59

Density as individuals per hectare. Gross migration per 100 population. Source Data: Census

In order to estimate the ward level scores for the years related to the survey waves of 1998, 2003 and 2008 the changes between Census years of 1991 and 2001, and between 2001 and 2011 were assumed to be evenly distributed throughout the periods. Estimates of ward level variable values for survey waves were based on this assumption. These estimated ward level scores for the survey waves were then attached to the survey data for that period, linking with the calculated standard ward of residence. Table 3.16 shows the distribution of ward level variables for the sample at each cross-sectional survey wave, again the ward Townsend score and gross migration rate have been averaged over the three survey waves as the scores do not vary much over the period. Table 3.17 shows the distribution of ward scores for the longitudinal sample. The sample distributions are similar to that of the population, although with a slightly smaller variance.

Table 3.16: Distribution of ward level scores, for the sample at cross-sectional survey waves

	Ward Percentage BME			Ward Population Density			Ward Townsend Index	Ward Gross Migration
	1998	**2003**	**2008**	**1998**	**2003**	**2008**	**Average**	**Average**
Minimum	0.21	0.16	0.30	0.08	0.08	0.08	-5.87	0.87
Mean	6.45	7.56	8.98	25.30	25.51	25.72	0.65	1.79
Maximum	77.86	83.02	86.78	175.42	188.07	245.73	13.22	6.38

Density as individuals per hectare. Gross migration per 100 population. Source date: BHPS, waves 1998, 2003 and 2008. Total n = 8,841 (1998) 7,178 (2003) 6,585 (2008).

Table 3.17: Distribution of ward level scores, for the longitudinal sample

Sample: longitudinal	Ward Percentage BME	Ward Population Density	Ward Townsend Index	Ward Gross Migration Rate
Minimum	0.11	0.10	-5.96	0.86
Mean	7.35	25.20	0.60	1.77
Maximum	86.78	245.70	13.52	6.58

Density as individuals per hectare. Gross migration per 100 population. Source date: BHPS, waves 1998, 2003 and 2008. Total n = 8,841 (1998) 7,178 (2003) 6,585 (2008).

3.4.6 Concluding comments on choice of explanatory variables

The explanatory variables outlined above have been chosen in order to enable the testing of the research hypotheses. Individual age has been associated with the outcomes under study in most empirical studies to date (Shumaker & Taylor 1983, Sampson 1988, Gieryn 2000, Trentelman 2009, Lewicka 2011). More importantly, age and cohort measures were required to test for cohort differences.

Within existing empirical studies there are contradictory results found in relation to levels of income and individual belonging to neighbourhoods and likelihood of talking to neighbours (Gerson et al, 1977, Sampson 1988, Hidalgo & Hernandez 2001, Brown et al 2003, Lewicka 2011). The objective of this thesis is to consider the relationship between household income, cohort change and neighbourhood level material deprivation, therefore in order to test the research hypotheses a measure of household income was included as an explanatory variable. Similarly, a measure of individual mobility between neighbourhoods was included as an explanatory variable in order to test the specific research hypotheses. Again, existing empirical research has produced contradictory results about the effects of individual mobility (David et al 2010, Nieuwenhuis et al 2013, Oishi et al 2013, Lewicka 2014). The objective of this thesis is to test for whether any effects associated with individual mobility are conditional on household income and neighbourhood deprivation.

As the research question is also primarily concerned with potential neighbourhood effects a number of neighbourhood level variables have been included, specifically neighbourhood material deprivation and neighbourhood ethnic diversity.

A number of other individual level variables could have been included in the model. The relationship with gender was examined, however no association was found to exit in the data. Potentially the models could have incorporated other individual and household measures, however the guiding principal adopted for models construction was to include all those variables that related to the hypotheses being tested while attempting to construct models as parsimoniously as possible. The objective is to capture as much of the underlying relationship between explanatory and outcome variables, in order to test the hypotheses, without over-specifying the models. It can be argued that parsimonious models, when correctly specified, enable greater prediction and a greater ability to generalise than over-specified models as they capture less 'noise' (Silver 2012).

3.5. Methods

The research question and hypotheses are concerned with individual patterns of change over time, and with the association between contextual, ward level, measures and the outcomes of belonging to the neighbourhood and talking to neighbours. Longitudinal, multilevel, models are employed to test the specific hypotheses. There are a number of issues that need to be addressed in order that the models are adequately specified, these relate to both the longitudinal and hierarchical aspects of the model. These issues are discussed and then appropriate models are outlined that enable the analysis to address the research question and to test the specific hypotheses.

This chapter outlines the approach taken in subsequent chapters, building a full multilevel model that considers longitudinal change and contextual effects. The first empirical chapter specifically addresses the hypothesis that the observed association between older age and more positive outcomes of belonging to neighbourhood and talking to neighbours is a result of cohort, generational change, rather than individual age related effects. The second empirical chapter then considers the hypotheses concerned with ward level effects, for each wave. The final empirical chapter then brings together the longitudinal and contextual levels into a single model that can examine individual change over time and ward level context together. The methodological approach employed in each chapter is set out below.

3.5.1 Longitudinal models to test for age and cohort effects.

The separation of age, period and cohort effects has long been a concern of demography and sociology (Hobcraft et al 1982). Age effects refer to the changes that occur within all individuals as a result of life cycle changes or life course events. Cohort effects can be thought of as independent of the effects of aging, this can be the unique experience of one birth cohort or systematic generational change. The concept of generational change, change between successive cohorts can be considered as fundamental to understanding the process of social change, (Ryder 1965, Glenn 1976). Period effects are differences related to a particular era, an effect that applies to all individuals in a given era independent of age or birth cohort. (For more detail on age, period and cohort effects see Schaie 1965, Firebaugh 1997).

Although, in the way described above, the effects of age, cohort and period can be considered as separate they cannot in practice be independently estimated in a statistical model, this is known as the identification problem (Mason et al 1973, Firebaugh 1997). In a single cross-sectional study age and cohort differences are confounded. In cross-sectional analysis the difference in outcomes by age group are often assumed to be age effects when they may in fact be cohort differences, and in longitudinal analysis change over time within individuals is often assumed to be due to age when there may be period effects in operation (Palmore 1978). Two individuals of different ages in a cross-sectional study, for example aged 30 and 40, have a difference of 10 years in age and 10 years in year of birth. For single cross-sectional studies period is fixed and so age is equal to cohort. In a longitudinal study it is still not possible to estimate independent effects of for all three in a single equation. For example it would not be possible to estimate the effect of a change in cohort while holding age and period constant; if these were constant it is not possible for cohort to vary. Similarly period effects could not be estimated for a fixed age and cohort and age cannot be estimated for a fixed cohort and period. In essence any one of the three variables of age, period and cohort is determined by the other two (Goldstein 1968).

To illustrate this, see figure 3.2. As stated, in any single period age and cohort are confounded. Because in this situation period is fixed and so any difference between individuals in age in years is the same as the difference in year of birth. This can be seen in figure 3.2 for any of the two given periods. With the introduction of more than one survey period then there are more possibilities for comparison. In essence period is no longer fixed. This means it is possible to compare different periods. This gives an indication of whether there are differences for overall population averages.

Figure 3.2: The relationship between age, period and cohort and the identification problem. Cohort as year of birth, period as year of survey.

P: 1998		P: 2008	
Person I	Person II	Person I	Person II
A: 30	A: 40	A: 40	A: 50
C: 1968	C: 1958	C: 1968	C: 1958

P (period) = A (age) + C (cohort), alternatively A = P - C, or C = P - A.

The analysis of age, period and cohort effects presented in chapter 4 begins with a consideration of repeated cross-sectional population averages. Such descriptive analysis is a useful starting point in understanding age and cohort differences in the outcomes under study. However, it only provides observed averages for groups at each period. Since the outcomes of interest are at the individual level, it is appropriate to progress with methods that enable the outcomes to be modelled at that level. As noted above, the proportion of individuals who agree that they belong to their neighbourhood, and talk regularly to neighbours, is similar at each period. But while levels of net change are small, there is a greater amount of within person change over the period, with around a quarter of individuals changing whether they agree with the outcomes between each five year period. Longitudinal models enable the measurement of change in outcomes at the individual level and provide the opportunity to predict patterns of individual change over time (Goldstein 1968, Diggle et al 2002, Singer and Willet 2003).

There have been some recent developments tackling the identification problem (Yang & Land 2006, Winship and Harding 2008). However, these methods are still to be fully evaluated and their strengths and weaknesses have not been fully explored yet (Harding 2009). All attempt statistical solutions to the identification problem, but even if this were possible the problem of substantive interpretation remains, that it makes little sense to conceive of separate effects of age, period and cohort. It is not conceptually possible to hold two of these variables constant and estimate the affect of the third, and there is no situation where this could occur out with the model (Goldstein 1979, Kosloski 1986).

The approach taken is to accommodate the longitudinal data in a multilevel structure whereby measurement occasions are nested within individuals. Laird and Ware (1982) and Sternio et al (1983) were the first to propose extending random effects multilevel models to account for longitudinal data. Singer and Willett (2003) demonstrate the approach of extending multilevel models to model longitudinal data in developing the ‘multilevel model for change’. The model allows for the simultaneous measurement of change within the individual and change between individuals, in conjunction with a number of time constant or time varying explanatory variables and can also accommodate missing data (Rogosa & Willett 1985, Raudenbush & Chan 1993, Plewis 1994, Goldstein 2011, Snijders & Bosker 2012).

Multilevel models have become the standard approach to the analysis of clustered data in the last twenty years, particularly growth curve models where repeated measures of outcomes are modelled within some metric of time (Steele 2008). The key aspect of such models is that they measure differences between individuals as well as within person change over time and, by making the effects of time random at the individual level, the models allow for individual differences in the rate of change over time. Therefore, in addition to the measurement of differences within individuals, such models are useful in evaluating the average change over time and whether these average effects over time vary between individuals, (Hox 2010, Goldstein 2011, Snijders and Bosker 2012).

A single level empty model, that is a model just estimating the overall individual level average, can be specified as in equation 2. The outcome y^*_i for individual i is estimated as the average plus the residual error term which is assumed to have a standard normal distribution with a mean of zero.

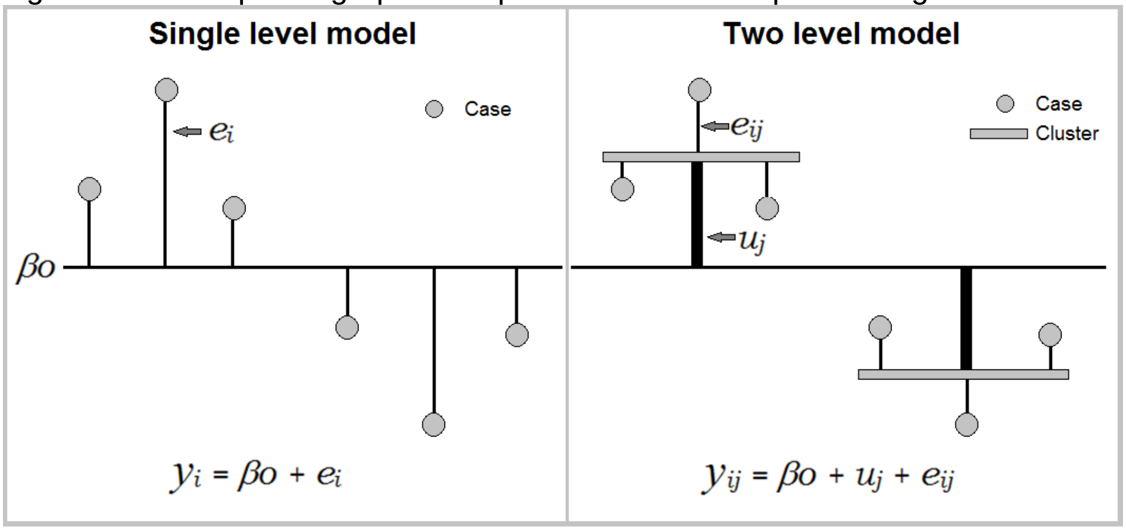
$$
\begin{aligned}
y^*_i &= \beta_{0i} cons \\
\beta_{0i} &= \beta_0 + e_i \\
(e_i) &\sim \mathrm{N}(0,\Omega_e): \ \Omega_e = (\sigma^2_e)
\end{aligned}
\tag{2}
$$

The addition of a second level of occasion at level one, with individual now at level two, can be expressed as in equation 3. Here the outcome y^*_{ij} for individual j at time point i is estimated as the average plus the residual at level two and the residual at level one, both of which are assumed to have a standard normal distribution with a mean of zero. This model enables the separate estimation of within person variance, σ^2_e, and between person variance, σ^2_u.

$$
\begin{aligned}
y^*_{ij} &= \beta_{0ij} cons \\
\beta_{0ij} &= \beta_0 + u_j + e_{ij} \\
(u_j) &\sim \mathrm{N}(0,\Omega_u): \ \Omega_u = (\sigma^2_u) \\
(e_{ij}) &\sim \mathrm{N}(0,\Omega_e): \ \Omega_e = (\sigma^2_e)
\end{aligned}
\tag{3}
$$

Therefore a key merit of the multilevel longitudinal model is the ability to distinguish between the variation in an outcome over time and the variation between individuals (Diggle et al 2002). In a cross-sectional analysis variation in the outcome is only measurable between individuals, with repeated measures it is possible to distinguish between variation within individuals, as well as variation between individuals. In the multilevel longitudinal model it is assumed that the correlation in repeated measures within individuals arises as a result of the variation that exists between individuals. Therefore it is assumed that individuals are drawn from a heterogeneous population and represent a random sample of that population (Diggle et al 2002). In this way it is possible to separate within person variation and between person variation in the outcomes under study. Figure 3.3 presents a simplified graphical representation of the partitioning of variance. In this simplified example cases (level 1) are nested within clusters (level 2).

Figure 3.3: a simplified graphical representation of the partitioning of variance



Another key reason for employing multilevel models is to increase precision of estimates, achieved by borrowing strength from other observations (Singer and Willett 2003). By applying a shrinkage factor, equivalent to the reliability of the estimated variance, unreliable estimated variances are weighted towards the overall population mean. These model based estimates, often referred to as empirical Bayes estimates, lead to greater precision. Increased precision is a fundamental motivation for employing multilevel models (Singer and Willett 2003). However, it is important to be aware that the increased precision is achieved at the expense of a degree of bias in estimated variances (Hox 2010, Snijders & Boskers 2012). For detail on how these empirical Bayes estimates are produced see appendix 1.

In order to investigate trajectories of individual change, and in particular to distinguish between age and cohort effects, the empty models, set out in equation 3, can be extended to include a metric of time, as in equation 4.

$$
\begin{aligned}
y^*_{ij} &= \beta_{0ij} cons + \beta_1 Time_{ij} \\
\beta_{0ij} &= \beta_0 + u_j + e_{ij} \\
(u_j) &\sim N(0, \Omega_u): \ \Omega_u = (\sigma^2_u) \\
(e_{ij}) &\sim N(0, \Omega_e): \ \Omega_e = (\sigma^2_e)
\end{aligned} \qquad (4)
$$

One key advantage of the longitudinal multilevel model, as previously noted, is the ability to model individual growth trajectories. Allowing for the change over time to vary, by introducing a random slope to the metric of time, enables individuals to have different rates of change (Singer & Willett 2003, Snijders & Bosker 2012). This is achieved as in equation 5. Now there are two random coefficients estimated at the individual level, variance between individuals as estimated by σ^2_{uo}, and variance in the trajectories of change, as estimated by σ^2_{u1}. Also σ_{u01} is estimated, which is the covariance between σ^2_{uo} and σ^2_{u1}. The additional assumption is that the two random effects at the individual level have a multivariate normal distribution. The term σ^2_{e0} remains the variance within individuals.

$$
\begin{aligned}
y^*_{ij} &= \beta_{0ij} cons + \beta_{1j} Time_{ij} \\
\beta_{0ij} &= \beta_0 + u_{0j} + e_{ij} \\
\beta_{1j} &= \beta_1 + u_{1j} \\
\begin{bmatrix} u_{0j} \\ u_{1j} \end{bmatrix} &\sim N(0, \Omega_u): \ \Omega_u = \begin{bmatrix} \sigma^2_{u0} & \\ \sigma_{u01} & \sigma^2_{u1} \end{bmatrix} \\
(e_{ij}) &\sim N(0, \Omega_e): \ \Omega_e = (\sigma^2_e)
\end{aligned} \qquad (5)
$$

Allowing the effects of time to be random at the individual level also acts to relax the assumption of compound symmetry, that the variance in the observations is constant over time and that the correlations between observations is not dependent on how far apart they are.

It would of course have been possible to use dummy variables to represent the survey years. This would be equivalent to estimating a group mean for all three occasions, a 'mean curve', that fits the observed data perfectly (Snijders 1996). This leads to a perfect model fit but may be of little use statistically. The model simply represents the observed data, it does not describe the data more parsimoniously than the raw data (Hershberger 2005). Also using such an approach there would be no way to allow the coefficients of the dummy variables of measurement occasion to be random at the individual level, that is to have individual level differences over time. If both dummy variables for measurement occasion were allowed to be random at the individual level then the model would not be identifiable. A model is identifiable if the values of its parameters can be ascertained from empirical observations, and not identifiable if different combinations of parameters are able to produce the same results (Bamber & van Santen 2000).

Having specified the structure of the longitudinal model there are now questions regarding the most appropriate metric of time to employ. The choice of metric of time is both a theoretical and empirical question, in that different metrics for indexing time that reflect alternative causal models of change may yield very different conclusions (Hoffman 2012). The two options for the metric of time in the models presented are individual age and study period years. The differing results from these metrics are expected to be of use in evaluating whether there are cohort effects.

The data covers an eleven year period but sample members are aged between 16 and 98 over the period. Using age as the metric of time has advantages, in that growth curves can be estimated for age ranges that are greater than the data collection period. This is known as an accelerated longitudinal design, or cohort sequential design (Hox 2010). The accelerated design uses a mixture of cross-sectional and longitudinal data and this necessitates the assumption that all cohorts are comparable, in other words, that there are no cohort effects (Hox 2010). This assumption, that developmental change, is the same for all cohorts, can lead to problems of inference when cohort differences exist (Raudenbush & Chan 1992, 1993; Miyazaki & Raudenbush 2000). If there are cohort effects then it is better to analyse the data using study period years as the unit of change rather than age (Hox 2010). This is particularly true if the age range of the sample is large and the time of the study is relatively short. When study period years is used as the metric of time then year of birth can be added to the model, as in equation 6. The addition of year of birth, equivalent to age at the start of the period, is only possible when study period years is the metric of time and not age, as age and year of birth are confounded in an accelerated design. Also year of birth is a level 2, individual level, variable in that it varies between individuals and not occasions.

$$
\begin{aligned}
y^*_{ij} &= \beta_{0ij} cons + \beta_{1j} Time_{ij} + \beta_2 YOB_j \\
\beta_{0ij} &= \beta_0 + u_{0j} + e_{ij} \\
\beta_{1j} &= \beta_1 + u_{1j} \\
\begin{bmatrix} u_{0j} \\ u_{1j} \end{bmatrix} &\sim \mathrm{N}(0, \Omega_u): \ \Omega_u = \begin{bmatrix} \sigma^2_{u0} & \\ \sigma_{u01} & \sigma^2_{u1} \end{bmatrix} \\
(e_{ij}) &\sim \mathrm{N}(0, \Omega_e): \ \Omega_e = (\sigma^2_e)
\end{aligned}
\qquad (6)
$$

Using study period years as the metric of time draws only on the longitudinal data, not the cross-sectional data and therefore makes no assumptions that the only differences between younger and older people are age differences. Essentially using study period years as the metric of time makes no assumptions about the processes causing change over time. The accelerated design, using age as the metric of time and predicting trajectories on a combination of longitudinal and cross-sectional data creates problems in the confounding of age and cohort effects in the same way as a purely cross-sectional design confounds age and cohort effects (Miyazaki & Raudenbush 2000, Singer & Willett 2003). But this difference can be used to explore the age and cohort differences. There is no single answer to whether age or study period years should be used as the metric, rather it depends on what makes sense for the outcomes under study and the research question (Singer & Willett 2003). With this is mind, and an awareness of the assumptions inherent in the use of age as the metric of time in an accelerated design the results of models with different metrics of time can be evaluated. The different assumptions and properties, along with the estimated results can be used to distinguish between age and cohort effects and test hypothesis 1.

In order to test hypothesis 2, which contends that cohort effects are conditional on income levels, the models are extended to include household income, and crucially to include an interaction between household income and year of birth, as set out in equation 7. This interaction directly tests whether cohort differences are conditional on levels of income.

$$y^*_{ij} = \beta_{0ij}cons + \beta_{1j}Time_{ij} + \beta_2 YOB_j + \beta_3 HouseholdIncome_{ij} + \beta_4 YOB*HouseholdIncome_{ij}$$

$$\beta_{0ij} = \beta_0 + u_{0j} + e_{ij}$$
$$\beta_{1j} = \beta_1 + u_{1j}$$
$$\begin{bmatrix} u_{0j} \\ u_{1j} \end{bmatrix} \sim N(0,\Omega_u): \ \Omega_u = \begin{bmatrix} \sigma^2_{u0} & \\ \sigma_{u01} & \sigma^2_{u1} \end{bmatrix}$$
$$(e_{ij}) \sim N(0,\Omega_e): \ \Omega_e = (\sigma^2_e) \qquad (7)$$

The longitudinal models then consider individual mobility between wards and the interaction between mobility and household income, in order to begin to test the effects of individual mobility between wards.

3.5.2 Multilevel models to test for cross-sectional contextual effects

The second empirical chapter looks at the contextual effects of ward level variables at each cross-sectional wave. The models are based on equation 3, but with the individual at level one and the ward at level two. Therefore the modelling approach is similar, though there are a number of specific issues related to the analysis of contextual data that need to be considered, these are discussed below.

3.5.2.1 Levels of analysis

Studies of place often fail to address the issues related to the level of analysis and are often guilty of committing inferential fallacies as a result (Theodori 2000). It has been known for some time that correlations between variables at the aggregate level can differ substantially from correlations at the individual level, and that a fallacy was committed when inferences made from aggregate level data are applied to the individual level (Robinson 1950). This has been termed the ‘ecological fallacy’ (Selvin 1958). It has been argued that the discovery of the ecological fallacy was a major reason behind the rise in the use of individual level survey data (Firebaugh 2001).

Along with the ecological fallacy it is also the case that inferences made from individual level data should not be used to make inferences about aggregate level effects, or structural processes (Coleman 1986). This has been called the ‘atomistic fallacy’ (Riley 1963) and the ‘individualistic fallacy’ (Scheuch 1969). The assumption that theoretical models constructed at one level can explain mechanisms operating at another level has been called the fallacy of the ‘displaced scope’ (Wagner 1964) and the ‘fallacy of the wrong level’ (Galtung 1967). As long ago as the late 1960’s it was argued that such cross-level inferential fallacies are a reason for developing a multilevel approach (Alker 1969).

Indeed it is only through constructing multilevel models that it will be possible to test the specific research questions because the analysis will require the partition of area level and individual level variance as well as an examination of the degree to which this variance can be explained by area level and individual level variables. Multilevel models enable both area level variables and individual level variables to be considered within the same model, and allow an examination of the extent to which variance in outcomes can be explained by compositional or contextual factors (Subramanian 2004).

3.5.2.2 Clustering, the endogenous group membership problem

The reason that the ecological fallacy exists is that individuals tend to be clustered geographically, individuals within the same area tend to be more alike than individuals in different areas (Holt et al 1996). The observed associations at the aggregate level reflect this clustering and, as well as inferential problems, there are statistical issues that arise from treating observations as independent when they are not so. Aggregation leads to loss of power, as data from many sub units are combined into fewer values for fewer higher level units. Disaggregation can lead to spurious significant results as standard statistical tests treat disaggregated data values as independent which they are not and this leads to incorrect, overly small, standard errors (Hox 2010). Multilevel models allow for the appropriate modelling of outcomes that have dependence due to clustering (Browne & Goldstein 2010).

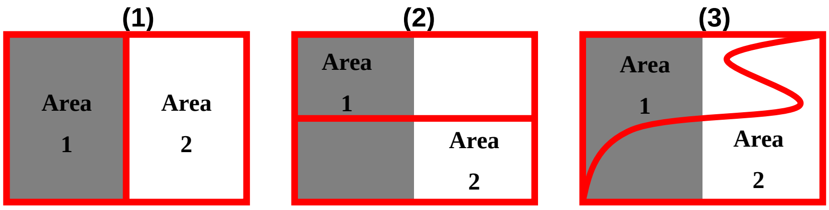
The 'endogenous group membership' problem (van Ham et al 2012) arises because of the clustering of similar individuals into particular neighbourhoods. Households do not choose where they live in a random manner; this is particularly a problem when the selection mechanism is related to the outcomes under study. This selection mechanism, or 'selection bias', has been identified as the greatest challenge facing the study of neighbourhood effects, generally in relation to the estimation of causal effects (Small & Feldman 2012, van Ham et al 2012). More recently there has been more interest in the actual mechanisms, and how these selection mechanisms relate to notions of neighbourhood effects (Hedman & van Ham 2012).

3.5.2.3 What is a neighbourhood? Conceptual and measurement issues

Conceptually respondents to surveys may have different definitions of what constitutes their neighbourhood. In studies from the US it was found that perception of neighbourhood ranged from a block to a half mile radius (Guest & Lee 1984), and that suburban residents defined neighbourhoods as on average 0.16 square miles while inner city residents averaged 0.03 square miles (Haney & Knowles 1978). And more recently a study where individuals drew out maps of what they considered to be their neighbourhood, found definitions varied, even for individuals living in the same area. Individual definitions of neighbourhood also differed from official administrative boundaries and such discrepancies in definition may be a possible source of bias in studies of neighbourhood effects (Coulton et al 2001).

The problems associated with using administrative boundaries as definitions of neighbourhoods have been recognised for some time, the modifiable areal unit problem (MAUP) was first identified in 1934. Administrative boundaries can be arbitrary, and depending on how boundaries are constructed boundary lines can result in very different aggregated measures (Openshaw 1984). The ways in which boundaries are drawn can influence any results obtained (Openshaw & Taylor 1979, Swift et al 2008). For an oversimplified example see figure 3.4.

Figure 3.4: Visual representation of the modifiable areal unit problem



The shaded and non-shaded blocks represent the geographical distribution of a variable. In situation (1) the association with area is 1. In situation (2) the association is 0 and as illustrated by situation (3) the association can be anywhere in between.

The MAUP consists of the above 'zoning effect' along with the scale effect (Tranmer & Steel 2001b). The scale effect results in different levels of association between variables at different levels of aggregation. The mean aggregate will change depending on the number of subdivisions made to the population under study. Generally associations become stronger as the size of the areal unit increases. Finding the appropriate geographic level at which to conceptualise neighbourhood or local area is therefore a challenge. The geographical level chosen to represent neighbourhood in this thesis is the electoral ward, with an average population of around 2,800, as described in section 3.4.5. It is felt that wards are a small enough geography to capture the concept of neighbourhood. Many previous studies have used the larger geographical unit of middle level super output level, which has an average population of 7,200 (Laurence & Heath 2008, Fieldhouse & Cutts 2010, Sturgis & Smith 2010, Becares et al 2011, Laurence 2011). However, this may be too large a unit to adequately represent neighbourhood. It is common in studies of spatial segregation to use wards as representations of neighbourhood (Simpson 2007, Dorling et al 2007). In a multilevel study of belonging to neighbourhoods in the UK Finney & Jivraj 2013 use wards to represent neighbourhood and argue that wards have a 'functional meaning' in relation to the concept of neighbourhood as boundaries tend to follow physical boundaries.

The quantitative approach taken necessitates measurement of neighbourhood context, which requires the use of official boundaries. In addition to the limitations of this approach, as outlined above, there is also an apparent contradiction in the conceptualisation of neighbourhoods as open and dynamic and the use of fixed geographical boundaries in the analysis of neighbourhood. However, while the use of fixed boundaries is a necessity for the purpose of measurement, this does not preclude the processes occurring within any given boundary from being dynamic.

3.5.2.4 Specification of cross-sectional multilevel models

Cross-sectional multilevel models, with the individual at level one and ward at level 2, can be specified as equation 3. This equation can be extended to test for contextual, ward level effects. Models based on these equations are presented in chapter 5, which begins to address hypothesis 3 and hypothesis 4. These cross-sectional models cannot distinguish between age and cohort effects, but allow for an initial investigation of ward level contextual effects.

Hypothesis 4 contends that after controlling for other neighbourhood level variables, higher levels of, or increases in, neighbourhood ethnic diversity are associated with higher levels of individual belonging to neighbourhoods and talking to neighbours, when compared to individuals in neighbourhoods that are not ethnically diverse, or do not experience an increase in neighbourhood ethnic diversity. Models are developed based on equation 8.

$$y^*_{ij} = \beta_{0ij}cons + \beta_1 Age_{ij} + \beta_2 HouseholdIncome_{ij} + \beta_3 Moved\ ward_{ij} + \beta_4 WardTownsendscore_j + \beta_5 WardBME_j + \beta_6 WardDensity_j + \beta_7 WardGrossMigration_j$$

$$\beta_{0ij} = \beta_0 + u_j + e_{ij}$$

$$(u_j) \sim \mathrm{N}(0, \Omega_u): \Omega_u = (\sigma^2{}_u)$$
$$(e_{ij}) \sim \mathrm{N}(0, \Omega_e): \Omega_e = (\sigma^2{}_e) \qquad (8)$$

First the ethnic diversity is considered alone, and then with all other ward level variables. Then to specifically address hypothesis 4 an interaction term between ward level material deprivation and ward level ethnic diversity is added, as in equation 9.

$$y^*_{ij} = \beta_{0ij}cons + \beta_1 Age_{ij} + \beta_2 HouseholdIncome_{ij} + \beta_3 Moved\ ward_{ij} + \beta_4 WardTownsendscore_j + \beta_5 WardBME_j + \beta_6 WardDensity_j + \beta_7 WardGrossMigration_j + \beta_8 WardTownsendscore * WardBME_j$$

$$\beta_{0ij} = \beta_0 + u_j + e_{ij}$$

$$(u_j) \sim \mathrm{N}(0, \Omega_u): \Omega_u = (\sigma^2{}_u)$$
$$(e_{ij}) \sim \mathrm{N}(0, \Omega_e): \Omega_e = (\sigma^2{}_e) \qquad (9)$$

Hypothesis 3 contends that remaining in materially deprived neighbourhoods, or moving into materially deprived neighbourhoods, will act to reduce levels of belonging to neighbourhoods and talking to neighbours for low income groups. In order to begin to address this hypothesis an interaction between ward level material deprivation and household income is considered, as in equation 10.

$$y^*_{ij} = \beta_{0ij}cons + \beta_1 Age_{ij} + \beta_2 HouseholdIncome_{ij} + \beta_3 Moved\ ward_{ij} + \beta_4 WardTownsendscore_j + \beta_5 WardBME_j + \beta_6 WardDensity_j + \beta_7 WardGrossMigration_j + \beta_8 WardTownsendscore*HouseholdIncome_{ij}$$

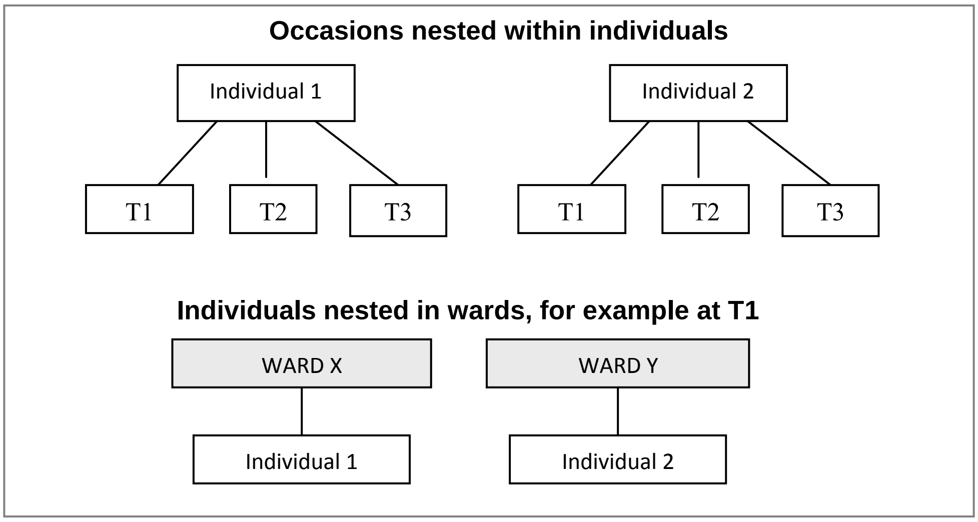
$$\beta_{0ij} = \beta_0 + u_j + e_{ij}$$

$$(u_j) \sim N(0,\Omega_u): \Omega_u = (\sigma^2_u)$$
$$(e_{ij}) \sim N(0,\Omega_e): \Omega_e = (\sigma^2_e) \qquad (10)$$

3.5.3 Multilevel models of change combining longitudinal and contextual levels

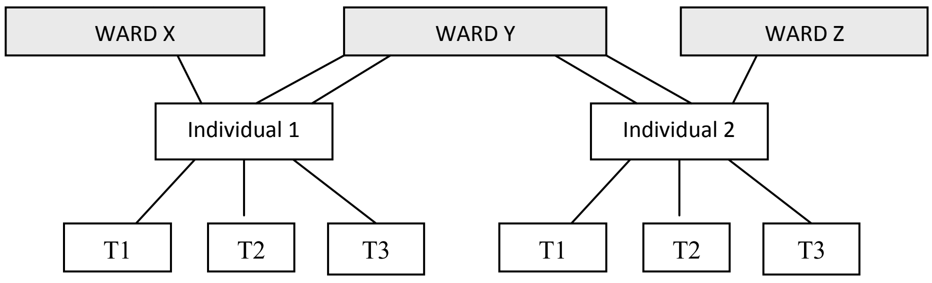
The final empirical chapter, chapter 6, considers the longitudinal and contextual levels together in a single model. There are some challenges in doing so. When each survey wave is considered in a cross-sectional way, and when two level growth trajectory models are considered, then the data are nested in a perfect hierarchy, as shown in figure 3.5.

Figure 3.5: Nested nature of the data in longitudinal and cross-sectional multilevel



However when considering the longitudinal and multilevel nature of the data together these perfect hierarchies break down as individuals can change wards between measurement occasions. This can be seen in the example given in figure 3.6. In this example individual 1 is in ward X at occasion 1, and ward Y at occasion 2 and 3. Individual 2 is in ward Y at occasion 1 and 2, and ward Z at occasion 3.

Figure 3.6. The imperfect hierarchy across time



In this example individual 1 is in ward X at T1, and ward Y at T2 and T3. Individual 2 is in ward Y at T1 and T2, and ward Z at T3.

It has been known for some time that there are situations where perfect hierarchies break down, particularly when using longitudinal data. For example if, in a longitudinal study of children nested in classes, a student changes class during the course of the study they can no longer be considered as nested within a particular class, (Raudenbush 1993, Fielding & Goldstein 2006, Snijders & Bosker 2012). Studies that have employed cross-classified multilevel models have almost exclusively considered such situation within the field of education, (Goldstein & Sammons 1997, Rasbash et al 2000, Goldstein et al 2007, Leckie 2009). Studies looking at the neighbourhood as a level that employ multilevel models tend to be cross-sectional and therefore issues of imperfect hierarchy do not arise. However, as there is a recognised need for more longitudinal studies within the field of neighbourhood effects, as discussed in chapter 2, then any such studies would need to consider, as this thesis does, imperfect hierarchies.

Dynamic structures that change over time can potentially cause problems in interpretation (Murphy 1996). Allowing for imperfect hierarchies means that different cross-classified units at the higher level will contribute to the outcome at different time points, and also to the overall individual trajectory (Snijders & Bosker 2012). This will require careful interpretation of results from the cross-classified models. However, such models have distinct advantages in that they enable the dynamic structure of the data to be correctly incorporated within the models.

Rasbash and Goldstein (1994) and Raudenbush (1993) show how cross-classified models can be specified as a hierarchical model. These approaches introduce more complex models based on classifications and nested nature of the data. This involves the creation of a large number of extra model parameters. Rasbash and Browne (2001) and Browne (2012) introduce a more simple approach to cross-classified models, see also Browne et al (2001). Here the response variable subscript i is given to the lowest level unit and then classification names are used for the subscript of random effects. As there may be any number of classifications then rather than using different letters for each they are represented by a subscript giving the classification number. This considers the lowest level of classification as level 1 and so individual becomes classification 2, and ward classification 3.

So based on the notation used by Fielding and Goldstein (2006) and Browne (2012) the formula for a three level cross-classified model, with individual, household and ward levels is as equation 11. Here i is the occasion, u(2) and u(3) are the random effects for individual and ward classifications respectively.

$$y^*_i = \beta_{0i} cons_i$$

$$\beta_{0i} = \beta_0 + u^{(3)}_{Ward(i)} + u^{(2)}_{Individual(i)} + e_i$$

$$\begin{aligned} [u^{(3)}_{Ward(i)}] &\sim N(0, \Omega u^{(3)}) : \quad \Omega u^{(3)} = [\sigma^2_{u}{}^{(3)}] \\ [u^{(2)}_{Individual(i)}] &\sim N(0, \Omega u^{(2)}) : \quad \Omega u^{(2)} = [\sigma^2_{u}{}^{(2)}] \\ [e_i] &\sim N(0, \Omega e) : \quad \Omega e = [\sigma^2_e] \end{aligned} \qquad (11)$$

This compares to a three level model which is incorrectly specified as having perfect hierarchy, as in equation 12.

$$y^*_{ijk} = \beta_{0ijk} cons$$

$$\beta_{0ijk} = \beta_0 + v_k + u_{jk} + e_{ijk}$$

$$\begin{aligned} &[v_j] \sim \mathrm{N}(0,\Omega_v):\ \Omega_v = [\sigma^2_v] \\ &[u_{jk}] \sim \mathrm{N}(0,\Omega_u):\ \Omega_u = [\sigma^2_u] \\ &[e_{ijk}] \sim \mathrm{N}(0,\Omega_e):\ \Omega_e = [\sigma^2_e] \end{aligned} \quad (12)$$

Equation 11 can be extended to allow the effects of time to be random at the individual level, as in the longitudinal growth trajectory models in chapter 4. Here individuals have random intercepts, allowing for differences between individuals, and random slopes, allowing for individual differences in trajectories of change over time. This is shown in equation 13. Models based on equation 13, presented in chapter 6, and with the addition of year of birth, household income and the interaction between year of birth and household income, these models can be used to test whether age and cohort effects observed in longitudinal models, presented in chapter 4 remain once ward level variance is accounted for.

$$y^*_i = \beta_{0i} cons_i + \beta_{1i} Time_i$$

$$\beta_{0i} = \beta_0 + u^{(3)}_{Ward(i)} + u^{(2)}_{0,\ Individual(i)} + e_i$$

$$\beta_{1i} = \beta_1 + u^{(2)}_{1,\ Individual(i)}$$

$$\begin{aligned} &[u^{(3)}_{Ward(i)}] \sim \mathrm{N}(0, \Omega u^{(3)}) : \Omega u^{(3)} = [\sigma^2_{u}{}^{(3)}] \\ &\begin{bmatrix} u^{(2)}_{0,\ Individual(i)} \\ u^{(2)}_{1,\ Individual(i)} \end{bmatrix} \sim \mathrm{N}(0, \Omega u^{(2)}) : \Omega u^{(2)} = \begin{bmatrix} \sigma^2_{u}{}^{(2)}_{0,0} & \\ \sigma_{u}{}^{(2)}_{0,1} & \sigma^2_{u}{}^{(2)}_{1,1} \end{bmatrix} \\ &[e_i] \sim \mathrm{N}(0, \Omega e) : \Omega e = [\sigma^2_e] \end{aligned} \quad (13)$$

In chapter 6 these models are developed to test hypothesis 3 and 4, by first considering all main ward effects, and then specific interactions. Cross-classified models with all main effects are as specified in equation 14.

$$y^*_i = \beta_{0i}cons_i + \beta_{1i}Time_i + \beta_2 YOB_i + \beta_3 Household\ Income_i + \beta_4 Moved\ Ward_i + \beta_5 Ward\ Townsend_i + \beta_6 Ward\ BME_i + \beta_7 Ward\ Migration_i + \beta_8 Ward\ Density_i$$

$$\beta_{0i} = \beta_0 + u^{(3)}_{Ward(i)} + u^{(2)}_{0,\ Individual(i)} + e_i$$
$$\beta_{1i} = \beta_1 + u^{(2)}_{1,\ Individual(i)}$$

$$[u^{(3)}_{Ward(i)}] \sim N(0, \Omega u^{(3)}) : \Omega u^{(3)} = [\sigma^2_{u(3)}]$$
$$\begin{bmatrix} u^{(2)}_{0,\ Individual(i)} \\ u^{(2)}_{1,\ Individual(i)} \end{bmatrix} \sim N(0, \Omega u^{(2)}) : \Omega u^{(2)} = \begin{bmatrix} \sigma^2_{u(2)0,0} & \\ \sigma_{u(2)0,1} & \sigma^2_{u(2)1,1} \end{bmatrix}$$
$$[e_i] \sim N(0, \Omega e) : \Omega e = [\sigma^2_e] \quad (14)$$

The final models, with all significant main variables and interactions are as specified in equation 15a for the outcome of belonging to the neighbourhood and equation 15b for the outcome of talking to neighbours.

$$y^*_i = \beta_{0i}cons_i + \beta_{1i}Time_i + \beta_2 YOB_i + \beta_3 Time{*}YOB_i + \beta_4 Household\ Income_i + \beta_5 Moved\ Ward_i + \beta_6 Ward\ Townsend_i + \beta_7 Ward\ BME_i + \beta_8 Ward\ Migration_i + \beta_9 Ward\ Townsend{*}Ward\ BME_i\ Migration_i + \beta_{10} Ward\ Townsend{*}Household\ Income_i + \beta_{11} Household\ Income{*}Moved\ Ward_i$$

$$\beta_{0i} = \beta_0 + u^{(3)}_{Ward(i)} + u^{(2)}_{0,\ Individual(i)} + e_i$$
$$\beta_{1i} = \beta_1 + u^{(2)}_{1,\ Individual(i)}$$

$$[u^{(3)}_{Ward(i)}] \sim N(0, \Omega u^{(3)}) : \Omega u^{(3)} = [\sigma^2_{u(3)}]$$
$$\begin{bmatrix} u^{(2)}_{0,\ Individual(i)} \\ u^{(2)}_{1,\ Individual(i)} \end{bmatrix} \sim N(0, \Omega u^{(2)}) : \Omega u^{(2)} = \begin{bmatrix} \sigma^2_{u(2)0,0} & \\ \sigma_{u(2)0,1} & \sigma^2_{u(2)1,1} \end{bmatrix}$$
$$[e_i] \sim N(0, \Omega e) : \Omega e = [\sigma^2_e] \quad (15a)$$

$$y^*_i = \beta_{0i}cons_i + \beta_{1i}Time_i + \beta_2 YOB_i + \beta_3 Household\ Income_i + \beta_4 Moved\ Ward_i$$
$$+ \beta_5 Ward\ Townsend_i + \beta_6 Ward\ BME_i + \beta_7 Ward\ Migration_i + \beta_8 Ward\ Density_i$$
$$+ \beta_9 Ward\ Townsend{*}Ward\ BME_i + \beta_{10} Ward\ Townsend{*}Moved\ Ward_i$$
$$+ \beta_{11} YOB{*}Household\ Income_i + \beta_{12} YOB{*}Moved\ Ward_i$$

$$\beta_{0i} = \beta_0 + u^{(3)}_{Ward(i)} + u^{(2)}_{0, Individual(i)} + e_i$$
$$\beta_{1i} = \beta_1 + u^{(2)}_{1, Individual(i)}$$

$$[u^{(3)}_{Ward(i)}] \sim N(0, \Omega u^{(3)}) : \Omega u^{(3)} = [\sigma^2_{u}{}^{(3)}]$$
$$\begin{bmatrix} u^{(2)}_{0, Individual(i)} \\ u^{(2)}_{1, Individual(i)} \end{bmatrix} \sim N(0, \Omega u^{(2)}) : \Omega u^{(2)} = \begin{bmatrix} \sigma^2_{u}{}^{(2)}_{0,0} & \\ \sigma_{u}{}^{(2)}_{0,1} & \sigma^2_{u}{}^{(2)}_{1,1} \end{bmatrix}$$
$$[e_i] \sim N(0, \Omega e) : \Omega e = [\sigma^2_e] \quad (15b)$$

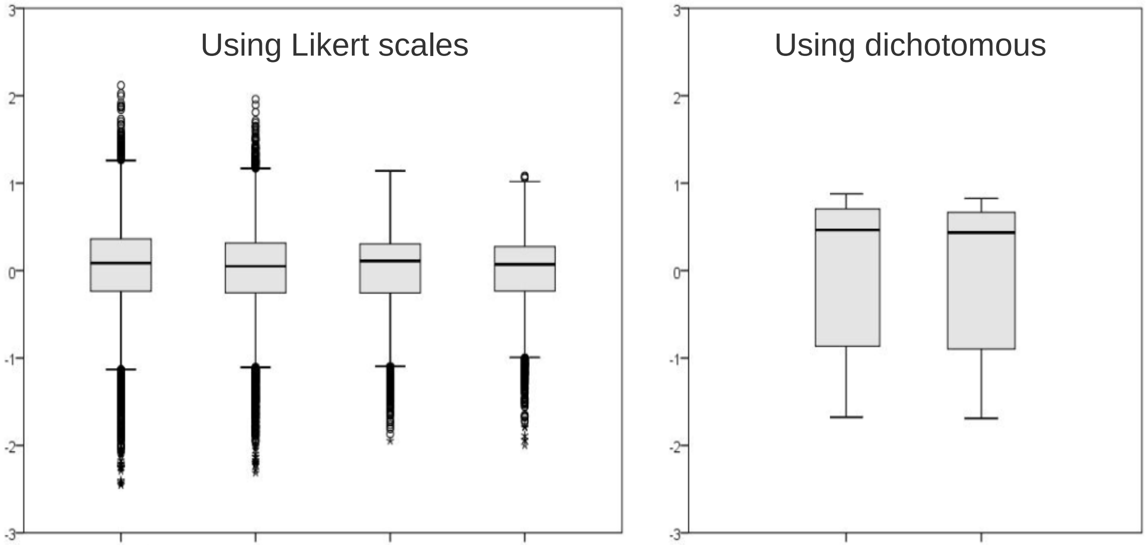
The models are estimated in MLWiN software (Rasbash et al 2005), using Monte Carlo Markov Chain (MCMC) methods within a Bayesian framework beginning with diffuse priors (Browne 2012, Rasbash et al 2012). The empty models presented below employ up to 500,000 iterations. See Gilks et al (1996) for more detailed discussion of MCMC and Browne (2012) for the implementation of MCMC method in MLWiN.

While It is possible to carry out a significance test for individual coefficients using a Wald test, based on a null hypothesis that a variable which does not explain any variance would have a coefficient of 0, the analysis will use tests of model fit to assess the models developed. Tests of model fit ideally involve two elements, how well the model fits the data and also the level of complexity of the model. While traditional Bayes factors do not include measures of model complexity Spiegelhalter et al (2002) devised a selection criterion, called the deviance information criteria (DIC) based on Bayesian measures of complexity and of how well the model fits the data. The (DIC) is a hierarchical modelling generalization of the Akaike information criterion (AIC) and Bayesian information criterion (BIC) and it is particularly suited to situations where posterior distributions have been obtained by MCMC methods. One key difference to Bayes factors, which summarises how well the prior predicted the obtained estimates, is that the DIC summarises how well the posterior may predict future estimates produced by the same process. Claeskens & Hjort (2008) show that the DIC is equivalent to the natural model-robust version of the AIC with large samples. Nested models can be compared and models with smaller DIC should be preferred to models with larger DIC. Spiegelhalter et al (2002) suggest that a decrease of between 3 and 7 in the DIC score suggests a better model fit (based on the measure of error that may be associated with estimates of DIC).

3.6 Concluding comments on model specification

It is important to evaluate the assumptions made in the statistical models presented, as any conclusions are dependent on the validity of these assumptions (Singer & Willett 2003). One assumption is that the residuals are normally distributed at each level. This is the key reason why the models employed in this chapter did not treat the outcomes as dichotomous. Figure 3.7 shows the residuals for models treating the Likert scales as continuous and as dichotomous, Note that level 1 residuals in dichotomous models are not estimated but assumed to have a mean of zero and a given distribution, in this case a standard deviation of 1 as the models employed a probit link. As can be seen, the level 2 residuals from the models when the outcomes are treated as dichotomous are not normally distributed. This leads to problems for estimated means. For example for the outcome of belonging to the neighbourhood, in the dichotomous model the median is 0.464, while the maximum residual value is 0.880. This skewed distribution of level 2 residuals became more extreme when explanatory variables were added to the model.

Figure 3.7: Comparison of residuals from 2 level empty longitudinal models, with linear regression using Likert scales and non linear dichotomous outcomes



	LEVEL 1 BELONG	LEVEL 1 TALK	LEVEL 2 BELONG	LEVEL 2 TALK	LEVEL 2 BELONG	LEVEL 2 TALK
Mean	0.000	0.000	0.000	0.000	0.001	0.003
Median	0.086	0.049	0.111	0.069	0.464	0.434
Std. Dev	0.598	0.510	0.472	0.427	0.818	0.797
Skewness	-0.715	-0.665	-0.784	-0.726	-0.555	-0.682
Kurtosis	0.795	1.235	0.412	0.737	-1.170	-1.038

A series of dichotomous models were estimated in parallel with the models presented in this thesis, and although the substantive inference regarding the relationship with explanatory variables was similar, the mean probabilities were estimated close to 1. This is assumed to be a result of the skewed nature of the residuals from these models. It is known that models with small numbers of cases per cluster, as in this study, are more difficult to estimate in cases where the outcome is dichotomous (Hox 2010, Sidjers & Bosker 2012). A consequence of this difficulty in estimating variances is that variances from the dichotomous models have less validity and the estimates of the variances produced were substantively different from estimates produced from the models treating the scale outcomes as continuous. The models presented range from 1 being the lowest belonging and likelihood of talking to neighbours, to 5 being the highest level of belonging and likelihood of talking to neighbours. For this reason it was decided to treat the scale outcomes as continuous. While recognising this is not ideal, it presented as the most valid approach.

Appendix 1 gives examples of models estimated using dichotomous and linear models. This indicates that, when estimating two level models, constant terms appear inflated when using dichotomous models, but not when using linear models. Also there is concern that this inflation extends to the coefficients for explanatory variables as well. Due to the relatively small number of cases per cluster it would appear that there are not enough cases to apply more complex dichotomous models (Hox 2010, Sidjers & Bosker 2012). Appendix 2 considers whether there is a difference to models estimated using MCMC or maximum likelihood methods (and comparisons also shown in Appendix 1). The results from both estimation methods are identical, and it was decided to estimate models using MCMC for practical purposes, as cross-classified models are easier to implement using MCMC methods.

The assumptions that the residuals at level 1 and level 2 were not correlated was also tested in the final models and found to be correct. This is important as it validates the assumption of additivity and allows for the partitioning of the variance.

Within the data there is also an additional level of clustering of individuals within households. This is something that tends not to be addressed in existing empirical studies, (McCulloch 2001), however failing to account for this level of clustering and treating individuals within households as independent within a multilevel model will result in the household variance being transferred to variance at other levels (Tranmer & Steel 2001a, van den Noortgate et al 2005, Snijders & Bosker 2012).

After consideration a decision was made not to include household as an additional level in the models. This was because the survey included all members of the household and so cannot be conceived of as a sample from a wider population of possible household members. Also the number of individuals per household is bounded by a low number and so all estimated household level residuals would be shrunk towards the mean. For example with the estimated intra-cluster correlation a two person household with two respondents would still have a household residual estimated that would be shrunk by a factor of around 0.59. See appendix 3 for detail of how the shrinkage factor is calculated. This means there is no reason to consider household members as a random sample of members of the household, and also little power for estimating variance at a household level, if it were treated as a level. The measure of household income does need to take account of the lack of independence of this measure, for individuals within the same household. There are fewer households than individuals. To account for this the approach taken was to calculate the design effect resulting from the clustering and to use this to adjust standard errors for household income estimates. For more detail on the calculation of design effects see Lohr (2010).

Alternative modelling strategies were considered, including fixed effects models. It has been suggested that fixed effects models are able to get closer to the 'experimental ideal' by controlling for all possible, time invariant, confounding variables in order to remove omitted variable bias (Allison 2009). Fixed effects models treat each individual as their own control and consider the effect of change in explanatory variables in relation to only within person change in the outcome variables. Therefore all between person variation is discarded in the fixed effects approach. Fixed effects models were constructed to compare with results from longitudinal models presented in chapter 4. Very broadly, the substantive results were similar in the general size and direction of effects. However, actual estimates were different and, as expected, standard errors far larger in the fixed effects models. This is not surprising as the fixed effects models are very differently specified, only considering individuals with a change in the outcome variable; and where there is change in explanatory variables. The large standard errors arise from a loss of efficiency when considering only within person change.

There are a number of reasons why fixed effects models were not thought to be the most appropriate in addressing the research question and testing the specific hypotheses. One reason is that by discarding the between person variance, differences between individuals, it is not possible to model the effects of time invariant explanatory variables, and this thesis is concerned with the effects of neighbourhood variables that do not change, as much as neighbourhood variables that do. Another reason for not using fixed effects models is that such models do not enable inference to be made outside the sample, to wider populations. Other quasi-experimental approaches were also explored, but these too restrict inference to the sample. Also fixed effects models and quasi-experimental approaches are less efficient, often as a result of discarding data.

In the models non-linear effects were tested for, to determine whether there were quadratic relationships between explanatory variables and the outcomes under study. Some ward level variables were found to be non-linear when considered in isolation, for example neighbourhood material deprivation. However when all neighbourhood level variables were included in the models any quadratic terms became non significant and were removed.

Chapter 4 Age and cohort effects

4.1 Introduction

The central aim of this thesis is to investigate the ways in which individual level belonging to neighbourhoods, and interaction with neighbours, may have changed over time, in relation to individual and neighbourhood context. Subsequent chapters will consider the type of neighbourhood that individuals live in, and individual experience of neighbourhood change. First, though, it is important to establish the nature of change within individuals over time. The analysis in this chapter will address the research questions associated with individual change over time, particularly in relation to age and cohort effects, and differences associated with levels of household income.

As discussed in chapter 2, there are strong arguments that individuals may be becoming increasingly detached from local place, their neighbourhoods and their neighbours, as a result of processes associated with globalisation, modernity and individualisation. It has been suggested that there has been a 'transcendence of place' (Coleman 1993), partly as a result of increased mobility (Szerszynski & Urry 2006). While processes of individualisation (Beck & Beck-Gernsheim 2002) are regarded by some as a threat to the possibility of shared experience (Bauman 2001), undermining the capacity for human cooperation (Sennett 2012). If these theoretical perspectives were correct then the expectation would be that there would be observable generation change, cohort effects, in the outcomes measuring belonging to neighbourhood and talking to neighbours. Previous empirical studies into the outcomes of belonging to the neighbourhood and likelihood of talking to neighbours have constantly found that these outcomes are positively associated with older age (Lewicka 2011). However it is not possible in cross-sectional studies to determine whether the observed relationships with age are as a result of individual age related life stage, or cohort differences associated with generational change, and there are a lack of longitudinal studies in the field of study (Hernandez et al 2014, Scannell & Gifford 2014).

This chapter will look to test hypothesis 1, that younger cohorts will have lower levels of belonging to neighbourhoods and talking to neighbours, independent of any individual age related effects associated with life stage. In other words, the positive association between older age groups and both higher levels of belonging to the neighbourhood, and increased likelihood of talking to neighbours, that have been observed in cross-sectional studies to date, are partly a result of cohort differences, reflecting decreasing levels of belonging to neighbourhoods and talking to neighbours in younger generations.

However, there are strong arguments to suggest that not all individuals have transcended the local neighbourhood. It may be that affluent individuals have become less attached to neighbourhoods, and have less interaction with others in the neighbourhood, while poorer individuals remain more localised (Massey 1991, Bauman 1998a). So, if this were the case, it would be expected that lower income groups would have higher levels of belonging to the neighbourhood and likelihood of talking to neighbours. Also that any reduction in levels of belonging to neighbourhoods or talking to neighbours, as a result of generation change, would be dependent on levels of income. Specifically that, over generations, more affluent groups will experience greater reductions in levels of belonging and interaction with neighbours. Therefore the analysis will be extended to examine the relationship between levels of household income and individual belonging to neighbourhoods and likelihood of talking to neighbours. This will test hypothesis 2, that any reduction in levels of belonging to the neighbourhood and likelihood of talking to neighbours in younger cohorts, as a result of generational change, is greater for high income groups.

Finally this chapter will consider the relationship between individual mobility and the outcomes of individual level belonging to neighbourhoods and talking to neighbours over time, particularly in relation to household income. In chapter 2 it was noted that most empirical studies assume that geographical mobility weakens the strength of individual belonging to neighbourhoods and likelihood of talking to neighbours (David et al 2010), though results from empirical studies are mixed. Hypothesis 3 is concerned with the relationship between individual mobility and neighbourhood context, and contests that remaining in materially deprived neighbourhoods, or moving into materially deprived neighbourhoods, will act to reduce levels of belonging to neighbourhoods and talking to neighbours for low income groups. This chapter presents preliminary analysis of mobility between wards, prior to a full testing of hypothesis 3 in later chapters, where neighbourhood level contextual variables will be considered, alongside individual mobility.

The structure of this chapter is as follows. First, population average levels of belonging to neighbourhoods and likelihood of talking to neighbours are examined in descriptive analysis, treating the data as repeated, cross-sectional samples. Following this, longitudinal models are developed which seek to predict individual level change over time. These models are employed to test hypothesis 1, regarding the existence of generational change, and extended to consider household income to test hypothesis 2. The rationale for these models, and the method for distinguishing age and cohort effects are set out in chapter 3. Models that consider individual mobility, and the interaction with household income, are also presented, in order to begin to address hypothesis 3. Finally conclusions are drawn together regarding the strength of the evidence in support of the hypotheses. Consideration is given to the development of the analysis in subsequent chapters.

4.2 Population average age period and cohort effects; descriptive analysis

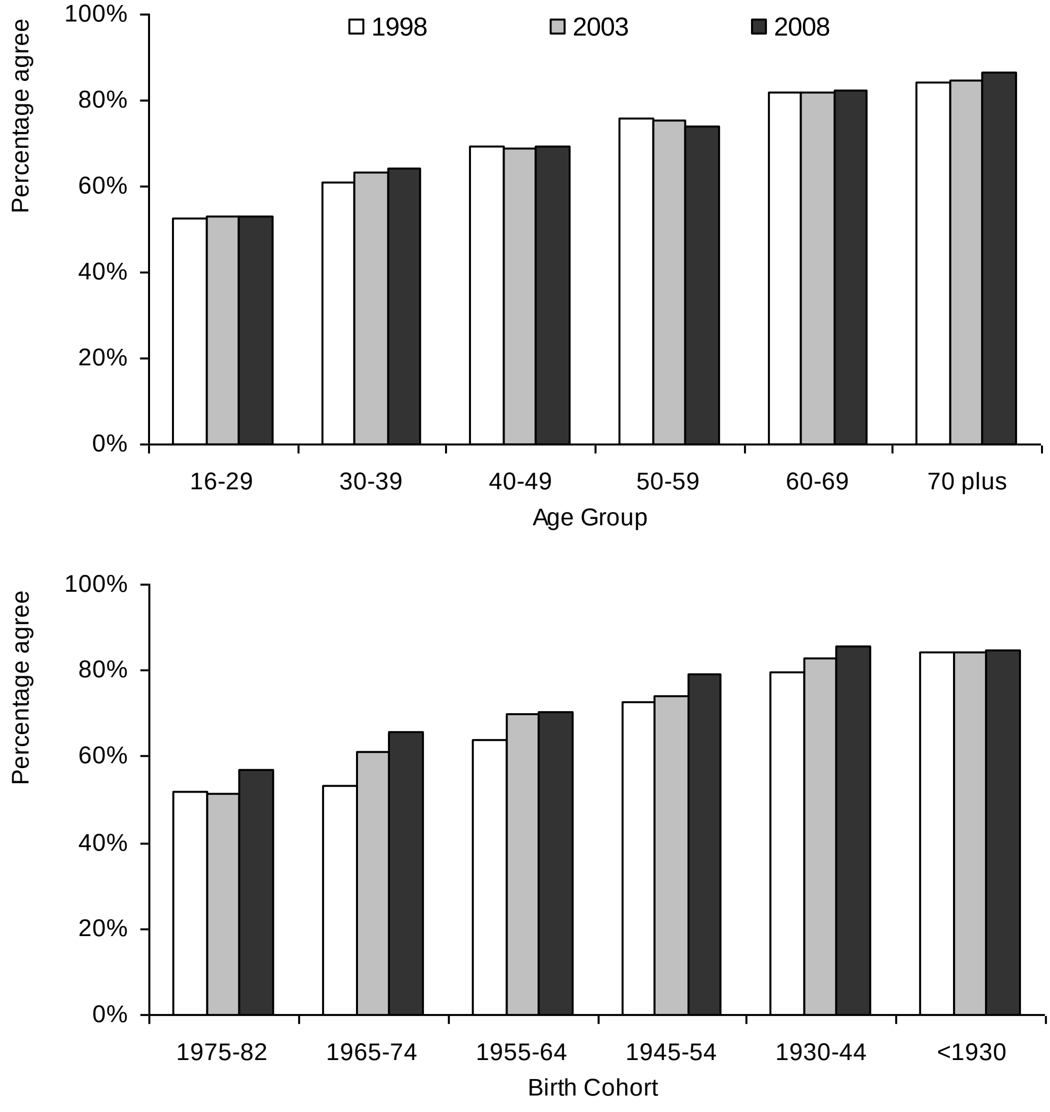
As seen in chapter 3, in table 3.8, most individuals agree that they belong to their neighbourhood and talk regularly to their neighbours. Also these outcomes are strongly positively associated, and the strength of this association is consistent over time, as shown in table 3.6.

For descriptive purposes the relationship between age, birth cohort and the outcomes of belonging to the neighbourhood and likelihood of talking to neighbours is considered grouping the outcomes into those that strongly agree or agree. Age and birth cohort are grouped into approximate ten year bands. The descriptive analysis is carried out using the relevant cross-sectional weights, as the interest is in population averages. For more details on the construction of these weights see Taylor et al (2010).

Figure 4.1 illustrates the relationship between belonging to the neighbourhood and age and cohort groups for each survey period. There is a fairly strong positive association between individual age and belonging to the neighbourhood, and a similar relationship for birth cohorts. Older age groups and birth cohorts are much more likely to agree that they belong to their neighbourhood. Comparing the differences at each period, it can be seen that the percentage of individuals that belong to the neighbourhood in each age group remains fairly consistent across time periods. However, within each birth cohort, particularly younger cohorts, levels of belonging increase over the time period. The distinction between age and cohort is set out in chapter three, in section 3.5.1, the important thing to note here is that the age groups at different periods are comparisons of different individuals, while the cohort groups are the same individuals at different periods. So, as seen in figure 4.1, different individuals have similar levels of belonging at the same age at different periods, while the same individuals, as cohort groups, increase levels of belonging over the period.

Figure 4.2 illustrates the relationship between the likelihood of talking to neighbours and age and cohort groups for each survey period. Again, there is a similar relationship with older age groups and birth cohorts being more likely to agree that they talk regularly to neighbours, though the strength of the associations are slightly weaker when compared to the outcome of belonging to the neighbourhood. However, the percentage of individuals in each age group who talk to neighbours generally decreases across the time period, so different individuals in the same age group at each period generally have declining levels of talking to neighbours. Also, there is not the same systematic increase in talking to neighbours for birth cohorts over the period, as there is for belonging, suggesting that these same individuals are not talking more to neighbours as they get older. Also the oldest birth cohorts experience a slight decrease in talking to neighbours. This may reflect a degree of social isolation that comes with very old age.

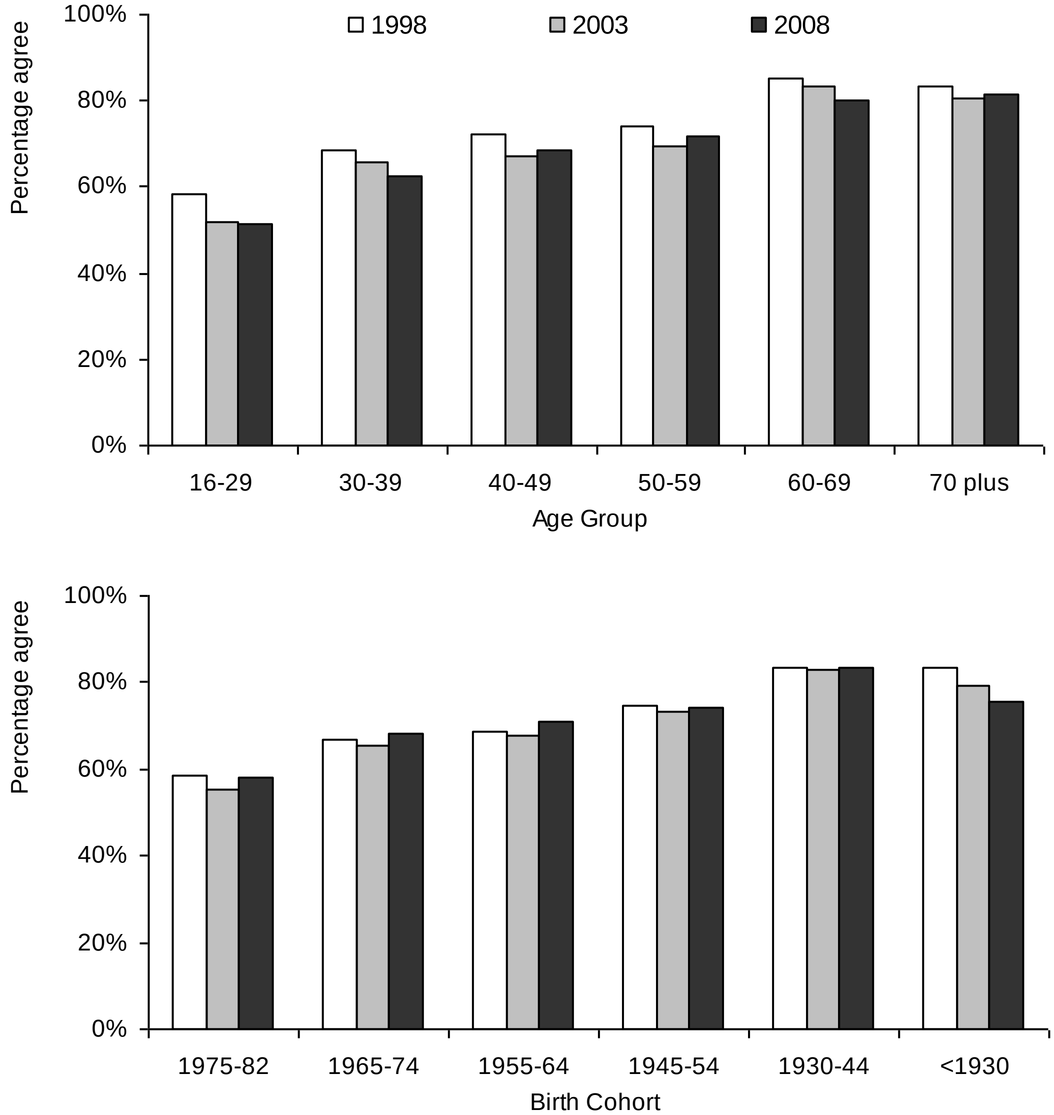
Figure 4.1: Percentage who belong to the neighbourhood by age and birth cohort



The association with belonging to the neighbourhood at each wave

Spearman's rho ρ	1998	2003	2008
Age group	0.271	0.259	0.244
Birth cohort	0.265	0.253	0.238
All significant at p <0.001			
Period average	69.3%	71.0%	72.3%

Figure 4.2: Percentage who talk to neighbours by age and birth cohort



The association with talking to the neighbours at each wave

Spearman's rho ρ	**1998**	**2003**	**2008**
Age group	0.200	0.206	0.199
Birth cohort	0.198	0.189	0.152
All significant at p <0.001			
Period average	72.8%	69.0%	70.4%

The descriptive analysis of age, period and cohort effects suggests that the outcomes of belonging to the neighbourhood and talking to neighbours are differently affected by age and cohort effects. For belonging to the neighbourhood there appears to be a clear linear relationship with age, with increased levels of belonging for subsequent age groups. Also these age differences do not vary much over time. In other words an individual of age x has a similar level of belonging at 1998, 2003 and 2008. Also birth cohorts show an increase in levels of belonging over the time period, so that an individual in birth cohort x would have higher levels of belonging in 2008 than in 1998. This is the case for all cohorts apart from those born prior to 1930 who already have high levels of belonging in 1998. Therefore it appears that levels of belonging increase with time, as individuals get older, and that age, rather than cohort effects are in operation.

There appears to be a different relationship with age and cohort for the outcome of talking to neighbours. There is still a relatively strong positive relationship with age and cohort groups, but while older age groups are more likely to talk to neighbours, this decreases in each age group over the time period. Also each cohort does not seem to change their level of talking to neighbours over the time period, there is no increase for cohorts over the period. This suggests that there may be cohort effects in operation and that the differences in talking to neighbours for different age groups may be partly due to generational changes. In addition the oldest birth cohort, those born prior to 1930, decrease their likelihood of talking to neighbours quite sharply over the period, suggesting that very old age has a negative effect.

The results from this descriptive analysis is informative, but it must be remembered that the comparison of age groups at different time periods compares different individuals, and the results only provide population averages. The research question is concerned with individuals change and for this reason longitudinal models are employed, that are capable of predicting individual level change over time.

4.3 Results from two level longitudinal models

4.3.1 Empty models

Results from the single level empty model, as specified by equation 2, in chapter 3, for both outcomes, are shown in table 4.1. Results from the two level empty model, as specified by equation 3, with measurement occasions clustered within individuals, for both outcomes, are shown in table 4.2. For both models the constant term represents the average. In the single level model, table 4.1, σ^2_e represents the overall variation in the outcomes. When a two level model is considered, table 4.2, the overall variation, as represented by σ^2_e, + σ^2_u, increases very slightly, but it has now been partitioned into within person variance σ^2_e, and between person variance σ^2_u. The large decrease in the DIC suggests that the two level models are a much better fit than the single level models (see chapter 3 for further detail on this measure of model fit). In the two level models the variation within individuals over time is estimated as over 50% of the total variation. Without considering this longitudinal individual change, as in the single level model, the variance is assumed to be all as a result of variation between individuals.

Table 4.1: Model 4.1: single level (individual) empty model

Level 1: Occasion (i) Level 2: Individual (j)	Model 4.1: Belong		Model 4.1: Talk	
	Est.	S.E.	Est.	S.E.
Constant (β_0)	3.725	0.006	3.654	0.007
σ^2_e Between individual variance	0.799	0.008	0.960	0.009
DIC	54809.78		58686.50	

Source data: BHPS, waves 1998, 2003 and 2008. Total n = 9,949

Table 4.2: Model 4.2: two level (individual and occasion) empty model

Level 1: Occasion (i) Level 2: Individual (j)	Model 4.2: Belong		Model 4.2: Talk	
	Est.	S.E.	Est.	S.E.
Constant (β_0)	3.700	0.008	3.636	0.009
σ^2_u Between individual variance	0.362	0.009	0.422	0.011
σ^2_e Between occasion variance	0.452	0.006	0.552	0.008
DIC	48830.52		52947.10	

Source data: BHPS, waves 1998, 2003 and 2008. Total n = 9,949

4.3.2 Testing hypotheses 1, age and cohort change over time

Hypothesis 1 is that younger cohorts will have lower levels of belonging to neighbourhoods and talking to neighbours, independent of any individual age related effects associated with life stage. In other words, the positive association between older age groups and both higher levels of belonging to the neighbourhood, and increased likelihood of talking to neighbours, that have been observed in cross-sectional studies to date, are partly a result of cohort differences, reflecting decreasing levels of belonging to neighbourhoods and talking to neighbours in younger generations. To test this hypothesis models are developed using equations 4 to 6, as outlined in chapter 3. Comparisons are made of the effects of age and study period years as the metric of time. The models from equation 4, with age and study period years as the metric of time are shown in table 4.3 and 4.4 respectively. The reported DIC shows that allowing the slope to be random improves the model fit, for both model types, when compared to equation 3, with fixed slopes.

In conceptualising the separate age and cohort effects it should be recognised that model 4.3 (table 4.3), confounds age and cohort, as this is an accelerated design, drawing on both cross-sectional and longitudinal data. Model 4.4 (table 4.4), confounds age and study period years. For the outcome of belonging to the neighbourhood it can be seen that the coefficient for age, in model 4.3, is the same as the coefficient for study period years, in model 4. This coefficient represents age and cohort in model 4.3 and age and study period years in model 4.4. As the effect of age is the same as the effect of study period years it can be concluded that there are no evident cohort effects. For the outcome of talking to neighbours the coefficient for age, in model 4.3, is positive and close to the value of the coefficient of age for belonging. However, in model 4.4, when study period years is the metric of time, the coefficient is negative, though is substantively very small. This suggests that the effects attributed to age in model 4.3 are actually cohort effects, and that there are cohort, rather than age differences in this outcome.

Table 4.3: Model 4.3: two level models (individual and occasion), with age as metric of time

Level 1: Occasion (i) Level 2: Individual (j)	Model 4.3: Belong		Model 4.3: Talk	
	Est.	S.E.	Est.	S.E.
Constant (β_0)	3.709	0.008	3.648	0.001
Occasion level:				
β_1 Age $_{ij}$	0.0122	0.0004	0.0095	0.0005
σ^2_{u0} Between individual variance: intercept	0.285	0.010	0.328	0.012
σ^2_{u1} Between individual variance: slope	0.00010	0.00002	0.00021	0.00003
σ_{u01} Intercept and slope covariance	-0.00108	0.00024	-0.00288	0.00033
σ^2_{u0}, σ^2_{u1} Correlation	-0.202		-0.347	
σ^2_{e} Between occasion variance	0.445	0.006	0.545	0.007
DIC	48300.12		52610.15	
DIC without random slope	*48400.80*		*52839.81*	

Age in units of one year, mean centred at 48 years. Source data: BHPS, waves 1998, 2003 and 2008. Total n = 9,949

Table 4.4: Model 4.4: two level models (individual and occasion), with years of study period as metric of time

Level 1: Occasion (i) Level 2: Individual (j)	Model 4.4: Belong		Model 4.4: Talk	
	Est.	S.E.	Est.	S.E.
Constant (β_0)	3.714	0.007	3.633	0.009
Occasion level:				
β_1 Time $_{ij}$	0.0122	0.0013	-0.0018	0.0014
σ^2_{u0} Between individual variance: intercept	0.363	0.009	0.429	0.011
σ^2_{u1} Between individual variance: slope	0.00225	0.00027	0.00155	0.00033
σ_{u01} Intercept and slope covariance	-0.00716	0.00088	-0.00172	0.00110
σ^2_{u0}, σ^2_{u1} Correlation	-0.25		-0.067	
σ^2_{e} Between occasion variance	0.394	0.008	0.515	0.01
DIC	47609.39		52452.78	
DIC without random slope	*48708.13*		*52946.70*	

Time in units of one year, mean centred at 5 years. Source data: BHPS, waves 1998, 2003 and 2008. Total n = 9,949

Table 4.3 and 4.4 also report the estimated variances at each level and the covariance between random slopes and random intercepts at level 2, along with the calculated correlation. The variance at level 2, between individual variance, is generally slightly larger in model 4.4, compared to model 4.3, particularly for the outcome of belonging. The level 1 variance is slightly bigger in model 4.4, where study period years is the metric of time, this is expected as model 4.3 draws on cross-sectional as well as longitudinal data. However the main difference between the models is the covariance, and correlation, between the random intercepts and slopes for the outcome of talking to neighbours. As can be seen in table 4.3, when using age as the metric of time the correlation for both outcomes is similar. The estimates are negative which suggests that the random slopes are 'fanning in', that those with higher starting values have flatter trajectories, while those with lower starting values have steeper trajectories. In model 4.4, with study period years as the metric of time, shown in table 4.4, the variances for intercepts and slopes are slightly higher. While the correlation between intercepts and slopes is similar for the outcome of belonging in both model 4.3 and 4.4, the correlations are much smaller for the outcome of talking to neighbours in model 4.4 compared to model 4.3. In model 4.4, with study period years as the metric of time, the main effect of time is very small, so the average trajectory of change is relatively flat. And the small correlation suggests that this flat rate of change does not vary much depending on starting values for this outcome.

In order to further examine age and cohort effects table 4.5 shows the results for model 4.5, based on equation 6 which introduces year of birth, extending model 4.4 with study period years as the metric of time. As noted above, year of birth cannot be added to model 3 as age and year of birth would be confounded. In model 4.5 year of birth represents cohort, but also the age of an individual at the start of the period. It should be noted that this variable is a level 2 variable, in that it varies between individuals, but not within individuals.

In model 4.5 the main effects of time, and the estimated variances, are similar to model 4.4. The coefficient for year of birth, which is mean centred at 1955, is similar for both outcomes, younger cohorts are less likely to belong to their neighbourhood or talk to neighbours. Year of birth represents the age of an individual at the start of the period, and time represents the effects of aging 11 years. So even though the coefficient for year of birth is similar for both outcomes, it is the coefficient of time that represents developmental change and year of birth captures age at the start of the period. This allows for a comparison of trajectories estimated from model 4.3, with age as the metric of time, and enables an evaluation of the extent of cohort effects. This is illustrated in figure 4.3 and 4.4 which compare predictions across age and cohort groups for both outcomes.

Table 4.5: Model 4.5: two level models (individual and occasion), with years of study period as metric of time, and year of birth (YOB)

Level 1: Occasion (i) Level 2: Individual (j)	Model 4.5: Belong		Model 4.5: Talk	
	Est.	S.E.	Est.	S.E.
Constant (β_0)	3.719	0.007	3.636	0.008
Occasion level:				
$\beta_{1\ \text{Time ij}}$	0.0149	0.0013	0.0005	0.0014
Individual level:				
$\beta_{2\ \text{YOB j}}$	-0.0119	0.0004	-0.0102	0.0005
σ^2_{u0} Between individual variance: intercept	0.317	0.008	0.395	0.011
σ^2_{u1} Between individual variance: slope	0.0023	0.0003	0.0015	0.0004
σ_{u01} Intercept and slope covariance	-0.0063	0.0008	-0.0009	0.0010
σ^2_{u0}, σ^2_{u1} Correlation	-0.235		-0.037	
σ^2_e Between occasion variance	0.394	0.008	0.514	0.011
DIC	47342.48		52298.59	
DIC: Model 4, without YOB	*47609.39*		*52452.78*	

Time in units of one year, mean centred at 5 years. YOB in units of one year, mean centred at 1955. Source data: BHPS, waves 1998, 2003 and 2008. Total n = 9,949

Figure 4.3 shows the predictions from model 4.3 and model 4.5 for the outcome of belonging to the neighbourhood. This illustrates that the developmental changes for different cohorts over the 11 year period are similar to the estimated trajectory from the accelerated design, which confounds age and cohort. This provides more support for the conclusion that the outcome of belonging is associated with age , rather than cohort effects.

Figure 4.3: Predicted values for belonging to neighbourhood from model 4.3 and 4.5

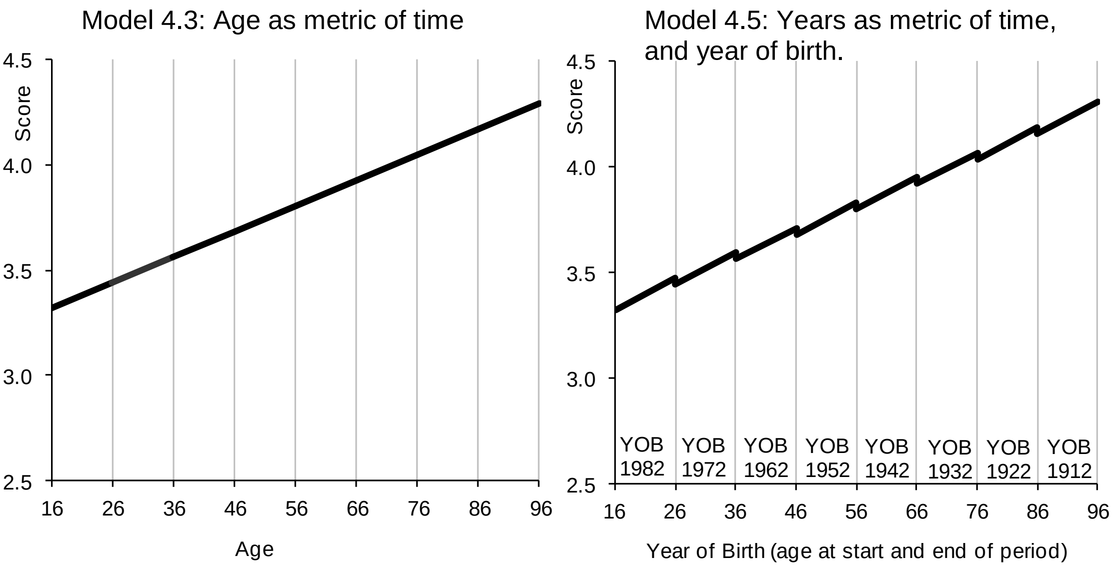


Figure 4.4: Predicted values for talking to neighbours from model 4.3 and 4.5

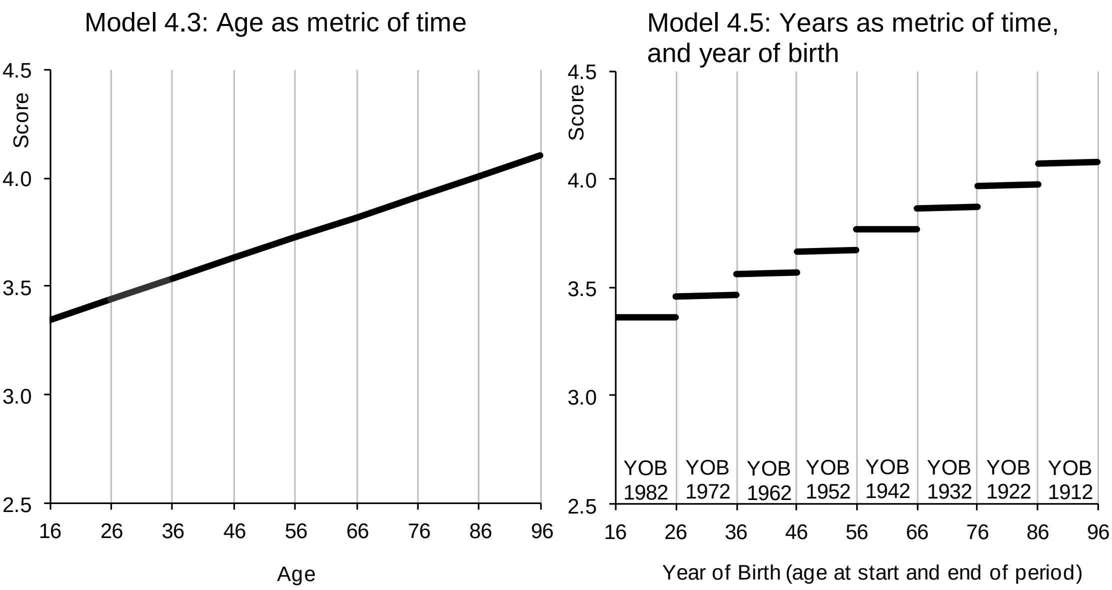


Figure 4.4 illustrates the predictions from model 4.3 and model 4.5 for the outcome of talking to neighbours. Model 4.3, which confounds age and cohort, shows a trajectory similar to the outcome of belonging. However, the

predictions from model 4.5 suggests that the difference by age is actually a result of cohort differences. Each cohort does not increase its likelihood of talking to neighbours over the time period but there are differences between cohorts. For example those aged 26 have a lower likelihood of talking to neighbours in 2008, compared to 1998. These predicted values suggest that, unlike the outcome of belonging to the neighbourhood, there is evidence of generational change in the likelihood of individuals talking to their neighbours.

An interaction between time and year of birth was introduced in model 4.6. This examines whether the developmental effects associated with 11 years of aging in the study period is different for individuals depending on their year of birth, their age at the start of the period. Results from this model are shown in table 4.6. This interaction did not improve the model fit for the outcome of talking to neighbours but did so for the outcome of belonging to the neighbourhood, though the effect size is relatively small. The interaction suggests that the effects of 11 years of time are greater for younger cohorts for the outcome of belonging to the neighbourhood. In other words, younger individuals increase their belonging more over the eleven year period, compared to older individuals, though of course older individuals already have, on average, high levels of belonging. The interaction is not significant for the outcome of talking to neighbours, and the main effect of time is substantively zero and not significant, so that older and younger individuals do not increase their likelihood of talking to neighbours over the eleven year period.

Table 4.6: Model 4.6: two level models (individual and occasion), with years of study period as metric of time, year of birth (YOB) and interaction between time and year of birth

Level 1: Occasion (i) Level 2: Individual (j)	Model 4.6: Belong		Model 4.6: Talk	
	Est.	S.E.	Est.	S.E.
Constant (β_0)	3.717	0.008	3.635	0.008
Occasion level:				
β_1 Time $_{ij}$	0.0149	0.0013	0.0004	0.0014
Individual level:				
β_2 YOB $_{i}$	-0.0117	0.0004	-0.0098	0.0005
Cross level interaction:				
β_3 Time*YOB $_{ij}$	0.00019	0.00007	-	-
σ^2_{u0} Between individual variance: intercept	0.317	0.008	0.396	0.011
σ^2_{u1} Between individual variance: slope	0.0022	0.0003	0.0015	0.0004
σ_{u01} Intercept and slope covariance	-0.0063	0.0008	-0.0009	0.0010
σ^2_{u0}, σ^2_{u1} Correlation	-0.238		-0.040	
σ^2_{e} Between occasion variance	0.394	0.008	0.514	0.010
DIC	*47342.48*		*52298.59*	
DIC: Model5, without interaction	47344.72		52296.75	

Time in units of one year, mean centred at 5 years. YOB in units of one year, mean centred at 1955. Source data: BHPS, waves 1998, 2003 and 2008. Total n = 9,949

4.3.3 Testing hypothesis 2, whether age and cohort changes are conditional on household income

Overall, the previous models suggest there is evidence for cohort effects for the outcome of talking to neighbours but not for belonging to the neighbourhood. Next the associations with household income are examined. This is to test the hypothesis 2, that any reduction in levels of belonging to the neighbourhood and likelihood of talking to neighbours in younger cohorts, as a result of generational change, is greater for high income groups. It is expected that lower income groups will have higher levels of belonging to the neighbourhood and likelihood of talking to neighbours. Also that, over time, more affluent groups will experience greater reductions in levels of belonging and interaction with neighbours as a result of generational change. This hypothesis is therefore testing whether any reduction in levels of belonging to neighbourhoods or talking to neighbours, as a result of generation change, is conditional, dependent on levels of income.

Household income is introduced into the models to test whether it moderates any observed cohort effects. The measure used is equivalised net household income, which is preferred to a measure of individual income. See chapter 3 for details of the calculation of this measure, and the range of equivalised household income values at each survey wave. The correlation between equivalised household income and the outcomes is shown in table 4.7. There is no significant association with belonging to the neighbourhood but individuals living in more affluent households are less likely to talk to neighbours. The relationships can be seen clearer in figure 4.5 which looks at the relationship using equivalised household income quintiles.

Table 4.7: Correlation between equivalised net household income and belonging to the neighbourhood and talking to neighbours at each survey wave

Year	Belong to neighbourhood	Talk regularly to neighbours
1998	-0.020 (p =0.065)	-0.099 (p <0.001)
2003	0.012 (p =0.304)	-0.082 (p <0.001)
2008	-0.015 (p =0.222)	-0.086 (p <0.001)

Correlations measured using Spearman's rho

Figure 4.5: The relationship between equivalised household income and both outcomes (average of three waves)

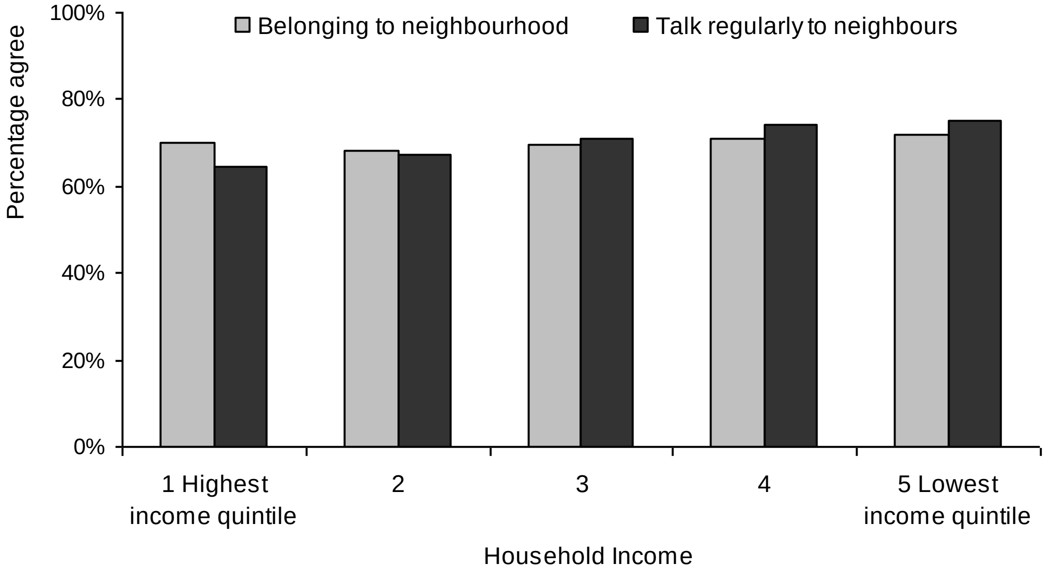


Figure 4.5 illustrates that the main difference is for the outcome of talking to neighbours, individuals in households with lower equivalised household income being more likely to talk to neighbours. It should be noted though that household income is associated with individual age, as seen in chapter 3.

Household income is added to the longitudinal models, and interactions between time, household income, and year of birth were tested. The results from this model are shown in table 4.8. The coefficient for household income represents the change in the outcome for every £100 increase in household income above the mean. The size of the effect is similar for both outcomes, and the addition of this variable improves the model fit, but the direction of the effect is opposite when considered in the longitudinal models. Those in households with higher incomes are more likely to belong to their neighbourhood and are less likely to talk to their neighbours.

An interaction with household income and time tests whether the household income effect is the same at each time period. If there were any differences then this interaction would capture the average differences for all cohorts. This interaction did not improve the model fit for either outcome. The interaction of year of birth and household income considers whether the income effects are different for different cohorts. This interaction did not improve the model fit for belonging but did improve the model fit for talking to neighbours.

If it were the case that individuals on low income have not transcended local neighbourhoods, as much as more affluent individuals, then it would be expected that differences in the outcomes by household income would be greater for younger birth cohorts. And this is the case, but only for the outcome of talking to neighbours.

Table 4.8: Model 4.7: two level models (individual and occasion), with years of study period as metric of time, year of birth (YOB), and household income, with interaction terms

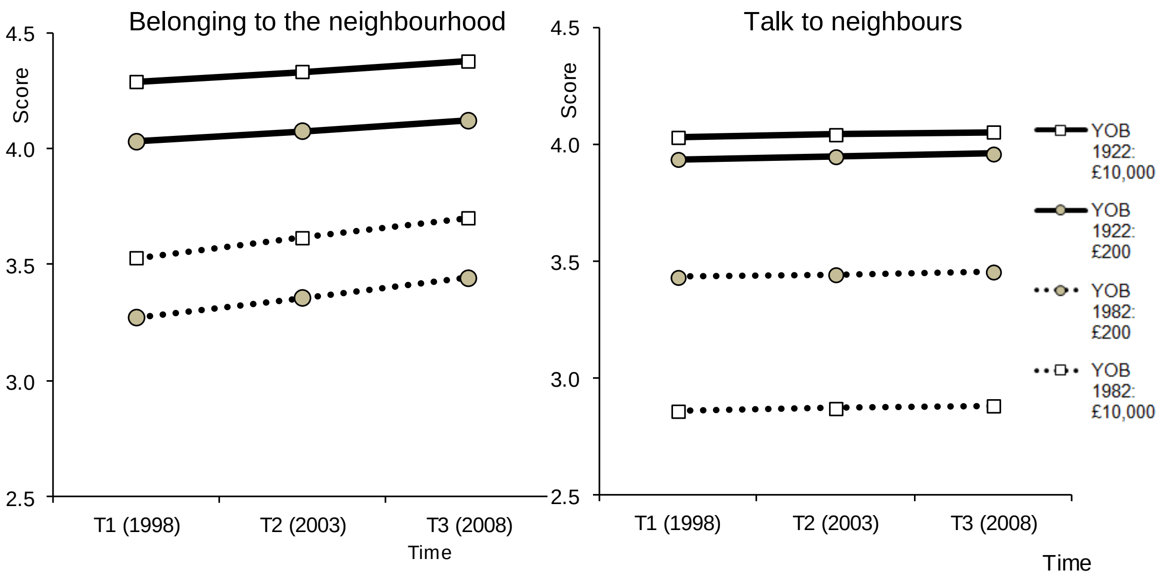
Level 1: Occasion (i) Level 2: Individual (j)	Model 4.7: Belong		Model 4.7: Talk	
	Est.	S.E.	Est.	S.E.
Constant (β_0)	3.716	0.008	3.639	0.009
Occasion level				
β_1 Time $_{ij}$	0.0134	0.0013	0.0023	0.0014
β_3 Household Income $_{ij}$	0.0026	0.0006	-0.0028	0.0006
Individual level				
β_2 YOB $_{j}$	-0.0120	0.0004	-0.0098	0.0005
Cross level interactions				
β_4 YOB*Household Income $_{ij}$	-	-	-0.00011	0.00004
β_5 Time*YOB $_{ij}$	0.00027	0.00007	-	-
σ^2_{u0} Between individual variance: intercept	0.316	0.008	0.392	0.011
σ^2_{u1} Between individual variance: slope	0.0023	0.0003	0.0015	0.0003
σ_{u01} Intercept and slope covariance	-0.0063	0.0008	-0.0011	0.0011
σ^2_{u0}, σ^2_{u1} Correlation	-0.235		-0.044	
σ^2_{e} Between occasion variance	0.394	0.008	0.515	0.010
DIC	47324.58		52249.76	
DIC: Model 5 without household income variables	*47344.72*		*52276.75*	

Time in units of one year, mean centred at 5 years. YOB in units of one year, mean centred at 1955. Household income in units of £100, mean centred at £1,400 equivalised net per month. Source data: BHPS, waves 1998, 2003 and 2008. Total n = 9,949

Predictions from model 4.7, for different cohorts and different household income groups, are shown in figure 4.6. This illustrates the difference in the outcomes by household income, lower income individuals belong less to the neighbourhood but talk more to neighbours. Figure 4.6 also illustrates the effects of the interactions with year of birth and household income. For the outcome of talking to neighbours, there is a greater difference in the outcome by household income for younger cohorts. This supports hypothesis 2, that poorer individuals talk more to neighbours, and that this difference is greater in younger cohorts.

For the outcome of belonging to the neighbourhood, there were no cohort differences, and so no cohort change conditional on income status, also individuals in households with higher incomes had higher levels of belonging in all cohorts.

Figure 4.6: Predicted outcomes from model 4.7, by cohort and household income



4.3.4: Investigating the relationship between individual geographical mobility and age and cohort changes

So far it has been seen that there are cohort differences for the outcome of talking to neighbours, but not for the outcome of belonging to neighbourhoods. Also those on lower household incomes talk more to neighbours, with larger differences by household income for younger cohorts. The final analysis in this chapter considers the effects of individual mobility between neighbourhoods. Therefore the final models presented in this chapter add a dummy variable which captures whether an individual had moved into the ward within the previous 5 years, at each survey wave. Also interactions were tested between year of birth and moving ward, investigating whether the effects of moving ward varied by birth cohort. The results from these models are shown in table 4.9. There was no significant interaction between household income and moving ward. This was slightly surprising, as this suggests that, in general, there is no difference in the effect of moving ward for individuals in households with different income levels. The results of these models are shown in table 4.9. In later chapters this relationship will be investigated in the context of ward level material deprivation. The aim for this later analysis will be to consider whether the effects of moving ward are conditional on levels of ward material deprivation.

Table 4.9: Model 4.8: two level models (individual and occasion), with years of study period as metric of time, year of birth (YOB), household income and whether moved ward, with interaction terms

Level 1: Occasion (i) Level 2: Individual (j)	Model 4.8: Belong		Model 4.8: Talk	
	Est.	S.E.	Est.	S.E.
Constant (β_0)	3.757	0.008	3.679	0.009
Occasion level				
β_1 Time $_{ij}$	0.0124	0.0013	0.0014	0.0017
β_3 Moved Ward $_{ij}$	-0.137	0.014	-0.099	0.0159
β_6 Household income $_{ij}$	0.0027	0.0006	-0.0029	0.0006
Individual level				
β_2 YOB $_j$	-0.0107	0.0005	-0.0074	0.0005
Cross level interactions				
β_5 YOB*Moved Ward $_{ij}$	-0.0016	0.0008	-0.0060	0.0009
β_7 Time*YOB $_{ij}$	0.0003	0.0001	-	-
β_8 YOB*Household income $_{ij}$	-	-	-0.0001	0.0000
σ^2_{u0}	0.309	0.008	0.389	0.011
σ^2_{u1}	0.0021	0.0003	0.0014	0.0003
σ_{u01}	-0.0059	0.0008	-0.0006	0.0011
σ^2_{u0} and σ^2_{u1} correlation	-0.231		-0.025	
σ^2_{e0}	0.396	0.008	0.517	0.01
DIC	47313.42		52195.63	

Time in units of one year, mean centred at 5 years. YOB in units of one year, mean centred at 1955. Household income in units of £100, mean centred at £1,400 equivalised net per month. Moved ward is a dummy variable with not moved as the reference category. Source data: BHPS, waves 1998, 2003 and 2008. Total n = 9,949

The main effect of having moved ward in the 5 years previously was found to be negative for both outcomes, particularly for the outcome of belonging to the neighbourhood. This suggests that mobility does, on average, have a negative effect on individual belonging to neighbourhoods and likelihood of interaction with neighbours. However the interactions between year of birth and moving ward improved the model fit for both outcomes. This interaction specifically tests whether the effects of moving ward are different depending on year of birth. This interaction is small, but suggests that the negative effect of moving ward is greater for younger cohorts and less so for older cohorts.

Predicted values from model 4.8 for different cohorts, for those that have not moved ward during the period, and those that have moved ward once during the period, are shown in table 4.10. These predicted values are for individuals in households with average income, the effect size are the same for all levels of household income as there is no interaction between household income and moving ward. For both outcomes, but particularly for the outcome of talking to neighbours, the interaction between year of birth and having moved ward in the previous five years means that the main negative effect of moving ward is less negative for older cohorts. For younger cohorts moving ward once in the period is associated with a very small reduction in levels of belonging to the neighbourhood, and a slightly larger reduction in the likelihood of talking to neighbours. But for older cohorts there is little difference in the level of belonging for those that have moved ward once during the period, compared to those that have not moved ward. Also for older cohorts those that do not move ward have a slightly lower likelihood of talking to neighbours, compared to those that moved ward once during the study period.

Table 4.10: Predictions from model 4.8 for different cohorts

	Belong			Talk		
Cohort:	1998	2008 Not moved	2008 Moved	1998	2008 Not moved	2008 Moved
Born 1922	4.04	4.17	4.09	3.97	3.87	3.97
Born 1952	3.72	3.85	3.72	3.70	3.70	3.62
Born 1982	3.40	3.53	3.35	3.42	3.53	3.27

4.4 Conclusions

The aim of this chapter was to investigate patterns of change in individual belonging to the neighbourhood and talking to neighbours. The central research question this chapter sought to address is whether there are cohort differences in the levels of individual belonging to neighbourhoods and likelihood of talking to neighbours, and whether any such cohort differences were conditional, dependent on household income.

The descriptive analysis, of repeated cross-sectional data, suggested that there may be cohort differences for the likelihood of talking to neighbours and age differences for the level of belonging to neighbourhoods. For belonging to the neighbourhood there are higher levels of belonging for older age groups, but these age differences do not vary much over time. In other words an individual of age x has a similar level of belonging at 1998, 2003 and 2008, though these are not the same individuals. Also birth cohorts show an increase in levels of belonging over the time period, so that an individual in birth cohort x would have higher levels of belonging in 2008 than in 1998. This is the case for all cohorts apart from those born prior to 1930 who already have high levels of belonging in 1998. Therefore it appears that levels of belonging to the neighbourhood increase with time, as individuals get older, and that age, rather than cohort effects are in operation. For the outcome of talking to neighbours, while older age groups are more likely to talk to neighbours, this decreases in each age group over the time period. Also each cohort does not seem to change their level of talking to neighbours over the time period. This suggests that there may be cohort effects in operation and that the differences in talking to neighbours for different age groups may be due to generational changes.

The descriptive analysis also showed that the overall population average level of belonging to the neighbourhood and talking to neighbours remained fairly constant across the time period. However this descriptive analysis was only on groups, not at the individual level, and could not distinguish within person change. Despite the consistency of population averages the longitudinal models were able to identify that there was a large degree of within person change over the period. The results from initial empty single level and two level models confirmed the degree of variation in individual outcomes that is attributable to within person change, is about 40% of the total variance.

This within person change was considered in longitudinal models with different metrics of time, to identify the extent of age and cohort effects. The results from the models provided evidence for cohort differences in the outcome of talking to neighbours but not for belonging. There is observable generational change in the likelihood of individuals talking to neighbours but belonging to neighbourhoods appear associated with individual aging processes.

The analysis then considered the hypothesis that lower income individuals have higher levels of belonging and talking to neighbours, and that, over time, negative cohort changes these outcomes are positively moderated by individual low income. Again, it was found there was evidence to support this hypothesis for the outcome of talking to neighbours but not for belonging to neighbourhood. Those in households with lower incomes were more likely to talk to neighbours but were less likely to belong to the neighbourhood. Also the interaction between year of birth and household income suggested that the differences in levels of talking to neighbours by income were greater for younger birth cohorts. Older cohorts were more likely to talk to neighbours, and the difference in the outcome for different household income groups was small for these older cohorts. However for younger cohorts the level of household income is associated with the extent of cohort change experienced, with more affluent younger cohort groups experiencing the greatest cohort change. This supports the hypothesis that cohort change in levels of talking to neighbours is moderated by income. For the outcome of belonging to the neighbourhood, there were no cohort differences, and so no cohort change conditional on income status.

Finally the analysis presented in this chapter considered the effect of individual mobility, moving between neighbourhoods. Generally those that have moved ward have lower levels of belonging to the neighbourhood. However, the differences are relatively small, particularly for older cohorts. For the outcome of talking to neighbours the main effect of moving ward is also negative. However, while the predicted results suggest that for younger cohorts moving ward leads to reduced talking to neighbours, for older cohorts the effects of moving ward are reversed. Older cohorts who have moved ward are more likely to talk to their neighbours compared to those that do not. Also, importantly, in the final models there was no significant interaction between household income and moving ward. Therefore the effect of moving ward did not vary with household income. This represents a preliminary analysis of individual mobility, prior to a full testing of hypothesis 3 in later chapters. In subsequent chapters contextual variables will be considered and the models developed so far will be extended to include the neighbourhood level, and consider ward level material deprivation. This will address the hypotheses concerned with the relationship between individual mobility and neighbourhood context.

Chapter 5 Contextual ward level effects

5.1 Introduction

In the previous chapter the nature of individual level change in the outcomes of belonging to the neighbourhood and likelihood of talking to neighbours was examined. Models were developed to estimate the difference between individuals in their levels of belonging to neighbourhoods and likelihood of talking to neighbours, and differences in trajectories of change in these outcomes over time. Evidence was found to support hypothesis 1, that there are cohort changes, and hypothesis 2, that these cohort changes are conditional on household income, but only for the outcome of talking to neighbours, not belonging to the neighbourhood. The focus of this thesis now moves to examine neighbourhood level context.

The aim of this chapter is to consider neighbourhood level context, particularly the relationship between the outcomes under study and neighbourhood level material deprivation and ethnic diversity, and also the relationship between neighbourhood context and individual mobility between neighbourhoods. As discussed in chapter two, there is a growing literature concerned with the notion of neighbourhood effects (Wilson 1987), that neighbourhood characteristics have a separate, independent effect on individual outcomes, over and above individual level characteristics (van Ham et al 2012). Much of the interest in neighbourhood effects is with the effect of concentrated poverty, but it has been recognised that the mainstream neighbourhood effects approach is fairly static (Hedman & Galster 2013). There is evidence to suggest that poorer individuals are more constrained to more materially deprived neighbourhoods during their life course (Kelly 2013), so this thesis contends that being in a low income household in a neighbourhood with high material deprivation will reduce levels of belonging to the neighbourhood for low income groups, those least likely to be able to move to less deprived neighbourhoods.

This chapter will therefore look to investigate the evidence in support of hypothesis 3: that remaining in materially deprived neighbourhoods, or moving into materially deprived neighbourhoods, will act to reduce levels of belonging to neighbourhoods and talking to neighbours for low income groups.

This chapter will also look at the neighbourhood contextual effects of ethnic diversity. Within the literature, it has been suggested that higher levels of neighbourhood ethnic diversity has a negative effect on trust between individuals within neighbourhoods (Putnam 2007). Subsequent empirical studies have produced mixed results, but largely suggest, in the UK at least, that neighbourhood material deprivation is more important, (Laurence and Heath 2008). The few empirical studies specifically investigating the relationship between neighbourhood ethnic diversity and individual belonging to the neighbourhood in the UK find that individual belonging is not lower in neighbourhoods with higher levels of ethnic diversity once other neighbourhood and individual variables are controlled for (Bailey et al 2012, Finney & Jivraj 2013).

A key argument that this thesis looks to develop is that, if neighbourhood can be thought of as intrinsically dynamic, as an event that is always in the process of being made (Massey 2005), then change and diversity can be regarded as being important to this process. Therefore, it is when there is no change, no diversity that neighbourhoods become static physical spaces rather than dynamic processes. The reasoning for this hypothesis is set out in chapter 2, and is based on the notion of neighbourhoods as functioning best as open, dynamic and fluid entities, rather than fixed, bounded and exclusionary. This chapter will look to test hypothesis 4, that, after controlling for neighbourhood level material deprivation, higher levels of, or increases in, neighbourhood ethnic diversity are associated with more positive individual outcomes when compared to individuals in neighbourhoods that are not ethnically diverse.

The structure of this chapter is as follows: first general context of changes to ethnicity and inequality are explored, before a descriptive analysis of ward level measures in England is presented. More detail on the construction of these ward level measures is given in the discussion on data and methods in chapter 3. Following this, descriptive analysis explores the relationship between ward level measures and the outcomes under study for the sample. Then, in order to test the hypothesis regarding contextual effects, multilevel models, at each survey wave, are developed. These models treat the individual as level one and ward as level two. In order to develop the analysis, and further test the hypothesis, interactions between ward level variables are considered. Such interactions are important to consider because, as will be seen in the descriptive analysis, ward level measures display patterns of association at this aggregated level. For example wards that have high levels of ethnic diversity also tend to be more materially deprived. Following the examination of ward level interactions, cross level interactions between ward level material deprivation and household income are considered. This enables the analysis to consider whether ward level effects differ depending on household income.

At the end of this chapter conclusions are drawn together and the evidence in support of the hypotheses are evaluated. Also implications for the final stages of analysis, which seeks to bring together the contextual level analysis and trajectories of individual level change, are considered.

5.2 Contextual analysis

Census data shows that there has been an increase in the levels of ethnic diversity in England over the period 1991 to 2011. While there are some difficulties in comparing ethnicity data from different Census periods, as the categories of ethnicity changed between 1991 and 2001, it is possible to compare certain groups between these periods (ONS 2006, Simpson and Akinwale 2007). There are minimal changes to Census categories between 2001 and 2011 (ONS 2012). Table 5.1 presents changes for the population of England between 1991 and 2011 for comparable ethnic groups, and the changes between 2001 and 2011 for comparable groups are shown in table 5.2. These illustrate an increasing level of ethnic diversity over time, with different ethnic minority groups increasing at different rates. It should be noted that the ‘other’ category is the only group that is not directly comparable between 1991 and other years.

Table 5.1: Population of England by ethnic group 1991, 2001 and 2011

Ethnic group	1991	2001	2011
White	93.8%	90.9%	85.4%
Caribbean	1.1%	1.1%	1.1%
African	0.4%	1.0%	1.8%
Indian	1.8%	2.1%	2.6%
Pakistani	1.0%	1.4%	2.1%
Bangladeshi	0.3%	0.6%	0.8%
Chinese	0.3%	0.4%	0.7%
Other	1.4%	2.4%	5.4%
Total	47,055,204	49,138,863	53,012,456

Source: ONS (2011 table KS201EW, 2001 table KS006, 1991 table SAS06).

Table 5.2: Population of England by ethnic group 2001 and 2011

Ethnicity	2001	2011	Change	Change: % of 2001 population
White British	87.0%	79.8%	-467,900	-1.1%
White Irish	1.3%	1.0%	-107,114	-17.2%
White Other	2.7%	4.7%	1,176,795	90.0%
Indian	2.1%	2.6%	367,160	35.7%
Pakistani	1.4%	2.1%	405,664	57.4%
Bangladeshi	0.6%	0.8%	161,097	58.5%
Black Caribbean	1.1%	1.1%	29,693	5.3%
Black African	1.0%	1.8%	501,875	105.5%
Mixed	1.3%	2.3%	549,536	85.4%
Chinese	0.4%	0.7%	158,793	71.9%
Other	1.1%	3.1%	1,097,994	200.5%
All	49,138,863	53,012,456	3,873,593	7.9%

Source: ONS (2011 table KS201EW, 2001 table KS006).

In the UK much of the increased ethnic diversity is as a result of the demographics of people already living in the UK, indeed the percentage of population change as a result of migration has decreased in the period 1998 to 2008, as shown in table 5.3.

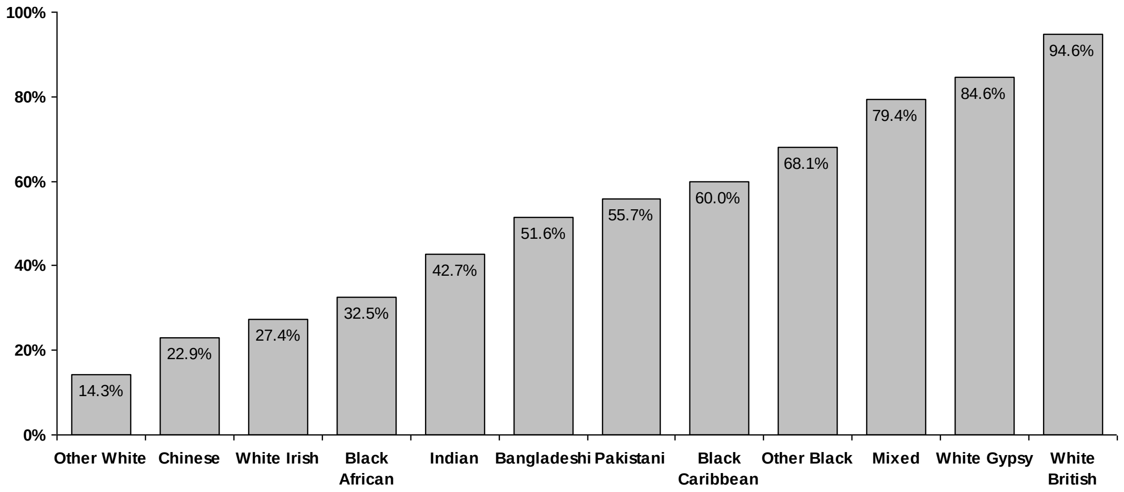
Table 5.3: Migration as a percentage of population change (all UK)

Year	Net migration	Total change	Net migration as percentage of change
1998-1999	132,800	209,500	63.4%
1999-2000	139,300	201,600	69.1%
2000-2001	153,200	227,400	67.4%
2001-2002	143,300	205,300	69.8%
2002-2003	156,500	233,400	67.1%
2003-2004	185,700	289,700	64.1%
2004-2005	266,800	393,600	67.8%
2005-2006	190,100	348,800	54.5%
2006-2007	214,400	401,300	53.4%
2007-2008	192,100	412,500	46.6%
2008-2009	177,200	393,700	45.0%

Source: Office for National Statistics; Population Estimates

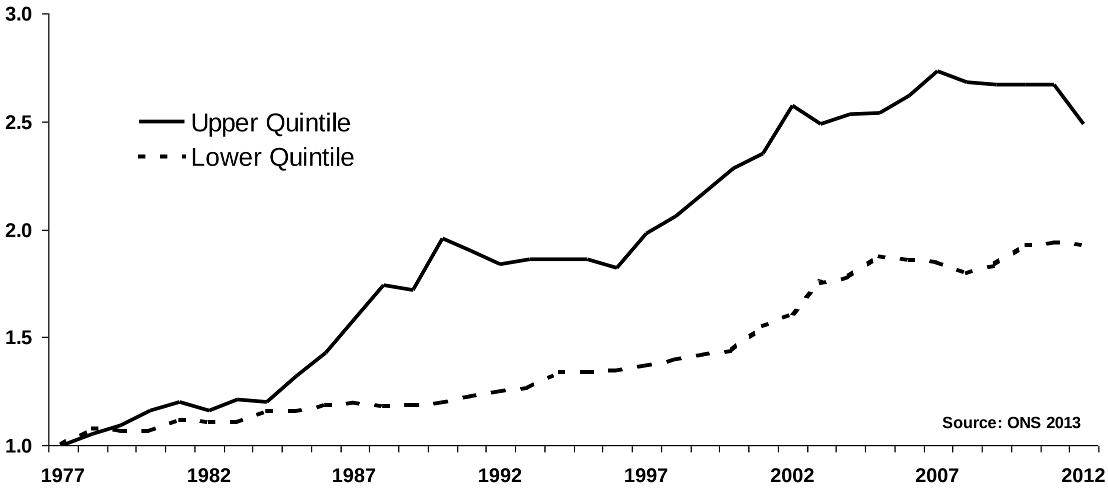
Also, as of 2011, more than half of individuals from many ethnic groups in England were born in England as shown in figure 5.1. This is important conceptually, as it demonstrates that increased ethnic diversity does not arise solely from migration, but also from existing patterns of diversity. For example, around four in five of those recorded as 'mixed' ethnicity in England were born in England. This challenges the notion of ethnic minorities as the 'other'.

Figure 5.1: Percentage of ethnic groups born in England 2011



At the same time as ethnic diversity has increased there has also been an increase in the levels of income inequality. Figure 5.2 illustrates the difference in income growth for upper and lower income quintiles in the UK between 1977 and 2012, for source data see ONS (2013). This demonstrates the increasing income inequality in the UK, particularly from the 1980's onwards.

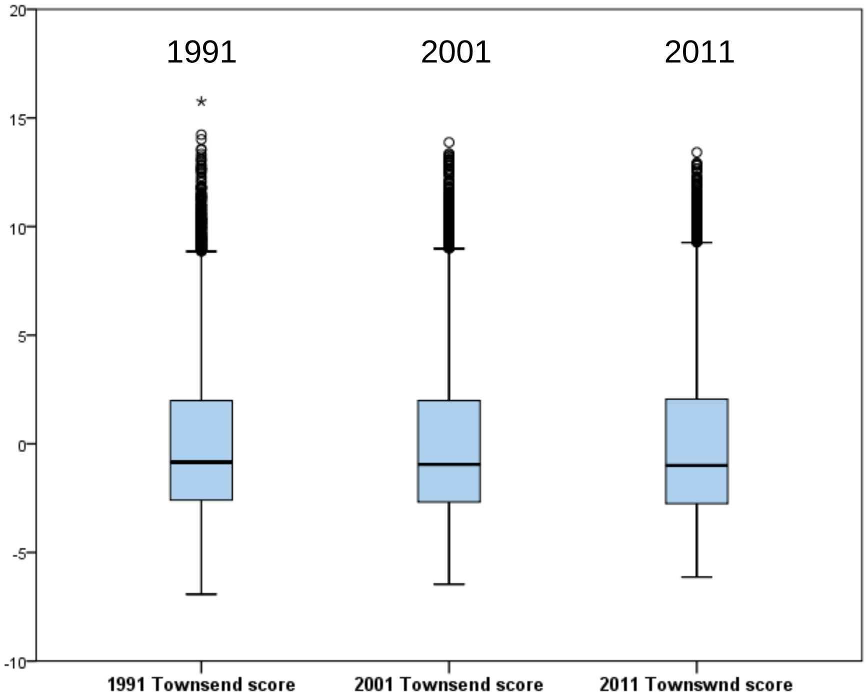
Figure 5.2: Change in income inequality in the UK, 1977 to 2012



5.3 Descriptive analysis: all England wards

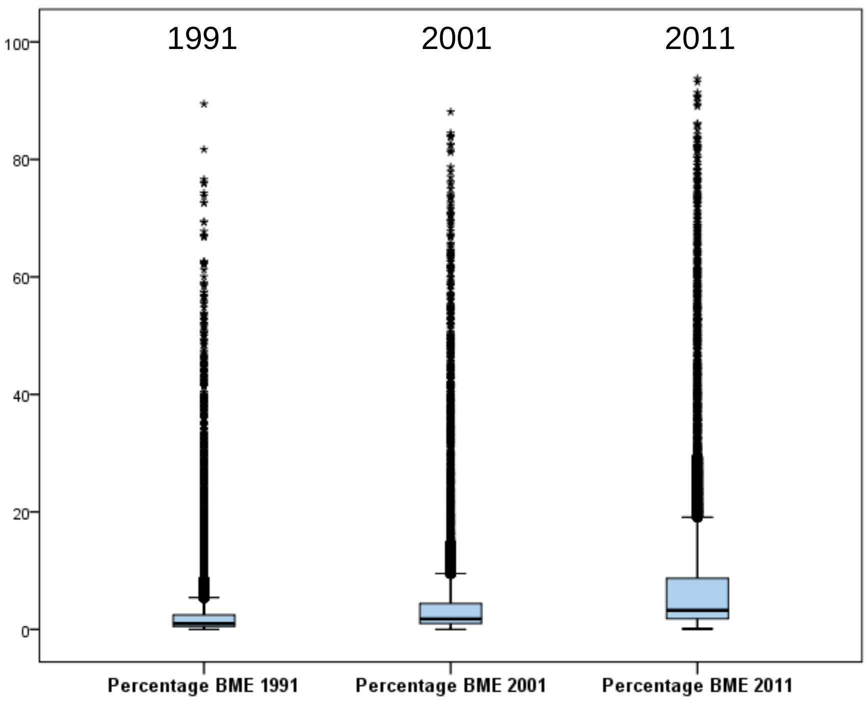
The above descriptive analysis presents the overall picture for change to ethnicity and income inequality. Next measures at ward level are considered. Measures of material deprivation and the percentage of the population from ethnic minorities have been calculated for all England wards as at Census years 1991, 2001 and 2011. The distribution of all England ward scores for material deprivation, as measured by Townsend scores is shown in figure 5.3. As the Townsend scores are standardised measures the distribution is similar at each period. The percentage of ward populations from ethnic minorities is shown in figure 5.4. This demonstrates the increases in ward level ethnic diversity over the period 1991 to 2011, with the mean ward BME population having more than doubled in the period.

Figure 5.3: Distribution of all England ward Townsend scores



Mean: 0.00 0.00 0.00

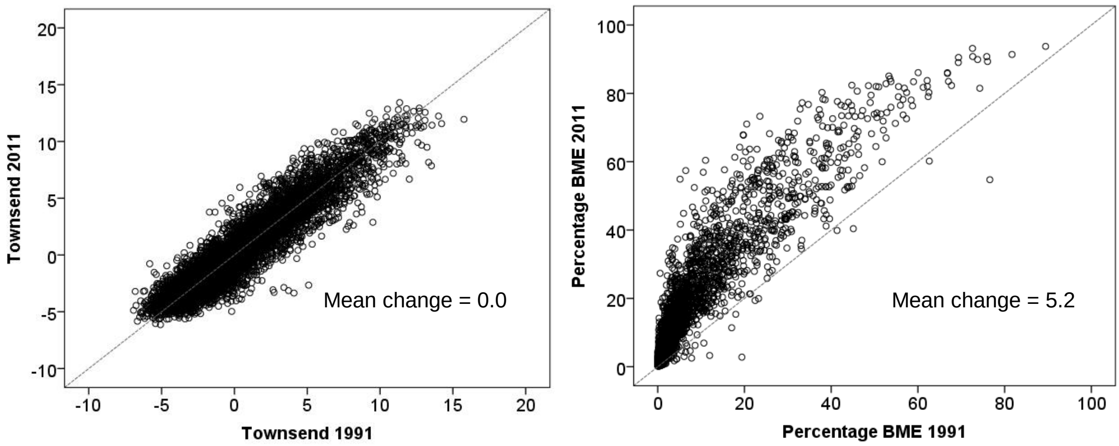
Figure 5.4: Distribution of all England ward percentage BME population



Mean: 3.75 5.64 8.95

There are also different patterns of change in ward scores over time. Wards tend to change little in the level of deprivation over time while almost all wards have experienced changes to levels of ethnic diversity. This is illustrated by figure 5.5, the distance from the diagonal line represents the change between 1991 and 2011.

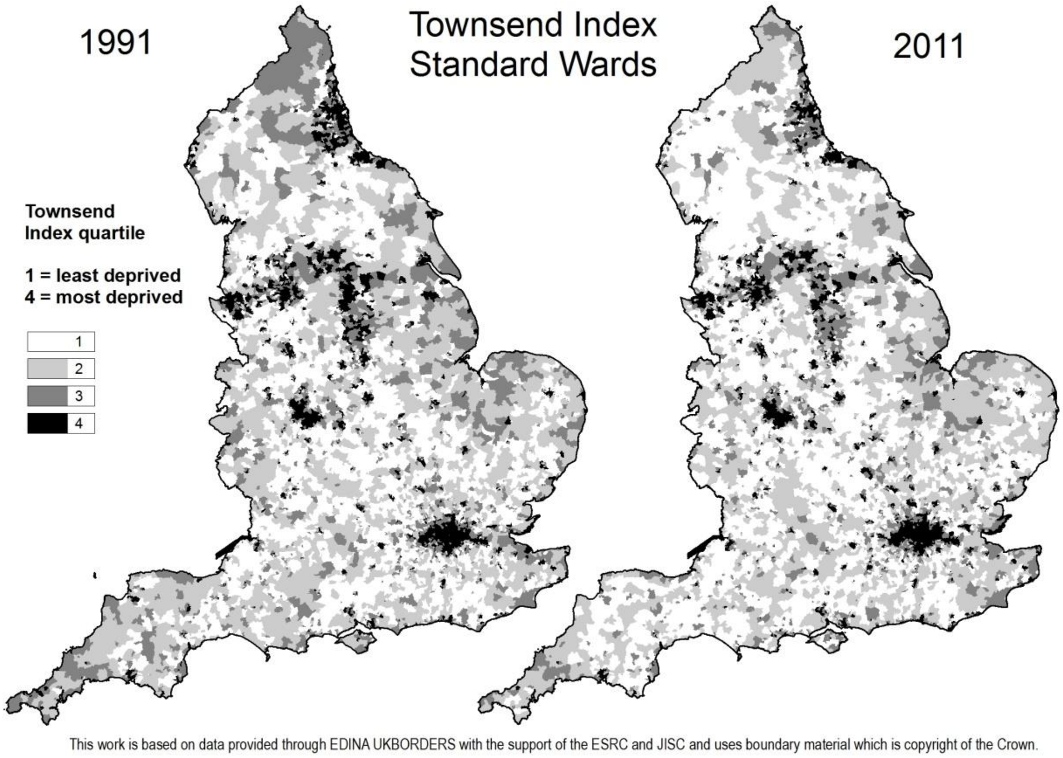
Figure 5.5: Change to Townsend score and percentage BME all 7932 England standard wards



The maps shown in figure 5.6 further describe the spatial nature of this change. In summary, there is a large degree of consistency in the Townsend scores for wards over time, while ethnic diversity is increasing for most wards, to varying degrees, as England as a whole becomes more ethnically diverse over time.

At the same time as the increased ethnic diversity there has been a decrease in the extent of segregation at ward level. There are a number of ways to measure diversity and segregation. The two most common measures are the index of dissimilarity and the index of isolation. The index of dissimilarity has been calculated for ethnic groups in England, using data from the Census, converted to standard ward geographies using the GeoConvert function provided by the Census Dissemination Unit (www.cdu.census.ac.uk). Results from these calculations are shown in table 5.4. Simpson (2007) produced similar results for 1991 and 2001, and this is an update on those measures.

Figure 5.6: Maps of Townsend score and percentage BME all 7932 England standard wards 1991 and 2011



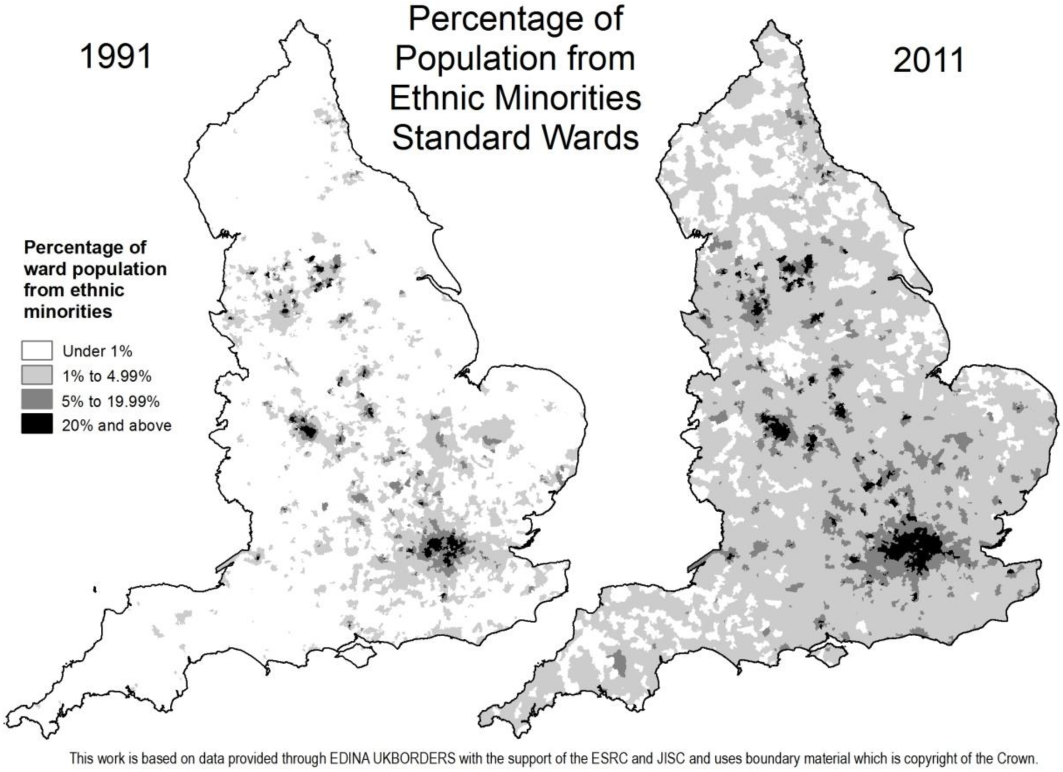


Table 5.4: Index of Dissimilarity (D) for standard wards, England 1991 to 2011

Ethnic group	1991	2001	2011
White	61.3	58.4	55.8
Black Caribbean	68.7	66.3	61.7
Black African	71.3	70.2	59.2
Indian	64.9	61.6	56.5
Pakistani	74.9	71.5	69.7
Bangladeshi	73.9	71.5	67.0
Chinese	41.4	41.0	42.0

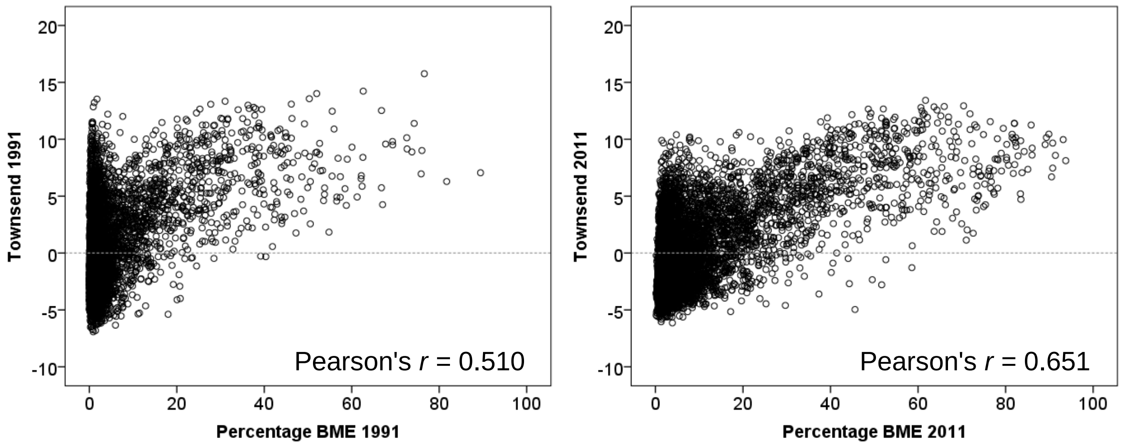
Source data: ONS Census

The results for the index of dissimilarity (D) can be interpreted as the percentage of a group that would have to move to different geographic areas in order to produce a distribution that matches that of all other groups. The results indicate that every group, apart from Chinese, have reduced their degree of segregation.

There is also evidence of spatial segregation by income, with the poorest and wealthiest groups most segregated, and some evidence that the level of income segregation has increased slightly in recent decades (Dorling et al 2007, Dorling & Ballas 2008).

Also there is a relatively strong relationship, at ward level, between ethnic diversity and material deprivation. This can be seen in figure 5.7 which shows the relationship between ethnicity and material deprivation, as measured by the Townsend Index, for standard wards in England at 1991 and 2011. There is an interesting pattern which shows that deprived wards have a full range of ethnicity mix but all areas with higher proportions of ethnic groups are also deprived wards. The growth in the percentage of BME in wards is largely in deprived wards. So while levels of ethnic segregation have decreased the overall growth in ethnic diversity is still in more materially deprived wards and the strength of the relationship is stronger in 2011 than 1991, though it should be noted that, while Pearson's r is reported, the relationship is not linear.

Figure 5.7: the relationship between Townsend Index and percentage of ethnic minorities for standard wards, (n = 7,932) in England



There is also a relationship at ward level between population density and both material deprivation and ethnic diversity. Density is calculated by calculating the area of standard wards (hectares) in GIS and then using total ward population from the census to calculate ward scores for 1991, 2001 and 2011. Figure 5.8 shows the relationship at ward level between material deprivation and population density and indicates that the growth in population has been largely in more materially deprived wards.

Figure 5.8: the relationship between Townsend Index and population density for standard wards, (n = 7,932) in England

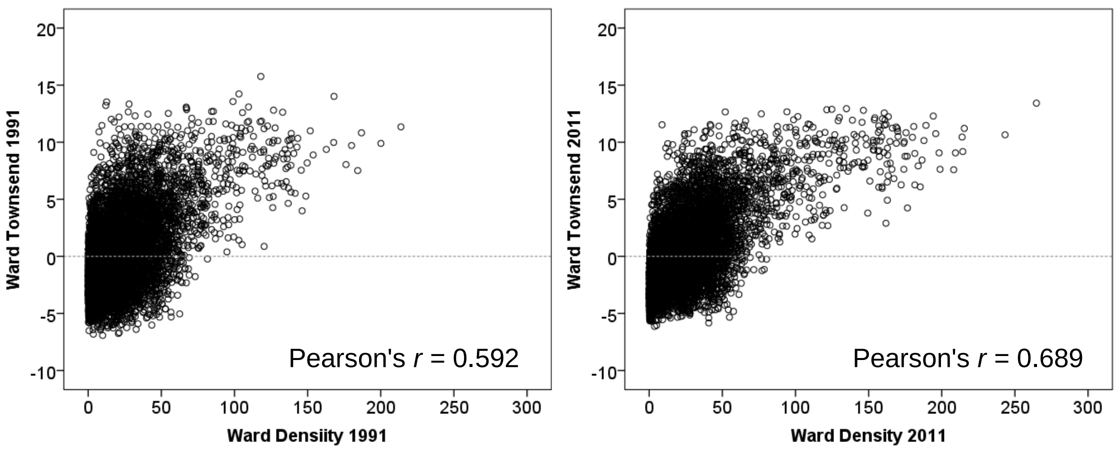
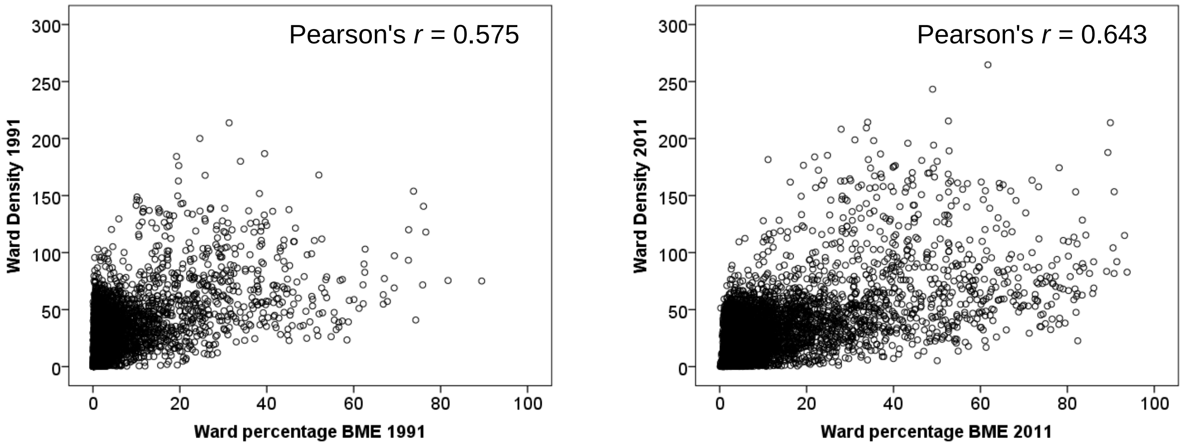


Figure 5.9 shows the relationship at ward level between ethnic diversity and population density this suggests that ethnic diversity has increased in wards

with all levels of population density. The strength of the correlation is presented but the relationship is not linear.

Figure 5.9: the relationship between percentage of ethnic minorities and population density for standard wards, (n = 7,932) in England



Ward level migration rates are higher in more deprived wards, although the relationship is not that strong. The relationship between ward level density and ward migration rates, and between ward level ethnic diversity and ward migration are also not so pronounced (see appendix 4).

5.4 Descriptive analysis of belonging to the neighbourhood, talking to neighbours and ward level variables

In the descriptive analysis of the relationship between ward level variables and the outcomes, ward level scores have been grouped into quintiles and outcomes are considered as dichotomous, with the percentage strongly agreeing or agreeing that they belong to their neighbourhood and talk to neighbours. This is for illustrative purposes, the statistical models presented later in this chapter are estimated treating the ward variables as continuous. The distribution and mean of ward level variables in the sample at each wave is shown in table 5.5.

Table 5.5: Distribution of ward level scores for the sample at each wave

Ward Variable	Year	Minimum	Mean	Maximum	Std. Dev.
Ward Density	1998	0.08	25.30	175.42	24.50
	2003	0.08	25.51	188.07	24.73
	2008	0.08	25.72	245.73	25.78
Ward gross migration rate	1998	0.88	1.79	6.28	0.53
	2003	0.86	1.80	6.28	0.56
	2008	0.86	1.78	6.58	0.54
Ward Townsend score	1998	-5.84	0.83	13.52	3.69
	2003	-5.82	0.59	13.22	3.54
	2008	-5.96	0.52	12.92	3.54
Ward percentage BME	1998	0.21	6.45	77.86	11.17
	2003	0.16	7.56	83.02	12.16
	2008	0.30	8.98	86.78	13.16

Source data: ONS Census

The percentage who agree, or strongly agree, that they belong to their neighbourhood by ward level scores at each wave are shown in table 5.6 and the average of the three waves is shown in figure 5.10. There is a similar association between the outcome of belonging to the neighbourhood and all ward level variables. Levels of belonging to the neighbourhood decrease with increasing ward level material deprivation, ethnic diversity, population density and gross migration rates. When interpreting these results it is important to recognise that all ward level scores are associated with each other, as discussed above.

Figure 5.10: The percentage who belong to their neighbourhood by ward level scores (average of three waves)

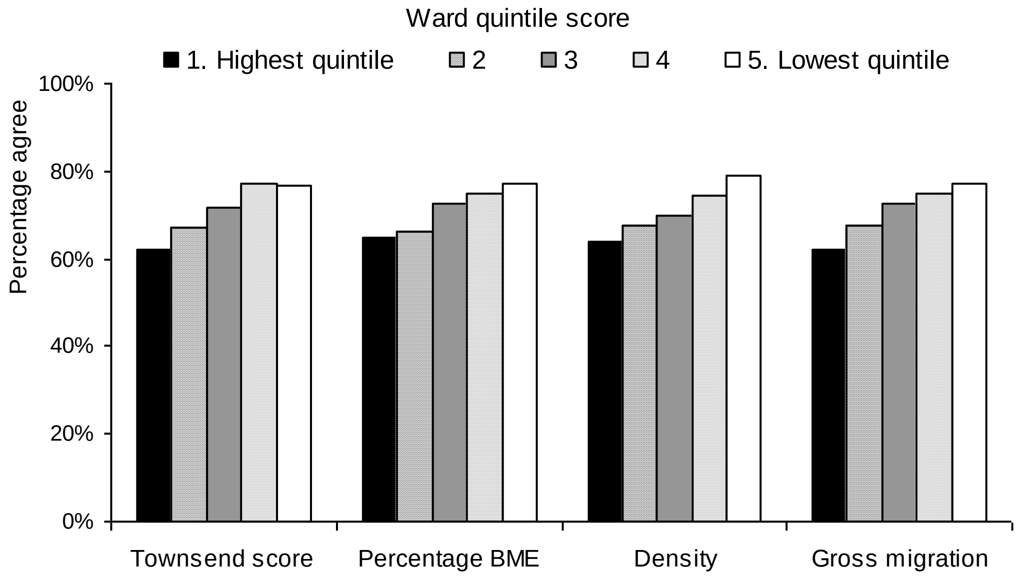


Table 5.6: The percentage who belonging to their neighbourhood at each wave by ward scores

Ward Townsend score	1998	2003	2008
1. Highest quintile	59.9%	63.3%	63.2%
2	67.5%	67.8%	66.6%
3	68.4%	71.3%	75.2%
4	75.3%	77.8%	78.1%
5. Lowest quintile	75.5%	75.4%	79.2%
Spearman's rho	*0.134*	*0.127*	*0.148*
Ward percentage BME	**1998**	**2003**	**2008**
1. Highest quintile	63.3%	64.8%	66.0%
2	64.3%	66.7%	68.1%
3	70.2%	72.5%	74.6%
4	74.7%	75.7%	74.4%
5. Lowest quintile	75.7%	75.7%	79.4%
Spearman's rho	*0.121*	*0.109*	*0.114*
Ward density	**1998**	**2003**	**2008**
1. Highest quintile	62.9%	64.9%	64.6%
2	67.5%	66.6%	69.2%
3	67.7%	71.4%	69.9%
4	72.2%	74.4%	76.9%
5. Lowest quintile	77.6%	78.1%	81.6%
Spearman's rho	*0.111*	*0.131*	*0.137*
Ward gross migration	**1998**	**2003**	**2008**
1. Highest quintile	59.4%	62.5%	64.9%
2	63.7%	69.5%	69.3%
3	71.8%	71.7%	73.7%
4	74.3%	75.2%	75.0%
5. Lowest quintile	77.6%	76.0%	78.7%
Spearman's rho	*0.174*	*0.144*	*0.136*

Spearman's rho all significant at $p < 0.001$, based on outcomes as 5 point scale.
Source date: BHPS, waves 1998, 2003 and 2008. Total n = 8,841 (1998) 7,178 (2003) 6,585 (2008).

Table 5.7: The percentage who talk regularly to neighbours at each wave by ward scores

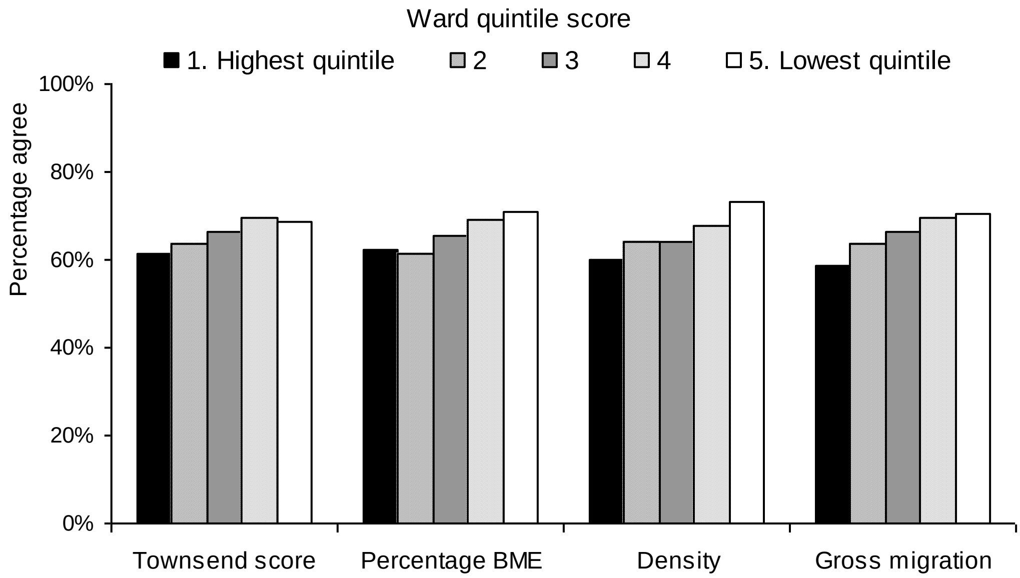
Ward Townsend score	1998	2003	2008
1. Highest quintile	70.1%	66.6%	66.1%
2	71.8%	66.4%	66.6%
3	73.4%	68.7%	70.7%
4	73.6%	74.1%	74.0%
5. Lowest quintile	74.7%	69.3%	74.8%
Spearman's rho	*0.044*	*0.061*	*0.090*
Ward percentage BME	**1998**	**2003**	**2008**
1. Highest quintile	69.2%	64.4%	66.3%
2	69.0%	65.7%	64.8%
3	72.0%	70.7%	71.1%
4	75.1%	71.2%	73.5%
5. Lowest quintile	79.4%	73.5%	76.7%
Spearman's rho	*0.091*	*0.096*	*0.113*
Ward density	**1998**	**2003**	**2008**
1. Highest quintile	67.4%	63.8%	65.4%
2	72.6%	66.7%	67.2%
3	70.9%	69.0%	67.5%
4	75.2%	72.0%	74.2%
5. Lowest quintile	78.5%	73.7%	77.9%
Spearman's rho	*0.083*	*0.105*	*0.115*
Ward gross migration	**1998**	**2003**	**2008**
1. Highest quintile	66.8%	63.5%	64.1%
2	68.2%	67.7%	68.6%
3	74.5%	68.3%	70.0%
4	76.0%	73.2%	74.1%
5. Lowest quintile	78.1%	72.3%	74.8%
Spearman's rho	*0.125*	*0.099*	*0.116*

Spearman's rho all significant at p < 0.001, based on outcomes as 5 point scale.

Source date: BHPS, waves 1998, 2003 and 2008. Total n = 8,841 (1998) 7,178 (2003) 6,585 (2008).

The percentage who agree, or strongly agree, that they talk regularly to neighbours by ward level scores at each wave are shown in table 5.7 and the average of the three waves is shown in figure 5.11. As with levels of belonging to the neighbourhood, the likelihood of talking to neighbours decreases with increasing ward level material derivation, ethnic diversity, population density and gross migration rate. However, it should be noted that the strength of associations are weaker for the outcome of talking to neighbours. This is particularly the case for the association between ward level material deprivation and talking to neighbours.

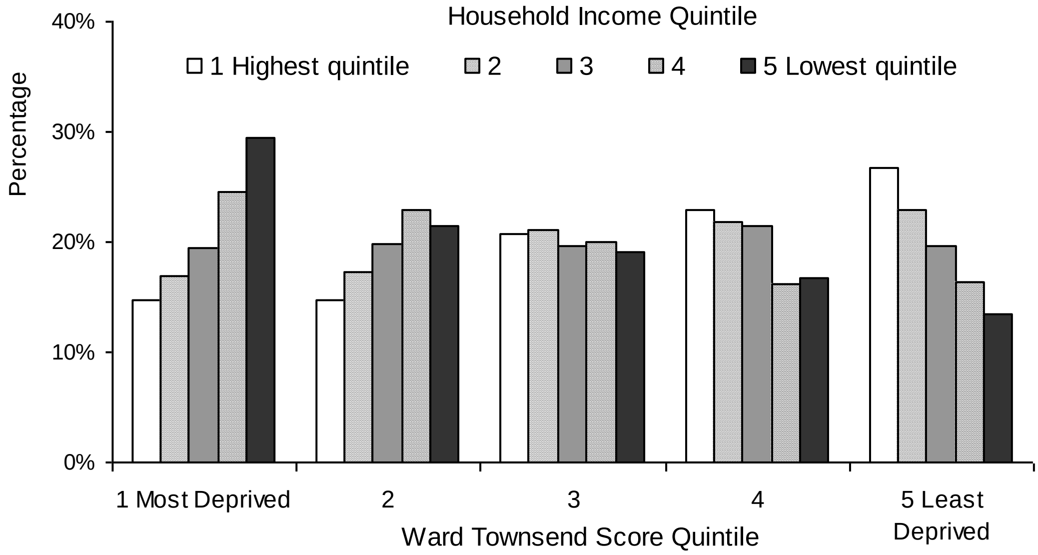
Figure 5.11: The percentage who talk regularly to neighbours by ward level scores (average of three waves)



There is also an association between ward level variables and household income. Those with the lowest household income are more likely to live in wards with higher levels of material deprivation. This is shown in figure 5.12, where it can be seen that, on average, around 30 per cent of those in the lowest household income quintile live in the most materially deprived ward quintile, and less than 15 percent of this lowest income group live in the least materially deprived ward quintile. However the strength of association, shown in figure 5.12, is not particularly strong, and there are individuals with all levels of household income in differently deprived wards.

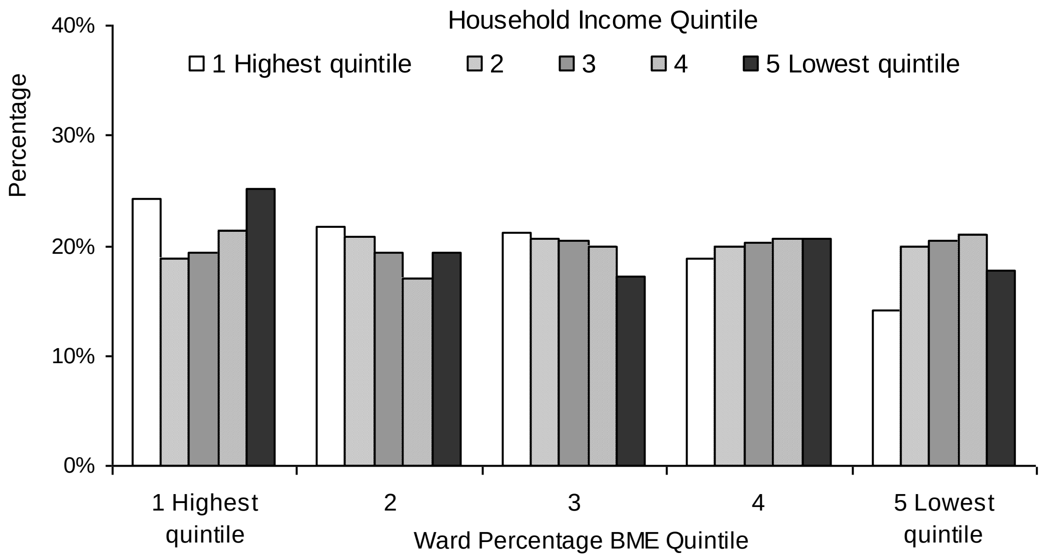
The association between the percentage of ethnic minorities in a ward and household income is largely not significant, as shown in figure 5.13. There is a significant association between ward level population density and household income, but this is weaker than the association with ward deprivation and the relationship is most marked in the lowest quintile ward density where there are more higher income groups, see figure 5.14. The relationship between household income and levels of ward level gross migration is not particularly strong, see figure 5.15.

Figure 5.12: The association between household income and ward deprivation (average of three waves)



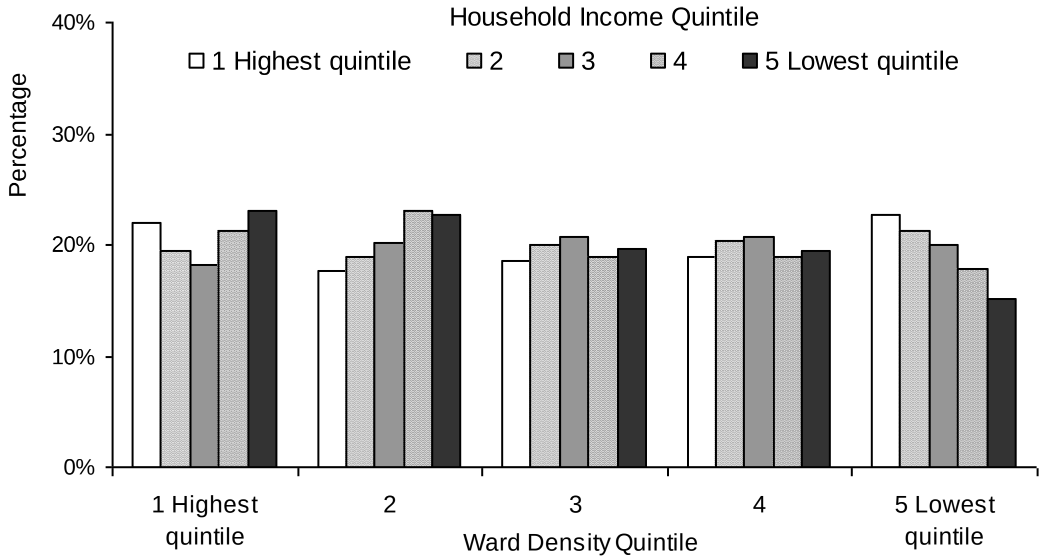
Spearman's rho: -0.200 (1998), -0.175 (2003), -0.156 (2008). All (p <0.001)

Figure 5.13: The association between household income and ward ethnic diversity (average of three waves)



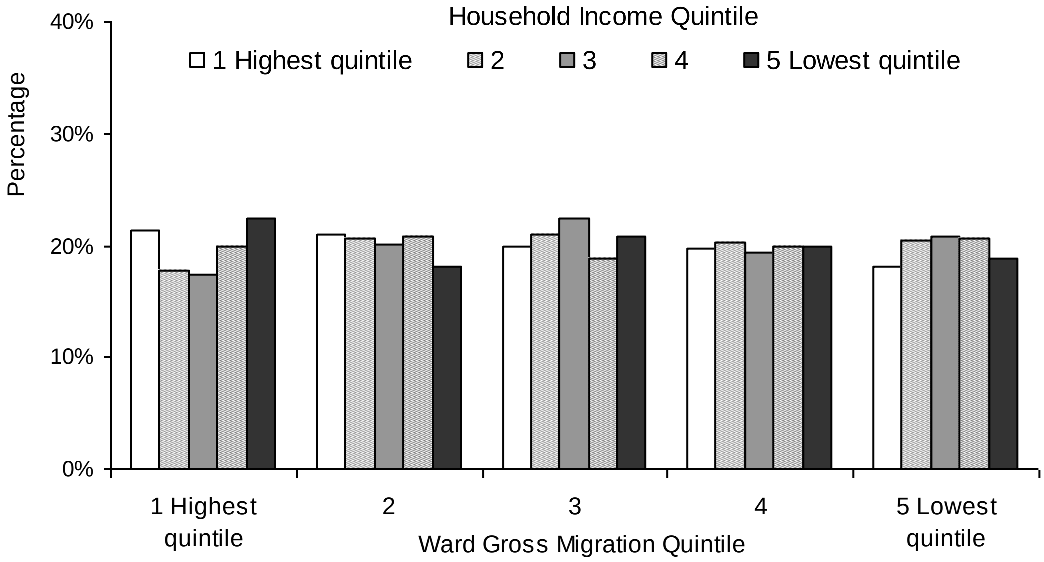
Spearman's rho: 0.020 p=0.069 (1998), 0.011 p=0.358 (2003), 0.033 p = 0.004 (2008).

Figure 5.14: The association between household income and ward population density (average of three waves)



Spearman's rho: -0.053 (1998), -0.062 (2003), -0.062 (2008). All (p <0.001).

Figure 5.15: The association between household income and ward population gross migration (average of three waves)



Spearman's rho: -0.034 p=0.002 (1998), -0.011 p=0.329 (2003), -0.045 p < 0.001 (2008).

Table 5.8 illustrates the association between ward level scores and a number of other explanatory variables by calculating the mean ward score for different grouped outcomes and explanatory variables.

Table 5.8: Mean ward scores for grouped individual and household level variables

	Ward density average	Ward gross migration average	Ward Townsend average	Ward Percentage BME		
				1998	2003	2008
Average	26.6	1.78	0.70	7.16	8.17	9.76
Belong: strongly agree	21.9	1.67	0.12	5.43	6.15	8.06
Belong: agree	25.7	1.76	0.46	6.50	7.70	9.03
Belong: neither	29.3	1.83	1.06	7.95	8.50	11.09
Belong: disagree	32.3	1.93	2.03	10.72	12.21	13.63
Belong: strongly disagree	33.5	1.96	2.67	9.02	13.15	12.72
Talk: strongly agree	22.7	1.71	0.41	5.62	6.10	8.45
Talk: agree	25.7	1.76	0.59	6.96	7.80	9.28
Talk: neither	27.5	1.80	0.73	7.84	8.83	10.16
Talk: disagree	31.4	1.87	1.07	8.23	9.63	11.42
Talk: strongly disagree	30.5	1.89	1.61	8.29	10.02	11.49
Age 16-29	30.1	1.89	1.33	8.37	9.65	11.72
Age 30-39	27.7	1.80	0.77	7.35	8.03	10.07
Age 40-49	27.1	1.76	0.58	7.19	8.68	9.21
Age 50-59	24.4	1.73	0.30	6.60	7.38	9.23
Age 60-69	24.3	1.70	0.37	6.76	7.39	8.69
Age 70 plus	24.9	1.75	0.67	6.12	7.41	9.26
Time in ward: <2 yrs	28.9	1.93	0.88	6.89	7.56	11.36
Time in ward: 2 to <5 yrs	26.7	1.82	0.53	6.14	9.09	8.41
Time in ward: 5 to <10 yrs	25.7	1.80	0.59	7.64	7.29	8.80
Time in ward: 10 to <20 yrs	25.8	1.75	0.60	7.02	7.64	9.59
Time in ward: 20 plus Yrs	26.9	1.73	0.84	7.57	8.88	10.13
Household income: 1 (high quintile)	26.7	1.80	-0.10	7.01	8.64	10.28
Household income: 2	25.2	1.75	0.22	6.54	6.99	8.72
Household income: 3	24.9	1.75	0.54	6.63	6.95	7.85
Household income: 4	27.2	1.77	1.20	7.26	8.20	10.02
Household income: 5 (low quintile)	28.3	1.82	1.64	8.34	9.86	11.44

This alternative way of presenting the associations, in table 5.8, gives an indication of the types of ward that different types of individuals live in. The ward scores have been presented as averages, apart from the ward percentage BME population as this changes much more than other ward scores over the period. This confirms that those that belong to their neighbourhood are more likely to live in wards that are not materially deprived, are low density, and are less ethnically diverse. There is less variation in the ward migration rate. There is a similar, if less marked, relationship between levels of talking to neighbours and the types of wards. The relationship between household income and types of wards demonstrates that the main relationship is with ward level material deprivation. Also younger individuals are more likely to reside in wards that are higher density, more materially deprived and have higher percentage of the population from ethnic minorities. However, there is no relationship between time spent in the ward and ward level variables.

This descriptive analysis has identified overall increases in ethnic diversity for England over the period. At the ward level there is a strong relationship between levels of ethnic diversity and levels of material deprivation. Wards with high levels of ethnic minority populations tend to also be wards with high material deprivation, though many materially deprived wards have small ethnic minority populations. Much of the growth in ethnic minority populations has occurred in more materially deprived wards, though some less deprived wards also experienced increases in ethnic minority populations. And over the period levels of ethnic segregation have decreased. While levels of material deprivation, at the ward level, remain fairly constant over time, levels of ethnic diversity increased in many wards. Overall there is a stronger relationship between ward level variables and the outcome of belonging than there is for talking to neighbours, though the direction of the relationships is the same. In more materially deprived wards levels of belonging and talking to neighbours are lower, despite those in lower income households having higher levels of talking to neighbours, and there being no significant difference in belonging for different household income groups. Those with lower household incomes are more likely to be in more deprived wards and wards with higher levels of population density. Higher ward level population density and ethnic diversity are also associated with lower levels of belonging and talking to neighbours. However all ward level measures are strongly associated.

5.5 Two level multilevel models with ward level variables

5.5.1 Developing two level multilevel models

As set out in the introduction to this chapter, the aim is to begin to address neighbourhood context and develop multilevel models in order to test hypotheses 3 and 4, which relate directly to contextual effects. The first step in developing these models is to consider two level empty models, then to introduce the individual level variables investigated in the previous chapter. Then ward level variables are considered, alone and in combination, followed by a consideration of key interactions to test the hypotheses.

As in the previous chapter, a single level empty model, that is a model just estimating the overall individual level average, and a two level empty model, which estimates the overall average and partitions the variance between levels, can be specified as in equation 2 and 3, as set out in chapter 3. Now level two represents ward, with individual at level one. In the two level model the outcome y_{ij} for individual i in ward j is estimated as the average plus the residual at level two and the residual at level one, both of which are assumed to have a standard normal distribution with a mean of zero. This model enables the separate estimation of within ward variance, σ^2_e, and between ward variance, σ^2_u. The mean number of individuals per ward declines from 4.6 to 3.5 between 1998 and 2003, this is due to individual geographical mobility, as outlined in chapter three.

Results from equation 2 and 3, models 5.1 and 5.2 respectively, are shown in table 5.9 to 5.12. Multilevel models with ward level and individual level variables are developed from this basic two level model. Model 5.1, the single level empty model with just the average at each wave, is shown in table 5.9 for the outcome of belonging, and 5.10 for the outcome of talking to neighbours. Once the level of ward is introduced, as in model 5.2, the variance at ward level and individual level is estimated. For the outcome of belonging to the neighbourhood, as in table 5.11, around 28 per cent of the variance is at the ward level, which represents the between ward difference, or the clustering that exists within wards. For the outcome of talking to neighbours the between ward variation is slightly lower, on average being around 18 per cent of the total, as shown in table 5.12. For both outcomes, in all survey waves, the two level model is a much better fit, as measured by the large decrease in the DIC. One interesting observation is that the level of variance at ward level, that is the variation between wards, tends to get larger in subsequent survey waves. This could be a result of increased clustering, that is, greater differences between wards, over time. It may also be related to the decreasing cases per cluster over time.

Table 5.9: Results for model 5.1 for belonging to the neighbourhood at each wave

	Belong 1998		Belong 2003		Belong 2008	
Level 1: Individual（i）	Est.	S.E.	Est.	S.E.	Est.	S.E.
Constant (β_0)	3.671	0.010	3.712	0.011	3.743	0.011
σ^2_e Between individual variance	0.879	0.013	0.791	0.013	0.742	0.013
DIC	23948.06		18692.27		16720.56	

Source date: BHPS, waves 1998, 2003 and 2008. Total n = 8,841 (1998) 7,178 (2003) 6,585 (2008).

Table 5.10: Results for model 5.1, for talking to neighbours at each wave

	Talk 1998		Talk 2003		Talk 2008	
Level 1: Individual（i）	Est.	S.E.	Est.	S.E.	Est.	S.E.
Constant (β_0)	3.675	0.011	3.576	0.012	3.599	0.012
σ^2_e Between individual variance	0.994	0.015	0.991	0.017	1.005	0.017
DIC	25048.12		20328.00		18720.33	

Source date: BHPS, waves 1998, 2003 and 2008. Total n = 8,841 (1998) 7,178 (2003) 6,585 (2008).

Table 5.11: Results for model 5.2, for belonging to the neighbourhood at each wave

Level 2: Ward (j) Level 1: Individual (i)	Belong 1998 Est.	 S.E.	Belong 2003 Est.	 S.E.	Belong 2008 Est.	 S.E.
Constant (β_0)	3.616	0.012	3.673	0.012	3.709	0.012
σ^2_u Between ward variance	0.214	0.016	0.230	0.018	0.237	0.018
σ^2_e Between individual variance	0.680	0.014	0.576	0.015	0.515	0.015
DIC	23141.25		17962.14		15966.36	

Source date: BHPS, waves 1998, 2003 and 2008. Total n = 8,841 (1998) 7,178 (2003) 6,585 (2008).

Table 5.12: Results for model 5.2, for talking to neighbours at each wave

Level 2: Ward (j) Level 1: Individual (i)	Talk 1998 Est.	 S.E.	Talk 2003 Est.	 S.E.	Talk 2008 Est.	 S.E.
Constant (β_0)	3.640	0.013	3.561	0.013	3.580	0.014
σ^2_u Between ward variance	0.176	0.018	0.172	0.021	0.210	0.024
σ^2_e Between individual variance	0.832	0.018	0.827	0.021	0.802	0.024
DIC	24610.05		20031.13		18377.33	

Source date: BHPS, waves 1998, 2003 and 2008. Total n = 8,841 (1998) 7,178 (2003) 6,585 (2008).

It has been recognised that failing to account for a level of clustering in a multilevel model can result in the variance at that level being transferred to variance at other levels included in the model (Tranmer & Steel 2001a, van den Noortgate et al 2005, Snijders & Bosker 2012). This is important to consider as within the data there is also an additional level of clustering of individuals within households. Sensitivity analysis was conducted in order to consider results of models when the household level was also included in the model. Appendix 5 presents results from this sensitivity analysis. As expected there is transference of variance from ward to household level once household level is included. However, after consideration a decision was made not to include household as an additional level in the models. This was because the survey included all members of the household and so is difficult to conceive of as a sample from a wider population of possible household members. Also the number of individuals per household is bounded by a low number. However, the results of the sensitivity analysis suggest that the estimated variance for each level in the models presented should be treated with some caution; as some of the estimated between ward variance will actually be between household variance.

Prior to the models that test the effects of ward level variables, level 1 variables of age, household income and geographical mobility, examined in the previous chapter, are added to model 5.2. Results from this model, model 5.3, are shown in table 5.13 for the outcome of belonging to the neighbourhood and table 5.14 for the outcome of talking to neighbours. For both outcomes, not surprisingly, there is a large reduction in DIC compared to model 5.2, and so a better model fit, with the introduction of explanatory variables. The effects of age and moving ward in the previous 5 years are similar for both outcomes. Those that have moved ward have, on average, lower levels of belonging to the neighbourhood and talking to neighbours. Older individuals have higher levels of belonging to the neighbourhood and talking to neighbours, though it should be noted that these cross-sectional models cannot distinguish age and cohort effects.

The effect of household income is different for each outcome: increased household income, on average, increases individual belonging but decreases the likelihood of individuals talking to neighbours. With the addition of the explanatory variables, in model 5.3, the level 2 variance decreases slightly, compared to model 5.2. The average variance at level 2, that is between ward variance, decreases, on average, from 28.0 per cent to 25.6 per cent for belonging to the neighbourhood, and from 18.5 per cent to 16.6 per cent for talking to neighbours.

Table 5.13: Results for model 5.3, for belonging to neighbourhood at each wave

Level 2: Ward (j) Level 1: Individual (i)	Belong 1998 Est.	S.E.	Belong 2003 Est.	S.E.	Belong 2008 Est.	S.E.
Constant (β_0)	3.712	0.014	3.766	0.014	3.762	0.013
Individual level						
β_1 Age	0.0101	0.0005	0.0104	0.0006	0.0094	0.0006
β_2 Household Income	0.0029	0.0010	0.0066	0.0010	0.0012	0.0008
β_3 Moved	-0.234	0.024	-0.232	0.025	-0.156	0.026
σ^2_u Between ward variance	0.160	0.014	0.162	0.016	0.193	0.017
σ^2_e Between individual variance	0.665	0.014	0.573	0.015	0.511	0.016
DIC	22721.15		17618.81		15734.34	

Source date: BHPS, waves 1998, 2003 and 2008. Total n = 8,841 (1998) 7,178 (2003) 6,585 (2008).

Table 5.14: Results for model 5.3, for talking to neighbours at each wave

Level 2: Ward (j) Level 1: Individual (i)	Talk 1998 Est.	S.E.	Talk 2003 Est.	S.E.	Talk 2008 Est.	S.E.
Constant (β_0)	3.729	0.014	3.620	0.015	3.628	0.015
Individual level						
β_1 Age	0.0078	0.0006	0.0098	0.0007	0.0104	0.0007
β_2 Household Income	-0.0039	0.0011	-0.0019	0.0012	-0.0031	0.0010
β_3 Moved	-0.238	0.026	-0.156	0.028	-0.153	0.030
σ^2_u Between ward variance	0.123	0.015	0.133	0.019	0.172	0.023
σ^2_e Between individual variance	0.831	0.017	0.815	0.021	0.786	0.023
DIC	24348.40		19767.75		18109.94	

Source date: BHPS, waves 1998, 2003 and 2008. Total n = 8,841 (1998) 7,178 (2003) 6,585 (2008).

5.5.2 Considering contextual, ward level, effects

The next step in the analysis is to consider the effects of ward level variables. First the ward variables are added to model 5.3 sequentially, in order to consider the main effects of ward level material deprivation and ward level ethnic diversity and the effects of these variables once controlling for other ward level variables. To begin with, ward level material deprivation is added, as in model 5.4, shown in table 5.15, for belonging to the neighbourhood, and table 5.16, for talking to neighbours.

Table 5.15: Results for model 5.4, for belonging to neighbourhood

Level 1: Occasion (i) Level 2: Individual (j)	Belong 1998 Est.	S.E.	Belong 2003 Est.	S.E.	Belong 2008 Est.	S.E.
Constant (β_0)	3.719	0.014	3.769	0.014	3.762	0.013
Individual level						
β_1 Age	0.0097	0.0005	0.0098	0.0006	0.0087	0.0006
β_2 Household Income	0.0014	0.0010	0.0051	0.0010	0.0003	0.0008
β_3 Moved	-0.249	0.024	-0.240	0.024	-0.152	0.026
Ward level						
β_4 Ward Townsend	-0.0410	0.0030	-0.0368	0.0032	-0.0388	0.0032
σ^2_u Between ward variance	0.137	0.013	0.149	0.015	0.176	0.016
σ^2_e Between individual variance	0.665	0.014	0.570	0.015	0.510	0.015
DIC	22604.24		17521.16		15638.92	

Source date: BHPS, waves 1998, 2003 and 2008. Total n = 8,841 (1998) 7,178 (2003) 6,585 (2008).

Table 5.16: Results for model 5.4, for talking to neighbours

Level 1: Occasion (i) Level 2: Individual (j)	Talk 1998 Est.	S.E.	Talk 2003 Est.	S.E.	Talk 2008 Est.	S.E.
Constant (β_0)	3.731	0.014	3.622	0.015	3.627	0.015
Individual level						
β_1 Age	0.0076	0.0006	0.0094	0.0007	0.0097	0.0007
β_2 Household Income	-0.0047	0.0011	-0.0028	0.0012	-0.0039	0.0009
β_3 Moved	-0.245	0.026	-0.160	0.027	-0.150	0.030
Ward level						
β_4 Ward Townsend	-0.0201	0.0032	-0.0213	0.0036	-0.0306	0.0037
σ^2_u Between ward variance	0.119	0.016	0.132	0.018	0.170	0.021
σ^2_e Between individual variance	0.830	0.017	0.811	0.020	0.778	0.022
DIC	24319.02		19732.82		18044.23	

Source date: BHPS, waves 1998, 2003 and 2008. Total n = 8,841 (1998) 7,178 (2003) 6,585 (2008).

Results for the outcome of belonging to the neighbourhood from model 5.4, once ward level deprivation is added, are shown in table 5.15. This leads to an improved model fit, the reduction in DIC from model 5.3 is, on average, around

100 points. Ward level material deprivation, as with other explanatory variables, has been mean centred, at 0.83, 0.59 and 0.52 for 1998, 2003 and 2008 respectively. The range is similar in each period, from around minus 6 to 13. So that every unit increase in ward level material deprivation decreases the likelihood of belonging to the neighbourhood by, on average, 0.039 points. So that, taking the average constant and average ward material deprivation effect over the three waves, those in most deprived wards will have an outcome of 3.245 and those in the least deprived wards will have an outcome of 3.983.

Results for the outcome of talking to the neighbours from model 5.4, once ward level deprivation is added, are shown in table 5.16. This leads to an improved model fit, the reduction in DIC from model 5.3 is, on average, around 40 points, so less of a reduction compared to the outcome of belonging to the neighbourhood. And this is reflected in the, relatively, smaller effects of ward level material deprivation for talking to neighbourhood, in comparison to belonging to the neighbourhood. Every unit increase in ward level material deprivation decreases the likelihood of talking to neighbours by, on average, 0.024 points. So that, taking the average constant and average ward material deprivation effect over the three waves, those in most deprived wards will have an outcome of 3.348 and those in the least deprived wards will have an outcome of 3.804.

Next the effects of ward level ethnic diversity are considered in isolation from ward level material deprivation. The results are shown in model 5.5, in table 5.17, for the outcome of belonging to neighbourhood, and table 5.18, for the outcome of talking to neighbours. In general the effects are similar to those of ward level material deprivation but of a smaller magnitude. Compared to model 5.3 the reduction in DIC is, on average, around 50 points for belonging to the neighbourhood and 38 points for talking to neighbours. So while the effect of increased ward level ethnic diversity is negative for both outcomes the effect sizes are smaller when compared to the effect of ward level material deprivation, when considered in isolation. The ward level percentage of population from ethnic minorities is mean centred, at 6.45, 7.56 and 8.98 per cent in 1998, 2003 and 2008 respectively. The average effect, over the three waves, for an increase in one percentage point in the proportion of the population from ethnic minorities is -0.008 for belonging to the neighbourhood, and -0.007 for talking to neighbours. So that, on average across the three waves, those in wards with close to zero percentage of the population from ethnic minorities are predicted to have a belonging score of 3.813, compared to a score of 3.503 for those in wards with 30 per cent of the population from ethnic minorities. For the outcome of talking to neighbours those in wards with close to zero percentage of the population from ethnic minorities are predicted to have a score of 3.713, compared to a score of 3.460 for those in ward with 30 per cent of the population from ethnic minorities.

Table 5.17: Results for model 5.5, for belonging to neighbourhood at each wave

Level 1: Occasion (i) Level 2: Individual (j)	Belong 1998 Est.	S.E.	Belong 2003 Est.	S.E.	Belong 2008 Est.	S.E.
Constant (β_0)	3.716	0.014	3.767	0.014	3.761	0.013
Individual level						
β_1 Age	0.0099	0.0005	0.0101	0.0006	0.0093	0.0006
β_2 Household Income	0.0031	0.0010	0.0066	0.0010	0.0014	0.0008
β_3 Moved	-0.243	0.024	-0.235	0.024	-0.154	0.026
Ward level						
β_4 Ward BME	-0.0090	0.0010	-0.0088	0.0009	-0.0067	0.0009
σ^2_u Between ward variance	0.151	0.014	0.152	0.015	0.185	0.017
σ^2_e Between individual variance	0.664	0.014	0.572	0.015	0.511	0.015
DIC	22665.29		17557.56		15700.30	

Source date: BHPS, waves 1998, 2003 and 2008. Total n = 8,841 (1998) 7,178 (2003) 6,585 (2008).

Table 5.18: Results for model 5.5, for talking to neighbours at each wave

Level 1: Occasion (i) Level 2: Individual (j)	Talk 1998 Est.	 S.E.	Talk 2003 Est.	 S.E.	Talk 2008 Est.	 S.E.
Constant (β_0)	3.731	0.014	3.621	0.015	3.627	0.015
Individual level						
β_1 Age	0.0077	0.0006	0.0095	0.0007	0.0102	0.0007
β_2 Household Income	-0.0038	0.0011	-0.0020	0.0011	-0.0030	0.0009
β_3 Moved	-0.243	0.026	-0.158	0.027	-0.151	0.030
Ward level						
β_4 Ward BME	-0.0058	0.0010	-0.0075	0.0010	-0.0067	0.0010
σ^2_u Between ward variance	0.121	0.016	0.130	0.018	0.169	0.021
σ^2_e Between individual variance	0.830	0.017	0.811	0.020	0.782	0.022
DIC	24322.64		19720.12		18069.83	

Source date: BHPS, waves 1998, 2003 and 2008. Total n = 8,841 (1998) 7,178 (2003) 6,585 (2008).

Next both ward level material deprivation and the percentage of the ward population from ethnic minorities were considered together in the same model. Results from this model, model 5.6, are given in table 5.19 for the outcome of belonging to the neighbourhood and table 5.20, for the outcome of talking to neighbours.

Table 5.19: Results for model 5.6, for belonging to neighbourhood at each wave

Level 1: Occasion (i) Level 2: Individual (j)	Belong 1998 Est.	 S.E.	Belong 2003 Est.	 S.E.	Belong 2008 Est.	 S.E.
Constant (β_0)	3.719	0.013	3.769	0.014	3.762	0.013
Individual level						
β_1 Age	0.0097	0.0005	0.0098	0.0006	0.0087	0.0006
β_2 Household Income	0.0016	0.0011	0.0054	0.0010	0.0003	0.0008
β_3 Moved	-0.249	0.024	-0.239	0.024	-0.152	0.026
Ward level						
β_4 Ward Townsend	-0.0373	0.0037	-0.0291	0.0039	-0.0385	0.0041
β_5 Ward BME	-0.0019	0.0012	-0.0028	0.0011	-0.0001	0.0011
σ^2_u Between ward variance	0.137	0.013	0.147	0.015	0.176	0.016
σ^2_e Between individual variance	0.665	0.013	0.570	0.015	0.510	0.015
DIC	22602.86		17518.39		15640.56	

Source date: BHPS, waves 1998, 2003 and 2008. Total n = 8,841 (1998) 7,178 (2003) 6,585 (2008).

Table 5.20: Results for model 5.6, for talking to neighbours at each wave

Level 1: Occasion (i) Level 2: Individual (j)	Talk 1998 Est.	 S.E.	Talk 2003 Est.	 S.E.	Talk 2008 Est.	 S.E.
Constant (β_0)	3.732	0.014	3.621	0.015	3.627	0.015
Individual level						
β_1 Age	0.0076	0.0006	0.0094	0.0007	0.0098	0.0007
β_2 Household Income	-0.0044	0.0011	-0.0024	0.0012	-0.0037	0.0010
β_3 Moved	-0.246	0.026	-0.159	0.027	-0.150	0.030
Ward level						
β_4 Ward Townsend	-0.0146	0.0039	-0.0097	0.0043	-0.0248	0.0048
β_5 Ward BME	-0.0031	0.0013	-0.0059	0.0013	-0.0035	0.0013
σ^2_u Between ward variance	0.119	0.015	0.129	0.019	0.170	0.021
σ^2_e Between individual variance	0.830	0.017	0.811	0.021	0.778	0.022
DIC	24314.90		19717.30		18041.01	

Source date: BHPS, waves 1998, 2003 and 2008. Total n = 8,841 (1998) 7,178 (2003) 6,585 (2008).

In model 5.6, for the outcome of belonging to the neighbourhood, the effect of ward level ethnic diversity reduces substantially when considered along with ward level material deprivation, while the effect of ward level material deprivation remains similar to model 5.4, which considered this variable in isolation. The effect of ward level ethnic diversity is now substantively very small, and the change in DIC compared to model 5.5, with ward level material deprivation but without ward level ethnicity, is -0.138, -2.77 and +1.64, in 1998, 2003 and 2008 respectively. Therefore in two of the three waves the addition of ward level ethnicity does not improve the model fit. This suggests that the observed relationship between ward level ethnic diversity and individual level belonging to neighbourhood are largely spurious, due to the association between ward level deprivation and ward level ethnic diversity.

The results from model 5.6 for the outcome of talking to neighbours are shown in table 5.20. Like the outcome of belonging to neighbourhoods, the effect of ward level ethnic diversity reduces when considered along with ward level material deprivation, though it does not reduce by the same extent and remains a significant effect. Indeed the change in DIC compared to model 5, with ward level material deprivation but without ward level ethnicity, is -4.12, -15.22 and -3.22, in 1998, 2003 and 2008 respectively. Therefore, after controlling for ward level material deprivation, the effects of ward level ethnic diversity are still significant for the outcome of talking to neighbours. Next the ward level variables of population density and gross migration rate were added to the model, as in model 5.7. Results for model 5.7 are shown in table 5.21, for the outcome of belonging to the neighbourhood, and table 5.22, for the outcome of talking to neighbours.

Table 5.21: Results for model 5.7, for belonging to neighbourhood at each wave

Level 1: Occasion (i)	Belong 1998		Belong 2003		Belong 2008	
Level 2: Individual (j)	Est.	S.E.	Est.	S.E.	Est.	S.E.
Constant (β_0)	3.717	0.013	3.767	0.014	3.761	0.013
Individual level						
β_1 Age	0.0096	0.0005	0.0097	0.0006	0.0086	0.0006
β_2 Household Income	0.0017	0.0010	0.0055	0.0010	0.0005	0.0008
β_3 Moved	-0.235	0.024	-0.229	0.025	-0.146	0.026
Ward level						
β_4 Ward Townsend	-0.0311	0.0042	-0.0238	0.0044	-0.0337	0.0047
β_5 Ward BME	-0.0016	0.0013	-0.0019	0.0012	0.0006	0.0012
β_6 Ward Density	0.0007	0.0006	-0.0003	0.0006	-0.0004	0.0006
β_7 Ward Migration	-0.1412	0.0236	-0.0698	0.0226	-0.0584	0.0242
σ^2_u Between ward variance	0.134	0.013	0.145	0.015	0.175	0.016
σ^2_e Between individual variance	0.664	0.013	0.571	0.015	0.511	0.015
DIC	22578.07		17511.08		15634.91	

Source date: BHPS, waves 1998, 2003 and 2008. Total n = 8,841 (1998) 7,178 (2003) 6,585 (2008).

For the outcome of belonging to the neighbourhood the effect size of ward level deprivation remains relatively large and ward level ethnic diversity remains non significant. Ward level gross migration rate, gross migration as a percentage of the population, also has a relatively large effect size, though it should be noted that the range of this variable is less than other ward variables, at around 0.9 to 6.3, with a mean of around 1.8. Ward density has no effect once the other ward level variables are controlled for. For the outcome of talking to neighbours the effect size of ward level ethnic diversity has now decreased substantially and is no longer significant. Also the effect of ward level material deprivation has substantially decreased, though remaining significant. Indeed the largest effect size for ward level variables for the outcome of talking to neighbours are now ward gross migration rate and ward level density.

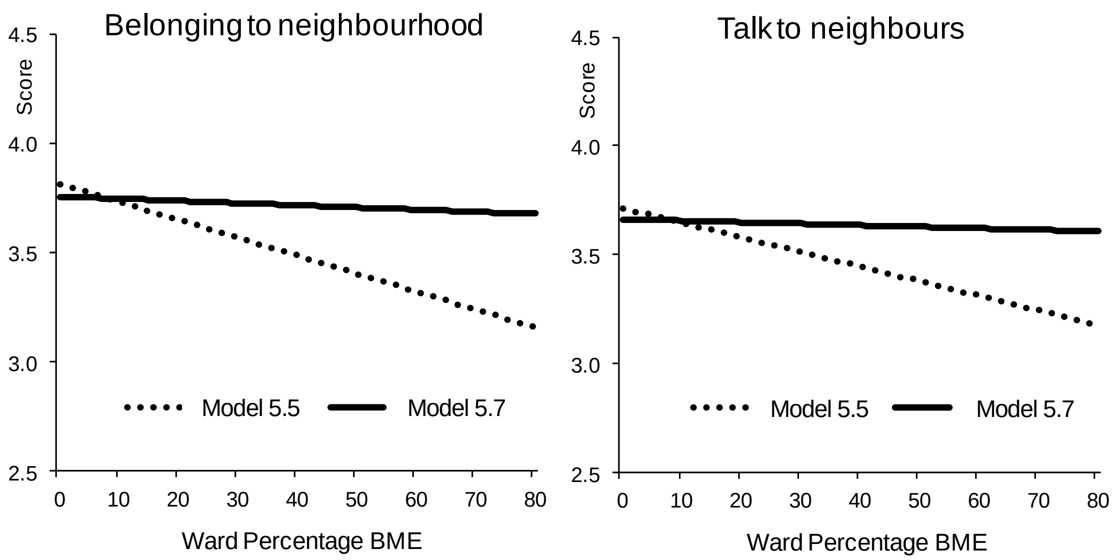
Table 5.22: Results for model 5.7, for talking to neighbours at each wave

Level 1: Occasion (i)	Talk 1998		Talk 2003		Talk 2008	
Level 2: Individual (j)	Est.	S.E.	Est.	S.E.	Est.	S.E.
Constant (β_0)	3.730	0.014	3.618	0.015	3.625	0.015
Individual level						
β_1 Age	0.0075	0.0006	0.0092	0.0007	0.0095	0.0007
β_2 Household Income	-0.0039	0.0011	-0.0021	0.0012	-0.0033	0.0010
β_3 Moved	-0.228	0.026	-0.143	0.027	-0.138	0.030
Ward level						
β_4 Ward Townsend	-0.0085	0.0044	-0.0082	0.0049	-0.0135	0.0054
β_5 Ward BME	-0.0001	0.0013	-0.0014	0.0014	-0.0006	0.0014
β_6 Ward Density	-0.0027	0.0006	-0.0025	0.0007	-0.0016	0.0007
β_7 Ward Migration	-0.1282	0.0250	-0.0868	0.0253	-0.1108	0.0281
σ^2_u Between ward variance	0.114	0.015	0.123	0.019	0.163	0.022
σ^2_e Between individual variance	0.828	0.017	0.812	0.021	0.780	0.022
DIC	24275.69		19700.52		18034.42	

Source date: BHPS, waves 1998, 2003 and 2008. Total n = 8,841 (1998) 7,178 (2003) 6,585 (2008).

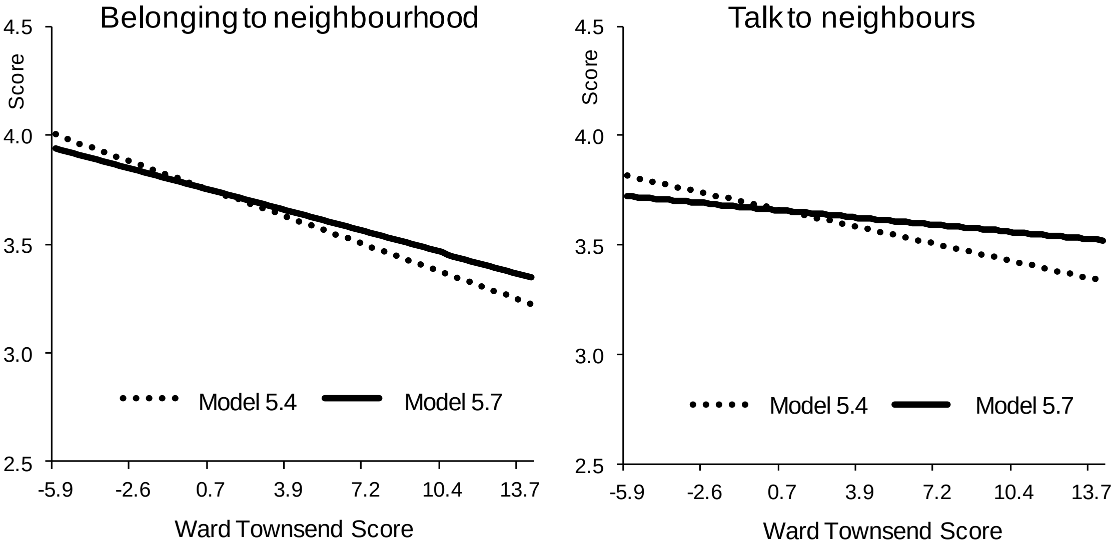
The analysis so far has considered the main ward level effects. One key finding is that, while there is an negative effect of ward level ethnic diversity for both outcomes, as also identified in the descriptive analysis, when this is considered in a model with other ward level variables the effect becomes non significant. For belonging to neighbourhood this happens once ward level deprivation is controlled for, suggesting that the observed association between ward level ethnic diversity and individual level belonging to the neighbourhood is spurious, as a result of the association between ward level material deprivation and ethnic diversity. For the outcome of talking to neighbours the association with ward level ethnic diversity becomes non significant once other ward level variables are controlled for. This can be seen in figures 5.16, which illustrates the main effect of ward level ethnic diversity, when all other variables are at mean value, in models that consider the effects of ward level ethnic diversity in isolation, model 5, and consider the effects of ward level ethnic diversity when controlling for other ward variables, model 5.7. This illustrates that the observed relationship between the outcomes and ward level ethnic diversity proves to be spurious once other ward level variables are considered.

Figure 5.16: Predicted values for Model 5.5 and Model 5.7, main effect of ward ethnic diversity for both outcomes



The change to the main effect of ward level ethnic diversity, once other ward level variables are considered is not replicated when considering ward level material deprivation in isolation, as in model 5.5, and then when controlling for other ward level variables, model 5.7. The main effect of ward level material deprivation remains similar once all ward level variables are considered. This is illustrated in figure 5.17.

Figure 5.17: Predicted values for Model 5.4 and Model 5.7, main effect of ward level material deprivation for both outcomes



To aid the substantive interpretation of model 5.7, which considers all ward level variables together, table 5.23 shows the predicted values for both outcomes considering the effects of each ward variable when all other variables in the model are at mean value. The table indicates the range of values in ward level explanatory variables and predicted values related to this range. These values represent the average, across the three survey waves, in explanatory variables and predicted values. This indicates that the largest substantive ward level effects for the outcome of belonging to the neighbourhood are levels of material deprivation and gross migration rate. The largest substantive ward level effects for the outcome of talking to neighbours are gross migration rates and population density.

Table 5.23: Range of ward level explanatory variables and predicted values from model 5.7, when all other variables at mean value (average of 3 waves)

Range of explanatory variables and predicted values		Townsend Index	Percentage BME	Density	Gross Migration
Ward level variable	Minimum	-5.87	0.19	0.1	0.87
	Mean	0.65	7.66	25.5	1.79
	Maximum	13.22	82.55	203.07	6.38
Belonging: predicted score	Minimum	3.94	3.76	3.75	3.83
	Mean	3.75	3.75	3.75	3.75
	Maximum	3.38	3.67	3.75	3.34
	Difference Min to Max	0.56	0.09	0.00	0.49
Talk: predicted score	Minimum	3.72	3.66	3.72	3.76
	Mean	3.66	3.66	3.66	3.66
	Maximum	3.53	3.61	3.25	3.16
	Difference Min to Max	0.19	0.05	0.47	0.60

Density (people per hectare). Gross Migration (rate per 100 population).

5.5.3 Testing hypothesis 3, moving ward and ward level material deprivation

In the previous chapter the interaction between household income and moving ward was not found to be significant, meaning that the effects of moving ward are the same for all household income groups. This section now looks at the cross level interaction between household income and ward level material deprivation. This interaction is investigated in order to address hypothesis 3, that remaining in materially deprived neighbourhoods, or moving into materially deprived neighbourhoods, will act to reduce levels of belonging to neighbourhoods and talking to neighbours for low income groups.

This interaction is of interest as the previous analysis has identified a negative effect, on both outcomes, of increased ward level deprivation, but different effects of household income. Increased household income has a positive effect on the outcome of belonging to the neighbourhood, but a negative effect on talking to neighbours. So the effects of ward level material deprivation and household income are in the same direction, both negative, for belonging to the neighbourhood, but in opposite direction for talking to neighbours. Results for model 5.8 which adds an interaction between ward level material deprivation and household income to model 5.7, are shown in table 5.24. The interaction improves the model fit for two of the three waves for both outcomes, full results at each wave are given in appendix 6.

Table 5.24: Results for model 5.8

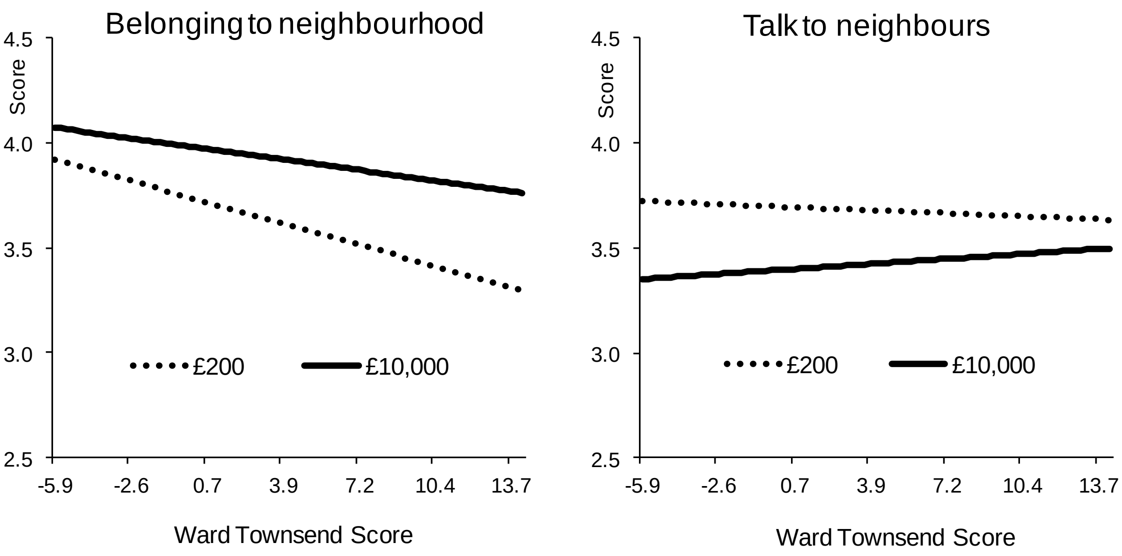
	MOD 5.8: belong		MOD 5.8: talk	
AVERAGES	Est.	S.E.	Est.	S.E.
Constant (β_0)	3.749	0.014	3.658	0.015
Individual level:				
β_1 Age	0.0093	0.0006	0.0087	0.0006
β_2 Hhinc	0.0026	0.0010	-0.0030	0.0011
β_3 Moved	-0.204	0.025	-0.170	0.028
Ward level:				
β_4 Ward Townsend	-0.0293	0.0045	-0.0030	0.0049
β_5 Ward BME	-0.0014	0.0012	-0.0014	0.0014
β_6 Ward Density	0.0000	0.0006	-0.0023	0.0007
β_7 Ward Migration	-0.0901	0.0235	-0.1091	0.0260
Cross level interaction:				
β_8 WTNSD*Hhinc	0.00043	0.00020	0.00036	0.00019
σ^2_u Between ward variance	0.151	0.015	0.134	0.018
σ^2_e Between individual variance	0.582	0.015	0.806	0.020

Source date: BHPS, waves 1998, 2003 and 2008. Total n = 8,841 (1998) 7,178 (2003) 6,585 (2008).

Figure 5.18 illustrates predicted values from model 5.8, for both outcomes. These charts confirm that those in households with higher income have higher levels of belonging to the neighbourhood but lower levels of talking to neighbours. However the effect of the interaction between ward level material deprivation and household income leads to the different effects of ward level material deprivation dependent upon levels of household income.

For the outcome of belong to the neighbourhood, while those with higher household incomes have more positive outcomes, there is little difference in wards with low material deprivation, and large differences in wards with high levels of material deprivation. Those in households with higher income belong to the neighbourhood more, and levels of belonging decrease slightly with increasing ward level material deprivation. Those in households with low income have a larger reduction in belonging to the neighbourhood as ward level material deprivation increases. For the outcome of talking to neighbours those on lower incomes have more positive outcomes, that is, talk more to neighbours, and this does not change with the level of ward level deprivation. Those in household with higher levels of income talk less to neighbours but this is particularly the case in wards of low material deprivation. As levels of ward level material deprivation increase so does the likelihood of those in high income households talking to neighbours. Therefore in the most materially deprived wards all household income groups talk to neighbours, but for those in households with high income talking to neighbours decreases as the ward becomes less materially deprived.

Figure 5.18: Predicted values from model 5.8, for both outcomes (average 3 waves)



However, there was no significant interaction between ward level material deprivation and moving ward for either outcome, and in the previous chapter no significant interaction was found between household income and moving ward for either outcome. This provides some evidence for assessing hypothesis 3, that remaining in materially deprived neighbourhoods, or moving into materially deprived neighbourhoods, will act to reduce levels of belonging to neighbourhoods and talking to neighbours for low income groups. The results so far do not provide much support for hypothesis 3. However this hypothesis cannot be fully tested in the cross-sectional multilevel models presented in this chapter. There are some doubts about what the substantive interpretation of the interactions with moving ward would mean in the cross-sectional analysis presented in this chapter. The cross-sectional analysis looks at one time point and the coefficient of moving ward in this context refers to people that have moved into the ward in the previous five years. In the next chapter the multilevel models presented in this chapter are combined with the longitudinal models presented in chapter four. These models will offer the opportunity to consider the effects of moving ward in a more dynamic way, and will enable the analysis of moving ward to consider the change in ward context resulting from moving ward. Therefore, while the analysis presented in this, and the previous, chapter is useful in the investigation of hypothesis 3, this hypothesis will be fully tested in the next chapter which combines multilevel and longitudinal analysis in models that allow for a more dynamic analysis of individual mobility between wards.

5.5.4 Testing hypothesis 4, the interaction between ward level material deprivation and ethnic diversity

So far ward level contextual variables have been considered in isolation and together. This analysis indicates that the observed negative association between ward level ethnic diversity and belonging to the neighbourhood becomes non significant once ward level material deprivation is controlled for. Also that the observed negative association between ward level ethnic diversity and talking to neighbours becomes non significant once ward level material deprivation, ward gross migration and ward density are controlled for. This suggests that the association between ward level ethnic diversity and the outcomes is spurious. However, hypothesis 4 contends that: after controlling for other neighbourhood level variables, higher levels of, or increases in, neighbourhood ethnic diversity are associated with higher levels of individual belonging to neighbourhoods and talking to neighbours, when compared to individuals in neighbourhoods that are not ethnically diverse, or do not experience an increase in neighbourhood ethnic diversity.

The relationship between ward level variables was discussed in the first part of this chapter and illustrated by figure 5.7. This illustrates that wards with high levels of ethnic diversity tend to be predominantly wards with higher levels of material deprivation, there are no wards with high levels of ethnic diversity and low material deprivation. However, wards that are materially deprived can have either low or high levels of ethnic diversity. Table 5.25 gives results for model 5.9, which adds the interaction between ward level material deprivation and ethnic diversity. These present results of averaged coefficients, across the three survey waves, full results for each wave are given in appendix 6.

Table 5.25: Results for model 5.9

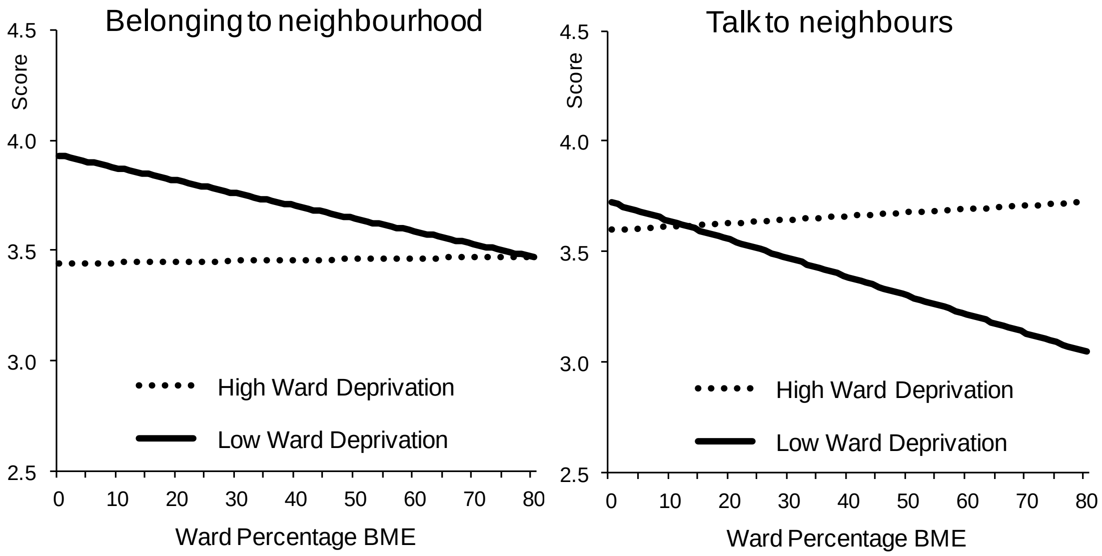
	Mod 5.9: Belong		Mod 5.9: Talk	
AVERAGES	Est.	S.E.	Est.	S.E.
Constant (β_0)	3.737	0.015	3.640	0.017
Individual level:				
β_1 Age	0.0093	0.0006	0.0087	0.0006
β_2 Hhold Income	0.0026	0.0010	-0.0030	0.0011
β_3 Moved	-0.202	0.025	-0.168	0.028
Ward level:				
β_4 Ward Townsend	-0.0294	0.0045	-0.0030	0.0049
β_5 Ward BME	-0.0037	0.0019	-0.0051	0.0021
β_6 Ward Density	0.0001	0.0006	-0.0021	0.0007
β_7 Ward Migration	-0.0867	0.0236	-0.1036	0.0261
Ward level interaction:				
β_8 WTNSD*WBME	0.00041	0.00026	0.00067	0.00028
σ^2_u Between ward variance	0.151	0.015	0.134	0.018
σ^2_e Between individual variance	0.582	0.015	0.806	0.020

Source date: BHPS, waves 1998, 2003 and 2008. Total n = 8,841 (1998) 7,178 (2003) 6,585 (2008).

The addition of the interaction improves the model fit for all three waves for belonging to the neighbourhood and talking to neighbours, though reduction in

DIC is small, in the range of 2.03 to 7.90. Also the size of the interaction effect is substantively small. The main effect of ward material deprivation is unchanged with the addition of the interaction effect for the outcome of belonging to the neighbourhood, but reduces in the model for the outcome of talking to neighbours. What is interesting is that, while the main effect of ward level ethnic diversity is close to zero in model 5.7, without the interaction, the main effect becomes a larger negative effect. So, for both outcomes, the models with the interaction effect predict a, small, negative effect of ward level ethnic diversity, but a positive interaction effect. Therefore the effect of ward level ethnic diversity is more negative in less materially deprived wards and less negative in more materially deprived wards. This relationship is illustrated in figure 5.19, which shows predicted outcomes at different levels of ward level ethnic diversity for individuals in wards with low material deprivation (Townsend score of minus five), and high material deprivation (Townsend score of plus ten).

Figure 5.19: Predicted values from model 5.9, for both outcomes (average of 3 waves)



As figure 5.19 illustrates, at the mean level of ward level ethnic diversity, around 8 per cent, there are differences in levels of belonging to the neighbourhood by level of ward material deprivation, but not so for the outcome of talking to neighbours. Because the effect of the interaction between ward level material deprivation and ethnic diversity is positive the substantive effect, when considered with the main effects, is that higher levels of ward ethnic diversity is associated with very slightly increased individual levels of belonging to the neighbourhood for those in wards with high material deprivation. But for those in wards with low material deprivation increasing ward level ethnic diversity reduces individual level belonging to the neighbourhood. For the outcome of talking to neighbours increased ward level ethnic diversity reduces the predicted outcome for those individuals in wards with low material deprivation. In wards with high material deprivation increased levels of ethnic diversity lead to a, very slight, increase in individuals talking to neighbours. These results need to be understood in the context of the relationship between these variables at the ward level. As discussed, wards with high levels of ethnic diversity tend to be predominantly wards with higher levels of material deprivation; there are no wards with high levels of ethnic diversity and low material deprivation. However, wards that are materially deprived can have either low or high levels of ethnic diversity. Therefore the very slight increase in belonging to the neighbourhood and talking to neighbours associated with increasing ethnic diversity in more materially deprived wards reflects the reality of wards that actually exist in the population of wards. The interaction effects lead to more negative outcomes with increased ward level ethnic diversity in wards with low material deprivation. However, wards with low material deprivation and high levels of ethnic diversity do not actually exist in the population of wards, as can be seen in figure 5.7.

The following chapter, which brings together the longitudinal analysis of chapter 4 and the multilevel analysis of this chapter will enable hypothesis 4 to be investigated further. Crucially, the models in the following chapter will enable a consideration of change in ward level context as a result of individuals moving between wards.

5.6 Conclusions

The aim of this chapter was to begin to consider contextual, ward level effects, on the outcomes of belonging to the neighbourhood and talking to neighbours.

This chapter began by considering population context, in relation to changes to ethnic diversity and income inequality. Census data was presented for all England wards for 1991, 2001 and 2011, measuring ward level material deprivation, ward ethnic diversity, ward population density and ward level gross migration rates. Descriptive analysis of the association between ward level variables and the individual level outcomes of belonging to the neighbourhood and likelihood of talking to neighbours was presented. Then multilevel models were developed in order to address the hypotheses concerned with contextual effects.

The initial descriptive analysis found that, when considered in isolation, there is a negative association between higher levels of ward level material deprivation, ethnic diversity, population density and gross migration rate and both outcomes. So that individuals living in wards with high material deprivation, ethnic diversity, population density and gross migration are less likely to belong to their neighbourhood or talk to neighbours. However, as also shown in the descriptive analysis, there are particular relationships between contextual variables at the ward level. Wards with high levels of ethnic diversity were more likely to also be wards with high levels of material deprivation. And while wards with high material deprivation could have high or low levels of ethnic diversity, wards with low levels of material deprivation have only low levels of ethnic diversity. There was a similar, slightly less marked, relationship between ward level material deprivation and both population density and migration. Though no such relationship exists between ward level ethnic diversity and gross migration rates.

Given these relationships at the ward level, multilevel models were developed to test for the main effects of ward level variables, in isolation, and after controlling for other ward level variables. Multilevel models, with individuals nested within wards, were constructed for both outcomes at each survey wave. The initial empty two levels models suggest that around 28 per cent of the total variance in the outcome of belonging to the neighbourhood, and around 18 per cent of the total variance in the outcome of talking to neighbours could be attributed to ward level variation. This represents the variation between wards, resulting from the clustering of individuals with similar outcomes within wards. The remaining variation in outcomes, around 72 per cent for belonging to the neighbourhood and 88 per cent for talking to neighbours, is a result of variation between individuals within wards.

In these models the effect of household income remains fairly constant and substantively similar to the effects identified in the previous chapter. Individuals in households with lower incomes are less likely to belong to the neighbourhood and more likely to talk to neighbours. Individuals in wards with high levels of material deprivation are less likely to belong to the neighbourhood but are also less likely to talk to neighbours. This is an intriguing paradox, the effect of household income and ward deprivation are in the same direction for belonging to the neighbourhood, but in the opposite direction for talking to neighbours. Those in households with low incomes talk more to neighbours, but those in more materially deprived neighbourhoods talk less. It should be noted that, after controlling for other ward level variables, the strength of the effect of ward level material deprivation is strongest for the outcome of belonging to the neighbourhood, and becomes smaller for talking to neighbours, however the effect is still significant. In order to explore this relationship, and to explore evidence for hypothesis 3, an interaction between ward level material deprivation and household income was considered.

While those in households with higher incomes belong more to the neighbourhood than those in households with lower incomes, this difference is greatest in the most materially deprived wards. In wards with low material deprivation there is little difference. So there is a negative effect on individual level belonging with higher levels of ward level material deprivation, and this effect is stronger for those in households with lower incomes. This suggests separate effects operating in the same direction. Those in households with lowest incomes and in wards with highest material deprivation are the least likely to belong to their neighbourhoods. For the outcome of talking to neighbours those on lower incomes have more positive outcomes, that is, talk more to neighbours, and this does not change with the level of ward level deprivation, so that individuals in low income households talk more to neighbours in deprived and affluent wards, there is no change in this outcome with increased ward level deprivation. Individuals in households with higher incomes, however, are less likely to talk to neighbours in less materially deprived wards, as compared to more materially deprived wards. Therefore those least likely to talk to neighbours are those in households with high incomes and in wards that are least materially deprived.

In chapter 4 there was no significant interaction between household income and moving ward, so that, in general, the effects of moving ward do not vary by household income. In this chapter, no significant interaction was found between ward level material deprivation and moving ward for either outcome. However the cross-sectional analysis presented in this chapter is not fully able to test hypothesis 3. In the following chapter multilevel and longitudinal models are combined in single models that are able to consider the effects of change, or lack of change, in ward level context as a result of mobility, or lack of mobility between wards.

In the modelling strategy random slopes were introduced for ward level variables; however there was no significant variance for ward level random slopes once all ward and individual level variables were considered together in the final models presented. When ward level ethnic diversity and material deprivation were considered in multilevel models in isolation, after controlling for age, household income and whether the individual had moved into the ward in the last 5 years, higher levels of both ward level variables were associated with lower levels of individual level belonging to the neighbourhood and likelihood of talking to neighbours. For the outcome of belonging to the neighbourhood the effect of ward level ethnic diversity becomes non significant once ward level material deprivation is considered in the same model. For the outcome of talking to neighbours, once ward level material deprivation, population density and gross migration rate were added to the model the effect of ward level ethnic diversity was no longer significant. This suggests that the observed association between ward level ethnic diversity and the outcomes was spurious, arising from the association between ward level variables. In the model considering all ward level variables, and controlling for age, household income and whether the individual had moved into the ward in the last 5 years, it was found that the largest substantive contextual effects, taking account of the range of ward level variables, was ward level material deprivation and gross migration for belonging to the neighbourhood, and ward level gross migration and population density for talking to neighbours.

This chapter also considered the interaction between ward level material deprivation and ethnic diversity. The estimates from this interaction indicate that increasing ethnic diversity is associated with more positive outcomes for individuals in wards with high levels of material deprivation, particularly for the outcome of belonging to the neighbourhood. Though overall, the effects of this interaction were relatively small. In contrast, increasing ward level ethnic diversity is associated with less positive outcomes for individuals in wards with low levels of material deprivation. However wards with high levels of ethnic diversity and low levels of deprivation do not exist in the sample, or the population of wards; while wards with higher levels of material deprivation can have low or high levels of ethnic diversity.

So, in conclusion, this chapter extends the analysis from the previous chapter, which considered individual level change over time, by examining the nature of contextual effects. Cross-sectional analysis of each wave using multilevel models has enabled an exploration of ward level contextual effects in isolation and in combination. However, as shown in the descriptive analysis at the beginning of this chapter, there is change to ward level variables over time. Therefore in the next chapter, the final empirical chapter of the thesis, the intention will be to combine the longitudinal and multilevel analysis into final models that can consider the effect of change in contextual level variables, in relation to individual trajectories of change over time. This will enable the full testing of hypothesis 3 and 4, explored in this chapter. Also combining longitudinal and multilevel models, in the next chapter, will enable a consideration of whether the findings regarding hypotheses 1 and 2 reported in chapter 4, remain once ward level contextual variables are considered.

Chapter 6 Cross-classified multilevel models of change

6.1 Introduction

So far this thesis has considered change in individual belonging to neighbourhoods and likelihood of talking to neighbours over time, in chapter 4, and the relationship between these individual level outcomes and ward level contextual variables at each, cross-sectional, survey wave, in chapter 5. The aim of this chapter is to build on what has already been found in this thesis, extending the analysis to consider longitudinal and contextual models together in a single model.

In chapter 4 support was found for hypothesis 1 and 2 for the outcome of talking to neighbours, but not for belonging to the neighbourhood. In relation to hypothesis 1, higher levels of talking to neighbours for older age groups was found to be a result of cohort changes in this outcome, not as a result of individuals talking more to neighbours as they got older. The opposite was true for the outcome of belonging to the neighbourhood, older groups belong more to their neighbourhood because levels of belonging increase within individuals as they get older. In relation to hypothesis 2, the cohort changes in levels of talking to neighbours were found to be moderated by household income, so that more affluent groups had experienced a greater cohort reduction in the levels of talking to neighbours than poorer groups. The association between household income and belonging to the neighbourhood did not vary between different cohorts. In general, these findings support the notion that younger cohorts talk less to neighbours, particularly more affluent younger cohorts, but that all cohorts experience an increase in belonging to the neighbourhood over time as individuals get older. In this chapter these patterns of individual change over time will be re-examined, taking into account ward level contextual variables. The intention is to see whether the cohort and age effects remain the same, or are moderated, when considering ward level context.

In chapter 5 ward level context was considered at each cross-sectional survey wave. This chapter considered evidence for hypothesis 3, that remaining in materially deprived neighbourhoods, or moving into materially deprived neighbourhoods, will act to reduce levels of belonging to neighbourhoods and talking to neighbours for low income groups. There was no significant interaction, for either outcome, between household income and moving ward in chapter 4, and in chapter 5, when ward level variables were considered there was no significant interaction between ward level material deprivation and moving ward. The results suggest that, in general, the moving ward reduces belonging to the neighbourhood and talking to neighbours, and this is the same for all household income groups. Also, the effect of moving ward was the same, regardless of the level of material deprivation in the ward that individuals had moved into. There was a significant interaction between ward level material deprivation and household income, particularly for belonging to the neighbourhood, which suggests that high levels of ward level material deprivation have a larger negative effect on levels of belonging for low income groups, and less of a negative effect for high income groups. Also that low income groups talk more to neighbours, regardless of ward level material deprivation, and high income groups talk more to neighbours in wards with high levels of ward level material deprivation, and less so in wards with low levels of material deprivation. However neither the two level longitudinal models in chapter 4, nor the two level, cross-sectional, multilevel models, in chapter 5, fully test hypothesis 3. To do so, it is necessary to consider ward level context, and mobility between wards in a more dynamic way, by combining longitudinal and ward level context in a single model, as this chapter aims to do.

Chapter 5 also considered hypothesis 4, that after controlling for other neighbourhood level variables, higher levels of, or increases in, neighbourhood ethnic diversity are associated with higher levels of individual belonging to neighbourhoods and talking to neighbours, when compared to individuals in neighbourhoods that are not ethnically diverse, or do not experience an increase in neighbourhood ethnic diversity. There was some evidence to support this hypothesis for both outcomes. However, as the models in chapter 5 are cross-sectional they are static, and cannot consider the aspect of this hypothesis that is concerned with individuals remaining in, or moving between wards. Again, this chapter, by combining the longitudinal and ward context in a single model, will aim to fully address this hypothesis. Consideration can be given to change in ward level context over time, in relation to individual mobility between wards. There are some challenges in developing models that can accommodate change over time and ward level context, and these are outlined in chapter 3. In short, the models developed need to be cross-classified in order to deal with the imperfect hierarchy that arises from individuals changing wards between measurement occasions. This chapter begins by presenting three level cross-classified empty models, with no explanatory variables, in order to estimate the variance in outcomes attributed to the various levels. The models are then developed, introducing time, with a random slope at the individual level, and year of birth. Results are presented for models with all main effects, building on what is known from previous chapters, and substantive effect size is considered, with reference to the range of explanatory variable values.

Then this chapter presents final models that contain a range of interaction terms, designed specifically to test the hypotheses under study. These interactions are discussed, and the final model is used to calculate a range of predicted outcomes. Evidence from these final models is used to consider each hypothesis in turn. Finally, at the end of this chapter, overall conclusions are drawn together.

6.2 Results from empty three level cross-classified models

Results from empty three level cross-classified models, that is models just estimating the average and the variance at each level, as specified by equation 11, are shown in table 6.1. For illustrative purposes results from a wrongly specified model, where levels are treated as if they were perfect hierarchies, as in equation 12, are also shown. Browne (2012) details the way in which MLwiN deals with non perfect hierarchies when models treat the data as perfectly nested within levels, as in the wrongly specified model, equation 6.2. If an individual changes ward in the period, and the model is not cross-classified, they are treated as being one individuals nested within two wards. The result is that the nested models count the same level 2 units multiple times. Exploring the hierarchy viewer in MLwiN for models specified as nested in a perfect hierarchy reveals that there are over three times as many wards in the nested structure than there are in reality, because of the creation of multiple cases, as outlined above. This is a particular problem for my data as there are a large number of individuals changing ward during the period under study. Running models that treat the data as nested in a perfect hierarchy results in misleading estimates (Browne 2012), but MLwiN does produce the estimates. Table 6.1 demonstrates that ward level variances, that is the variation between wards, is estimated as much larger in the incorrectly specified models, when compared to a correctly specified cross-classified model. Therefore it is possible to obtain estimates from models that are incorrectly specified as perfect hierarchies but the method creates more wards than exist in reality and estimates larger between ward variance.

Table 6.1: Results from model 6.1, three level cross-classified model, compared to three level perfect hierarchy model

	Model 6.1: Cross-classified Belonging		Model 6.1: Not Cross-classified Belonging		Model 6.1: Cross-classified Talk		Model 6.1: Not Cross-classified Talk	
	Est.	S.E.	Est.	S.E.	Est.	S.E.	Est.	S.E.
Constant (β_0)	3.623	0.012	3.603	0.009	3.581	0.012	3.568	0.009
$\sigma^2_u{}^{(3)}$	0.164	0.010	0.261	0.015	0.143	0.010	0.206	0.018
$\sigma^2_u{}^{(2)}$	0.290	0.009	0.247	0.011	0.368	0.011	0.360	0.015
σ^2_e	0.401	0.006	0.346	0.005	0.505	0.007	0.447	0.007
DIC	46921.85		45564.16		51581.98		50676.45	

Level 1: Occasion（i）, Classification 2: Individual, Classification 3: Ward
Source data: BHPS, waves 1998, 2003 and 2008. Total n = 9,949

These models were run in 120,000 iterations, with diffuse priors. An examination of the trajectories and residuals for the cross-classified models demonstrated that the estimates produced have converged and residuals at each classified levels are normally distributed. Trajectories and residuals are shown in appendix 7. The total variance from these three level empty models can be compared to the variances calculated from the two level longitudinal models, set out in chapter 4, and the two level cross-sectional multilevel models, set out in chapter 5. This comparison is shown in table 6.2.

Table 6.2: Estimated variances at each level from two level and three level models

Belong to neighbourhood	2 Level Longitudinal	2 Level Multilevel (average)	3 Level Cross-classified	3 Level Not Cross-classified
Total Variance	0.814	0.814	0.855	0.854
Ward		28.0%	19.2%	30.6%
Individual	44.5%	72.0%	33.9%	28.9%
Occasion	55.5%		46.9%	40.5%

Talk to neighbours	2 Level Longitudinal	2 Level Multilevel (average)	3 Level Cross-classified	3 Level Not Cross-classified
	0.974	1.006	1.016	1.013
Ward		18.5%	14.1%	20.3%
Individual	43.3%	81.5%	36.2%	35.5%
Occasion	56.7%		49.7%	44.1%

Source data: BHPS, waves 1998, 2003 and 2008. Total n = 9,949

As table 6.2 shows, the total variances are similar in all models for each outcome. However, as discussed above, the incorrectly specified three level models, where the levels are treated as perfect hierarchies, appears to inflate the ward level variance, compared to the three level cross-classified models. The ward level variance in the three level cross-classified models are slightly higher than the average ward level variance in the two level cross-sectional models, and the individual and occasion variances are slightly larger in the two level longitudinal model compared to the three level cross-classified models. However, the main difference in the estimated variances of the different models, as set out in table 6.2, relates to the individual and occasion level variances. The inclusion of occasion enables the individual level variance to be broken down into between individual and between occasion variance. In the cross-sectional multilevel models the between person and between occasion variance is confounded and assumed to be all between person variance.

6.3 Three level cross-classified models with time and year of birth

The empty three level cross-classified models can be extended, as in equation 13, where time in years is added and allowed to be random at the individual level, the estimated values from model 6.2 are given in table 6.3. Compared to model 6.1, the empty three level cross-classified models, the variance at each level is reduced slightly for both outcomes. The proportion of the variance that is at the individual level, between individuals, increases slightly in model 6.2, now that individual trajectories over time are allowed to vary between individuals. The coefficient for time represents the average effect of units of one year in the study period. There is, on average, an increase in levels of belonging while there is no significant change in average levels of talking to neighbours over the study period. The size of the coefficients for time are the same as models considering just individual change over time as set out in chapter 4. The addition of time, random at the individual level, leads to a reduction in DIC, which suggests that these models are a better fit compared to models 6.1, without the random slope for time. However it is worth noting that the decrease in DIC is far greater for the outcome of belonging to the neighbourhood, a reduction of 1,224 points, compared to the outcome of talking to neighbours, with a reduction of 31 points.

In model 6.2 there are now two random effects associated with the individual level. $\sigma^2_u{}^{(2)}{}_{0,0}$ represents the variance around the average intercept, $\sigma^2_u{}^{(2)}{}_{1,1}$ represents the variance around the average slope trajectory, and $\sigma^2_u{}^{(2)}{}_{1,0}$ represents the co-variance between intercept and trajectory. These estimates are shown in table 6.3 along with the calculated correlation between random intercept and random slope at the individual level.

The estimated correlation is negative for both outcomes, which suggests that the random slopes are 'fanning in', that those with higher starting values have flatter trajectories, while those with lower starting values have steeper trajectories. The correlation is much larger for the outcome of belonging to the neighbourhood compared to the outcome of talking to neighbours. The main effect of time is very small for the outcome of talking to neighbours, so the average trajectory of change is relatively flat, and the small correlation between random intercept and slope suggests that this flat rate of change does not vary much depending on starting values for this outcome.

Table 6.3: Results from model 6.2, three level cross-classified models with time, random at the individual level

	Model 6.2: Belonging		Model 6.2: Talk	
	Est.	S.E.	Est.	S.E.
Constant (β_0)	3.632	0.011	3.580	0.012
Occasion level classification:				
Time	0.01228	0.00126	-0.00188	0.00139
$\sigma^2_{u(3)}$	0.160	0.009	0.142	0.010
$\sigma^2_{u(2)0,0}$	0.288	0.008	0.372	0.011
$\sigma^2_{u(2)1,1}$	0.00182	0.00022	0.00106	0.00027
$\sigma^2_{u(2)0,1}$	-0.00683	0.00082	-0.00161	0.00105
Correlation ($\sigma^2_{u(2)0,0}/\sigma^2_{u(2)1,1}$)	-0.298		-0.081	
σ^2_e	0.355	0.007	0.480	0.009
DIC	45697.66		51551.05	
Change in DIC from model 6.1	-1224.19		-30.93	

Level 1: Occasion（i）, Classification 2: Individual, Classification 3: Ward
Source data: BHPS, waves 1998, 2003 and 2008. Total n = 9,949

Table 6.4 shows the results from models that extend model 6.2 by adding year of birth and an interaction between time and year of birth. The reduction in DIC suggests that adding year of birth improves the model fit, for the outcome of belonging to the neighbourhood, but not talking to neighbours. The interaction between time and year of birth is significant for the outcome of belonging to the neighbourhood, but not for talking to neighbours. The interaction suggests that the effects of 11 years of time have a greater positive effect for younger cohorts for the outcome of belonging to the neighbourhood. In other words, younger individuals increase their belonging more over the eleven year period, compared to older individuals, though of course older individuals already have, on average, high levels of belonging. The interaction is not significant for the outcome of talking to neighbours, and the main effect of time is substantively zero and not significant, so that older and younger individuals do not increase their likelihood of talking to neighbours over the eleven year period.

Table 6.4: Results from model 6.3, three level cross-classified models with time and year of birth

	Model 6.3: Belonging		Model 6.3: Talk	
	Est.	S.E.	Est.	S.E.
Constant (β_0)	3.654	0.011	3.597	0.012
Occasion level classification:				
Time	0.01392	0.00126	-0.00032	0.00140
Individual level classification				
YOB	-0.01053	0.00042	-0.00895	0.00049
Cross level interaction:				
Time*YOB	0.00018	0.00007	0.00024	0.00008
$\sigma^2_u{}^{(3)}$	0.139	0.009	0.120	0.010
$\sigma^2_u{}^{(2)}{}_{0,0}$	0.260	0.008	0.352	0.010
$\sigma^2_u{}^{(2)}{}_{1,1}$	0.00184	0.00024	0.00121	0.00031
$\sigma^2_u{}^{(2)}{}_{0,1}$	-0.00624	0.00080	-0.00120	0.00105
Correlation ($\sigma^2_u{}^{(2)}{}_{0,0}/\sigma^2_u{}^{(2)}{}_{1,1}$)	-0.286		-0.058	
σ^2_e	0.357	0.007	0.479	0.010
DIC	45670.51		51549.50	
Change in DIC from model 6.2	-27.15		-1.55	

Level 1: Occasion（i）, Classification 2: Individual, Classification 3: Ward
Source data: BHPS, waves 1998, 2003 and 2008. Total n = 9,949

For the outcome of belonging to the neighbourhood the average change over time is positive, while there is no average change for the outcome of talking to neighbours. The coefficient of year of birth represents age at the start of the study period and the effect size is similar for both outcomes, in that older birth cohorts have higher levels of belonging to the neighbourhood and talking to neighbours. As discussed in chapter 4, this, together with the effects of time, suggests that differences between older and younger individuals are as a result of cohort differences for the outcome of talking to neighbours, and age related differences for belonging to the neighbourhood. The coefficients for time, for both outcomes, in the three level model, as set out in table 6.3 are the same as the coefficients for time in the two level longitudinal models, as set out in table 4.4 in chapter 4. Also the coefficients for time, year of birth and the interaction between time and year of birth in the three level cross-classified models, as set out in table 6.4, are virtually identical to the coefficients in the two level longitudinal model, as in table 4.6 in chapter 4. The substantive interpretation being that the cohort and age effects observed in chapter 4 remain unchanged once ward level is introduced. Later in this chapter these coefficients are considered again, once ward level contextual variables are added to the model.

6.4 Three level cross-classified models, all main effects

Before developing the final models, all main effects of the key explanatory variables identified in previous chapters are considered in a single model, as specified by equation 14 in chapter 3. Results from this model are given in table 6.5.

Table 6.5: Results from model 6.4, three level cross-classified models with all main effects

	Model 6.4: Belonging		Model 6.4: Talk	
	Est.	S.E.	Est.	S.E.
Constant (β_0)	3.708	0.012	3.651	0.013
Occasion level classification:				
Time	0.01108	0.00135	0.00046	0.00148
Individual level classification:				
YOB	-0.00968	0.00044	-0.00750	0.00049
Household income	0.00168	0.00056	-0.00298	0.00063
Moved ward	-0.125	0.014	-0.122	0.015
Ward level classification:				
Ward Townsend	-0.03255	0.00381	-0.00526	0.00405
Ward BME	-0.00191	0.00109	-0.00215	0.00119
Ward Migration	-0.07581	0.01967	-0.09650	0.02086
Ward Density	-0.00035	0.00051	-0.00202	0.00056
$\sigma^2_u{}^{(3)}$	0.106	0.008	0.097	0.008
$\sigma^2_u{}^{(2)}{}_{0,0}$	0.254	0.008	0.346	0.010
$\sigma^2_u{}^{(2)}{}_{1,1}$	0.00170	0.00024	0.00096	0.00034
$\sigma^2_u{}^{(2)}{}_{0,1}$	-0.00612	0.00077	-0.00116	0.00104
Correlation($\sigma^2_u{}^{(2)}{}_{0,0}/\sigma^2_u{}^{(2)}{}_{1,1}$)	-0.295		-0.064	
σ^2_e	0.363	0.007	0.487	0.010
DIC	45582.04		51420.70	

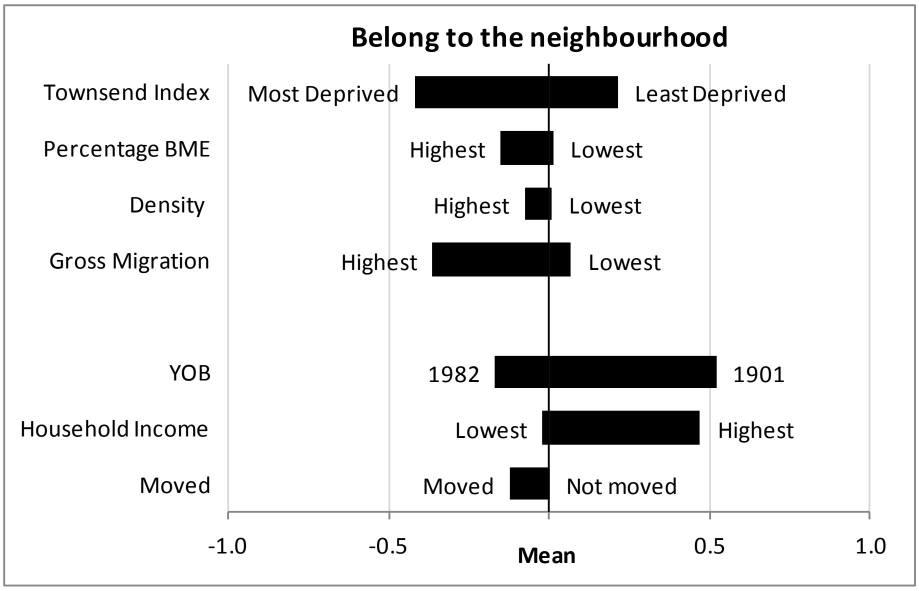
Level 1: Occasion（i）, Classification 2: Individual, Classification 3: Ward
Source data: BHPS, waves 1998, 2003 and 2008. Total n = 9,949

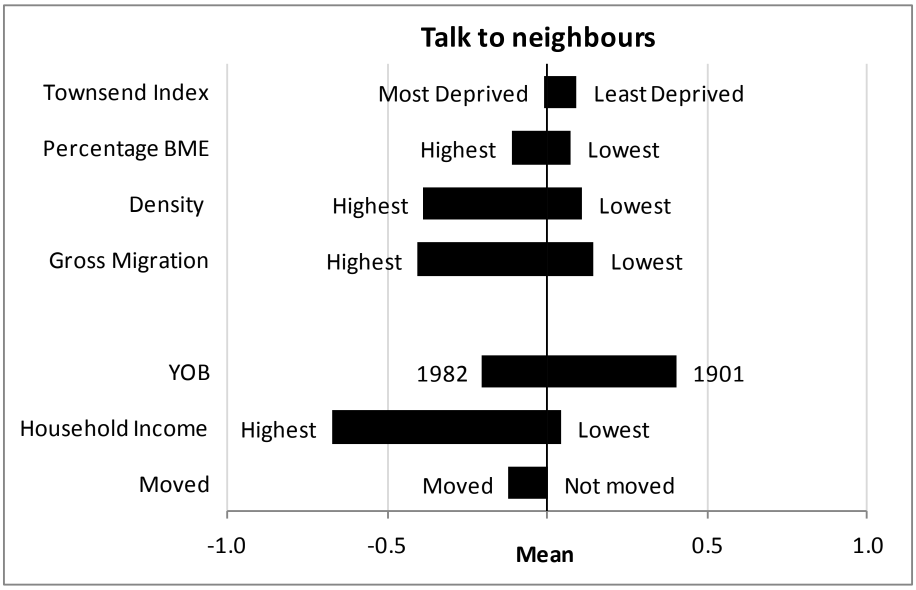
To aid the substantive interpretation of effect sizes from model 6.4 table 6.6 shows the range of explanatory variable values, and figure 6.1 illustrates the predicted outcomes for the minimum to maximum values of explanatory variables, when all other explanatory variables are at mean value.

Table 6.6: Range of explanatory variables values used in model 6.4

Range of explanatory variables used in model 6.4	Minimum	Mean	Maximum
Ward Townsend index	-5.96	0.60	13.52
Ward percentage BME	0.11	7.35	86.78
Ward density (people per hectare)	0.1	25.2	245.7
Ward gross migration (per 100 population)	0.86	1.77	6.58
Time (years of study period)	0	5	10
Year of birth	1901	1955	1982
Net household income (units of £100)	0	1,401	24,015

Figure 6.1: Range of effect sizes from model 6.4, with all main effects, for each explanatory variable, when all other explanatory variables are at mean value





The largest substantive effect for belonging to the neighbourhood is year of birth, with older individuals having higher levels of belonging. As discussed previously this difference by year of birth is understood as age related differences, reflected in the age of individuals at the start of the study period. The next largest, with a similar effect size, is ward level material deprivation where individuals in the most deprived wards have lowest levels of belonging. The third largest substantive effect on belonging to the neighbourhood is household income, with those in households with higher incomes belonging more. Due to the distribution of the household income explanatory variable those in households with the lowest incomes are only slightly lower than average, while those in households with the highest incomes have much larger differences from the average. Of the other ward level variables considered only gross migration rates had a substantively large effect, individuals in wards with lowest levels of gross migration have slightly higher levels of belonging than average. Moving ward is, on average, associated with lower levels of belonging to the neighbourhood. Though in all of the above it is important to remember that these effect sizes are when all other variables are at the mean value, and not moving is the reference category for this explanatory variable.

For the outcome of talking to neighbours the largest substantive effect is household income. In contrast to the outcome of belonging, those with lowest household income talk more to neighbours. Due to the distribution of the household income explanatory variable those in households with the lowest incomes have only slightly higher than average levels, while those in households with the highest incomes have much larger differences from the average with low levels of talking to neighbours. Year of birth is the second largest substantive effect for the outcome of talking to neighbours, and the effect size is similar to the outcome of belonging. Though, given the previous analysis of individual level change, and the effect of time for the outcome of talking to neighbours, the effects of year of birth represent cohort differences.

Of the ward level variables the largest effect, for talking to neighbours, is gross migration rate, followed closely by ward density. The effect is in the same direction as with the outcome of belonging to the neighbourhood, with individuals in wards with the highest levels of gross migration and density having lower levels of talking to neighbours, however the effect sizes are much larger.

Like the outcome of belonging the effect size of ward level ethnic diversity is small. However, unlike the outcome of belonging, the effect size of ward level material deprivation is also substantively very small for the outcome of talking to neighbours. The effect size for moving ward is similar for both outcomes, and while the coefficient for moving ward is relatively large, this is a categorical variable and so, as the effective units are one, the substantive effect is relatively small.

6.5 Final three level cross-classified models

Final models, model 6.5, were then constructed, considering a range of interaction effects in order to test the specific hypotheses under study. These models are specified as in equation 15a for the outcome of belonging to the neighbourhood, and equation 15b for the outcome of talking to neighbours. These models and equations are discussed in chapter 3.

In the previous models, model 6.4, which included all main effects, it was found that ward level ethnic diversity did not improve model fit for either outcome, and ward level material deprivation did not improve the model fit for the outcome of talking to neighbours, once all main ward and individual explanatory variables were included in the models. However in model 6.5 there is a significant interaction between ward level material deprivation and ward level ethnic diversity and so the main ward effects, and the interaction, were included in the model.

This interaction allows the testing of whether higher levels of ward level ethnic diversity leads to more positive outcomes for individuals in wards that remain materially deprived.

The cross level interaction between ward level material deprivation and household income was also introduced into model 6.5, and, as in chapter 5, this interaction improved the model fit for the outcome of belonging to the neighbourhood but not for talking to neighbours. Unlike the longitudinal models in chapter 4, it was found that the interaction between household income and moving ward improved the model fit for the outcome of belonging to the neighbourhood. Also it was found that an interaction between moving ward and ward level material deprivation led to a better model fit for the outcome of talking to neighbours.

As ward level population density did not improve the model fit for the outcome of belonging, and there were no significant interactions between this variable and any other in the model, this variable was removed for the outcome of belonging to the neighbourhood. Ward level population density remains a significant variable for the outcome of talking to neighbours.

Table 6.7 details the estimates produced from the final models, model 6.5, which includes all significant variables along with significant interactions. Diagnostics, checking the assumptions, and performance of these final models were examined. Tajectories and residuals from model 6.5, for the outcome of belonging to the neighbourhood, are given in appendix 8.

Table 6.7: Results from model 6.5, final three level cross-classified models

	Model 6.5: Belonging		Model 6.5: Talk	
	Est.	S.E.	Est.	S.E.
Constant (β_0)	3.687	0.013	3.631	0.014
Occasion level classification:				
Time	0.01212	0.00135	0.00017	0.00149
Individual level classification:				
YOB	-0.00967	0.00043	-0.00700	0.00051
Household income	0.00108	0.00063	-0.00286	0.00063
Moved ward	-0.124	0.014	-0.090	0.016
Ward level classification				
Ward Townsend	-0.03003	0.00354	0.00008	0.00428
Ward BME	-0.00604	0.00160	-0.00803	0.00176
Ward Migration	-0.07864	0.02026	-0.09410	0.02149
Ward Density			-0.00194	0.00054
Individual level interactions:				
Household income* Moved	0.00197	0.00106		
YOB* Household income			-0.00014	0.00004
YOB* Moved			-0.00467	0.00093
Ward level interactions				
Ward Townsend* Ward BME	0.00032	0.00017	0.00046	0.00018
Cross level interactions (occasion and individual levels)				
Time*YOB	0.00013	0.00007		
Cross level interactions (individual and ward levels)				
Ward Townsend* Household income	0.00025	0.00014		
Ward Townsend* Moved			-0.00905	0.00430
$\sigma^2_{u(3)}$	0.104	0.008	0.093	0.009
$\sigma^2_{u(2)0,0}$	0.252	0.008	0.344	0.010
$\sigma^2_{u(2)1,1}$	0.00166	0.00024	0.00098	0.00031
$\sigma^2_{u(2)0,1}$	-0.00608	0.00077	-0.00122	0.00102
Correlation ($\sigma^2_{u(2)0,0}/\sigma^2_{u(2)1,1}$)	-0.297		-0.066	
σ^2_e	0.364	0.007	0.487	0.010
DIC	45573.60		51402.53	

Level 1: Occasion (i), Classification 2: Individual, Classification 3: Ward
Source data: BHPS, waves 1998, 2003 and 2008. Total n = 9,949

Table 6.8 compares the variances at each level estimated from model 6.2, with time as a random effect, model 6.4, all main effects, and model 6.5, the final model. The total variance reduces slightly for both outcomes as the models develop, in the final models there is more overall variance remaining for the outcome of talking to neighbours than belonging to the neighbourhood. Also as the models develop, for both outcomes, the largest decrease in variance, in absolute terms and as a proportion of the total variance, is at level 3. In other words the variation between wards decreases as the models are built up, once ward level variables, individual level variables and significant interactions are included. In the final models 14 percent of the remaining variance is between wards for the outcome of belonging to the neighbourhood, compared to 10 percent for the outcome of talking to neighbours.

To a lesser extent the total variance at level 2, the variation between individuals also decreases in absolute terms as the models are developed, but as the overall variance decreases the proportion of the total remaining variance attributable to level 2, between person variance remains similar. The amount of level 1 variance, variance within individuals over time, actually increases slightly as the models are developed and the proportion of the remaining variance that attributable to this level also increases.

Table 6.8: The variance at each level and total variance for model 6.2, 6.4 and 6.5

	Belonging			Talk		
	Model 6.2	Model 6.4	Model 6.5	Model 6.2	Model 6.4	Model 6.5
Level 1: Ward	0.160	0.106	0.104	0.142	0.097	0.093
Level 2: Individual (total)	0.290	0.256	0.253	0.373	0.347	0.345
Level 1: Occasion	0.355	0.363	0.364	0.480	0.487	0.487
Total variance	0.805	0.725	0.722	0.995	0.931	0.925
<u>Level 2</u>						
Intercept $\sigma^2_u{}^{(2)}{}_{1,1}$	0.288	0.254	0.252	0.372	0.346	0.344
Slope $\sigma^2_u{}^{(2)}{}_{1,1}$	0.0018	0.0017	0.0008	0.0011	0.0010	0.0010
Correlation ($\sigma^2_u{}^{(2)}{}_{0,0}$ /$\sigma^2_u{}^{(2)}{}_{1,1}$)	-0.298	-0.295	-0.297	-0.081	-0.064	-0.066

Source data: BHPS, waves 1998, 2003 and 2008. Total n = 9,949

The variances reported in table 6.8 remain significant at all levels for both outcomes. However, the covariance is not significant in any model for the outcome of talking to neighbours, but is significant for all models for the outcome of belonging to the neighbourhood. Therefore variation in the random slopes at the individual level in the final model is similar for both outcomes, but the correlation between random intercepts and random slopes is only significant for the outcome of belonging. For the outcome of talking to neighbours the variation in trajectories of individuals are not correlated with the mean centred intercept. In contrast, the significant negative correlation between slopes of trajectories and mean centred intercepts suggests that those individuals with higher levels of belonging have the shallowest trajectories of change and those with the lowest levels of belonging have the steepest trajectories.

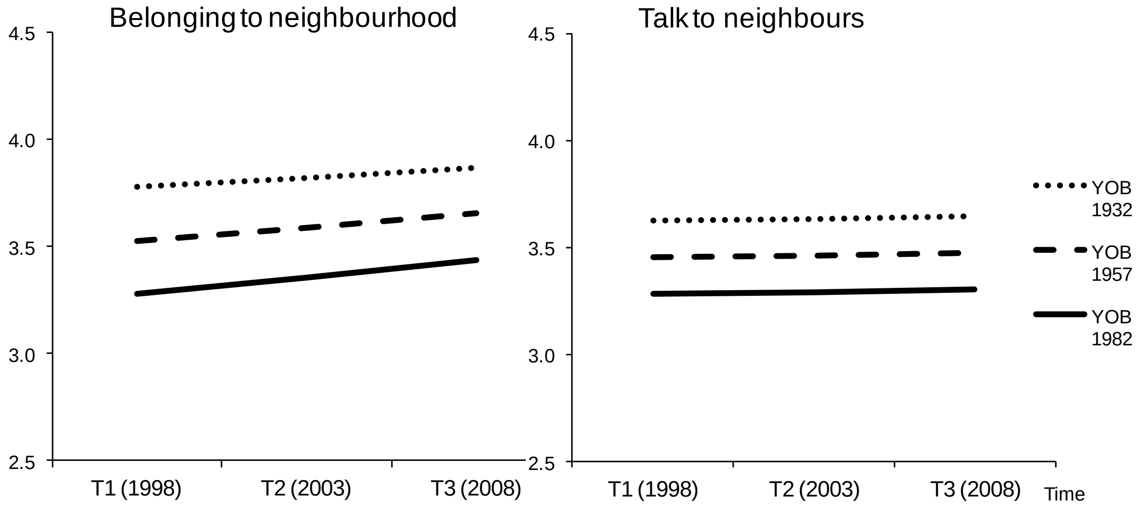
6.6 Testing hypothesis 1, whether there are cohort effects

Hypothesis 1 contests that younger cohorts will have lower levels of belonging to neighbourhoods and talking to neighbours, independent of any individual age related effects associated with life stage. Chapter 4 found evidence in support of this hypothesis for the outcome of talking to neighbours, but not for belonging to the neighbourhood. In this chapter this finding was considered in the models which also contained ward level contextual variables.

The average trajectories over time are shown in figure 6.2. This illustrates that all cohorts increased levels of belonging over time but, despite cohort differences, each cohort does not increase levels of talking to neighbours over time. The small interaction effect between time and year of birth for the outcome of belonging suggests that levels of belonging increase very slightly more for younger cohorts. But, as noted, this interaction is not significant for the outcome of talking to neighbours. Therefore trajectories of change for all cohorts are flat for talking to neighbours, and there is no increase for younger cohorts over time.

As seen earlier in this chapter, when considering models with time, year of birth and the interaction between time and year of birth, as in table 6.4, the coefficients are virtually identical to the coefficients for similar two level longitudinal models, as in table 4.6 in chapter 4. In the final models presented in this chapter, in table 6.7, the coefficients for time and year of birth have reduced very slightly, but are very similar to the two level longitudinal models without ward level contextual effects. So, once ward level context is considered, the substantive interpretation of time and year of birth effects remains the same. Therefore the conclusion is that the cohort effects for talking to neighbours, and the age effects for belonging to neighbours, found in chapter 4 remain once ward level context is considered.

Figure 6.2: Predicted values from model 6.5 by year of birth



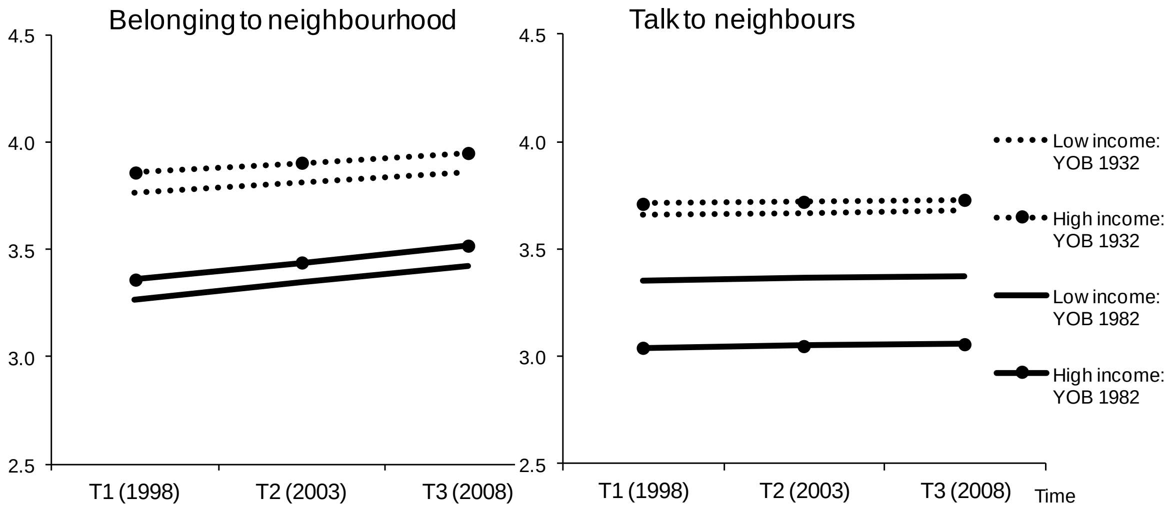
6.7 Testing hypothesis 2, whether change in outcomes over time is conditional on household income

Hypothesis 2 is that any reduction in levels of belonging to the neighbourhood and likelihood of talking to neighbours in younger cohorts, as a result of generational change, is greater for high income groups. So it is expected that lower income groups will have higher levels of belonging to the neighbourhood and likelihood of talking to neighbours. Also that, over time, more affluent groups will experience greater reductions in levels of belonging and talking to neighbours as a result of generational change. Again, this hypothesis was tested in chapter 4, where evidence was found for such conditional cohort effects for the outcome of talking to neighbours, but not belonging to the neighbourhood. Also, like hypothesis 1, the findings from this chapter, once ward level contextual variables are taken into account, are substantively the same. Figure 6.3 shows predicted values from the final three level cross-classified model, model 6.5, for different household income and cohort groups. For the outcome of belonging to the neighbourhood it can be seen that the main differences are related to year of birth. Older individuals belong to their neighbourhoods more than younger cohorts, while individuals in households with high net equivalised incomes have higher levels of belonging whether they are young or old cohorts. Though, compared to the outcome of talking to neighbours, the effect size of household income is relatively small. Crucially, in relation to hypothesis 2, there is no significant interaction between household income and year of birth for the outcome of belonging to the neighbourhood, so that the, small, effect of household income is the same for all cohorts.

Compared to model 6.4, which includes all main effects without interactions, the main effect of household income for the outcome of belonging to the neighbourhood reduces in model 6.5, once interactions between household income and moving ward, and between ward level material deprivation and household income, are considered. So the main effect of household income is not significant, but the effect is conditional, depending on ward level material deprivation and mobility between wards. This is considered more in the next section which considers evidence for hypothesis 3.

For the outcome of talking to neighbours the main effect of household income remains significant, those in households with lower incomes are more likely to talk to neighbours. However there is an interaction between year of birth and household income. The size of these effects for this outcome are similar to those obtained in the two level longitudinal models presented in chapter 4. Therefore the results from this chapter provide further support for hypothesis 2 for the outcome of talking to neighbours. As shown in figure 6.3, those that talk most to neighbours are older cohorts. Younger cohorts are less likely to talk to neighbours, but particularly younger more affluent cohorts. Put another way, the observed cohort differences in talking to neighbours are greater for high income groups, compared to low income groups.

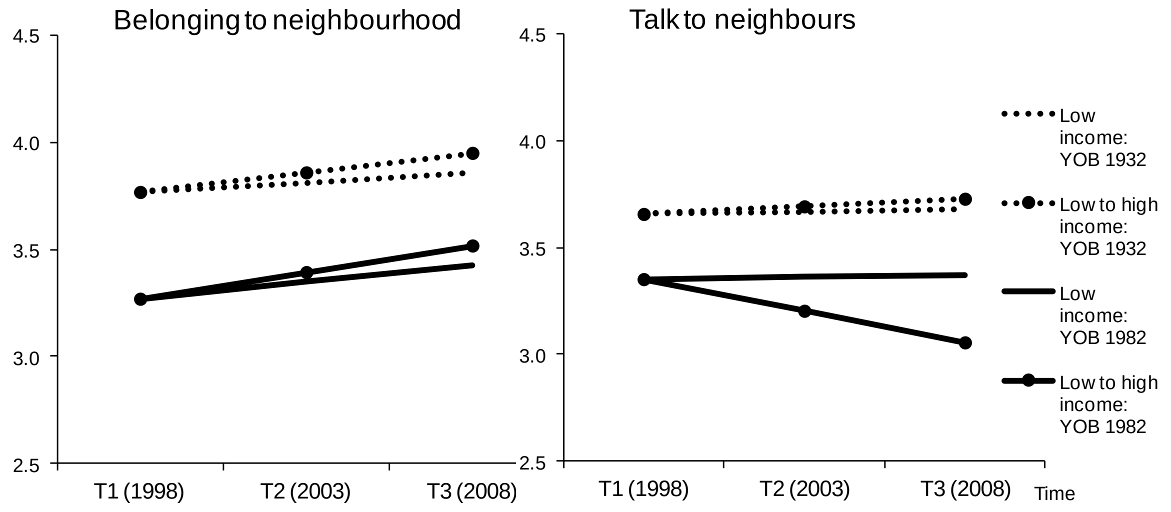
Figure 6.3: Predicted values from model 6.5 by net equivalised household income and year of birth



(Low household income £200 per month, high household income £10,000 per month)

Figure 6.4 underlines this, by predicting the outcomes for individuals who are in low income households (net equivalised income of £200 per month), comparing those that remain low income against those that increase household income (to a high level of £10,000 per month).

Figure 6.4: Predicted values from model 6.5 by change in net equivalised household income and year of birth



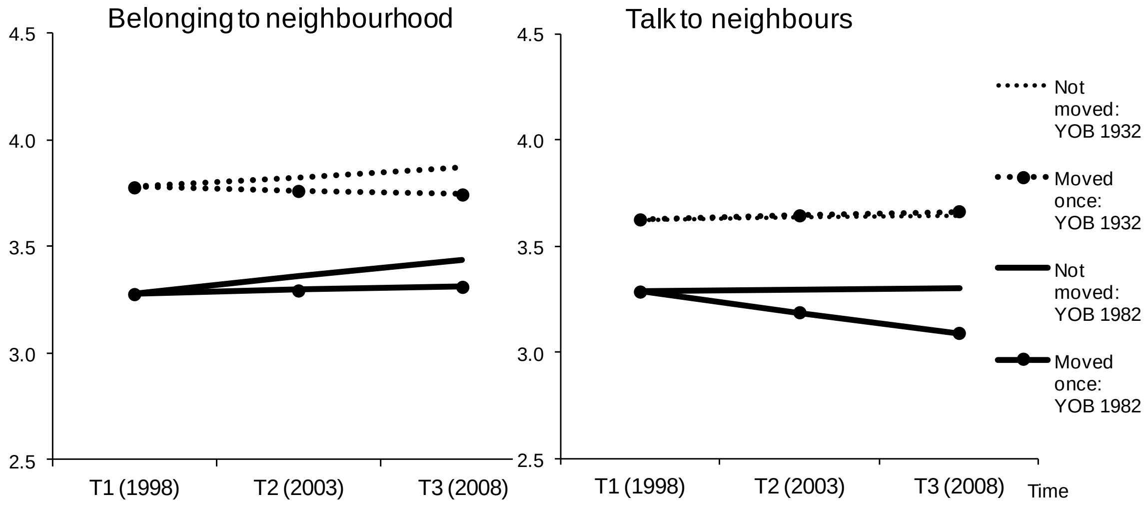
(Low household income £200 per month, high household income £10,000 per month)

For the outcome of talking to neighbours it can be seen that those that remain in low income households do not decrease in predicted outcomes, but those that experience an increase in household income over the period are predicted to decrease levels of talking to neighbours. For the outcome of belonging to the neighbourhood, both older and younger cohorts in low income households increase levels of belonging. If individuals experience an increase in household income over the period, the rate of increase in belonging is a little steeper.

6.8 Testing hypotheses 3, the effects of individual mobility, and lack of mobility, between wards, in the context of household income and ward level material deprivation

Hypothesis 3 contends that remaining in materially deprived neighbourhoods, or moving into materially deprived neighbourhoods, will act to reduce levels of belonging to neighbourhoods and talking to neighbours for low income groups. To test this hypothesis the main effects of individual mobility between wards are considered along with the conditional effects of being in a low income household, in wards with high material deprivation. The results from the models presented in this, and previous chapters, consistently show that the main effect of individual mobility between neighbourhoods is negative for both outcomes. Figure 6.5 demonstrates predicted outcomes comparing the trajectories over time for those that do not move ward in the study period and those that moved once in the study period by year of birth. For the outcome of belonging to the neighbourhood it can be seen that moving ward in the study periods leads to levels of belonging remaining the same over the period, while those that do not move ward increased levels of belonging over the period, and this effect is the same for all cohorts. For the outcome of talking to neighbours there is a significant interaction in the final model between individual mobility between neighbourhoods and year of birth, this interaction means that for every year above the average year of birth the effects of moving ward are less negative. The predicted outcomes in figure 6.5 show that individual mobility has little effect on the oldest cohorts and a large negative effect on younger cohorts.

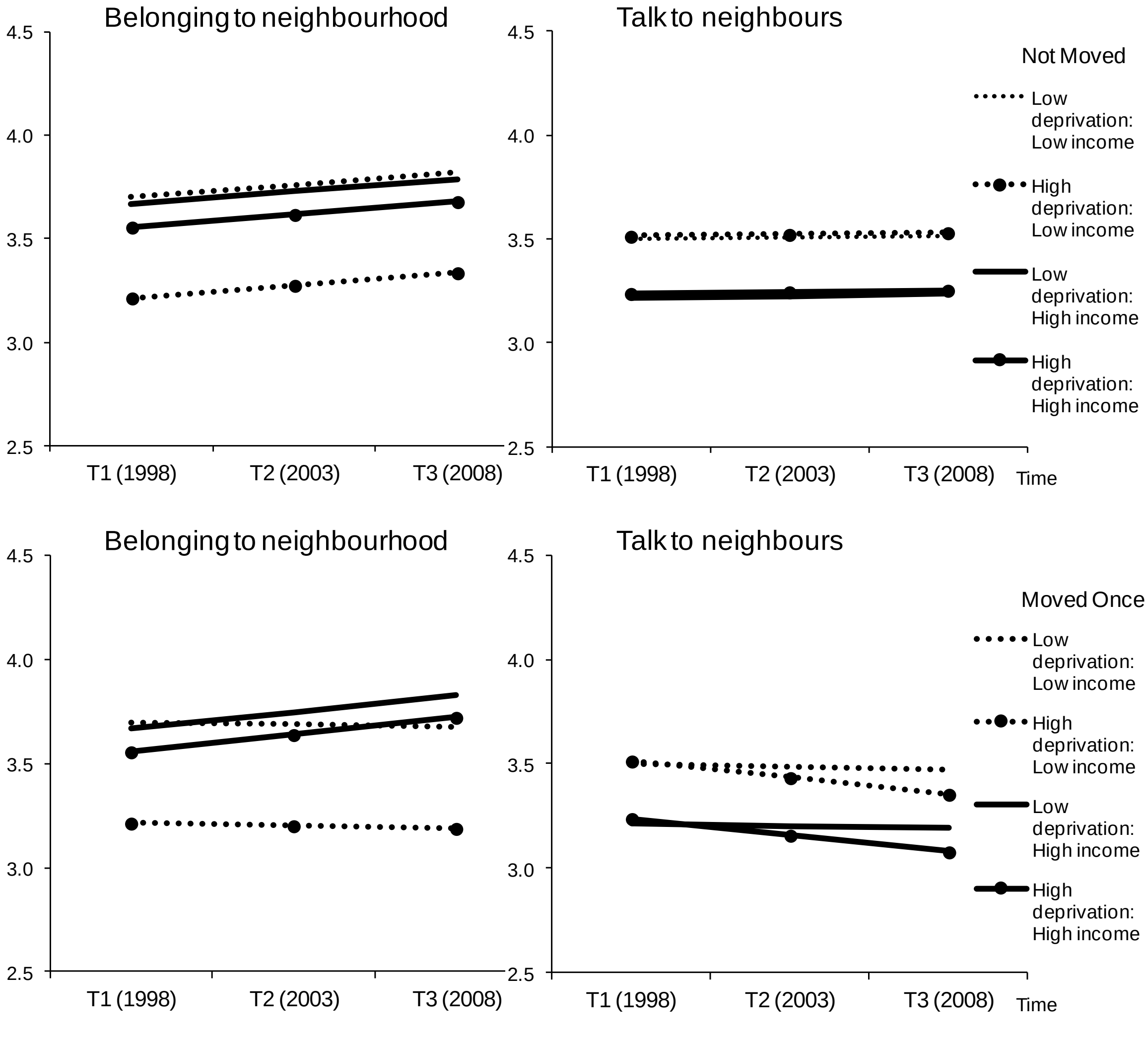
Figure 6.5: Predicted values from model 6.5 by individual mobility and year of birth



In models 6.5 interactions between individual mobility, household income and ward level material deprivation are considered in order to test whether the effect of moving between wards varies for different income groups in wards with differing levels of deprivation. For the outcome of belonging to the neighbourhood there is a significant interaction between individual mobility and household income. This interaction suggests that the negative effects of moving ward on levels of belonging are less negative for those in households with higher incomes. In other words, moving between neighbourhoods reduces belonging to the neighbourhood, but this applies to low income groups, for higher income groups there is not such a reduction in belonging associated with moving neighbourhoods. For the outcome of talking to neighbours there is a significant interaction between ward level material deprivation and individual mobility. This interaction suggests that moving wards reduces the level of individuals talking to neighbours more if this movement between wards results in a move to a more materially deprived ward. Conversely the reduction in individuals talking to neighbours associated with moving ward is less when individuals move to wards with lower levels of material deprivation. These relationships are considered in more detail below, with a series of predicted outcomes for individuals in low and high income households, in wards with high and low material deprivation, and who move, or do not move ward.

Figure 6.6 illustrates predicted values for individuals in wards with high and low levels of material deprivation (Townsend scores of 10 and -5, respectively), and high and low levels of equivalised net household income (£10,000 and £200 a month, respectively). The predicted values shown are for those individuals who do not move ward in the study period and those that have moved ward once in the study period. For those that moved ward these predicted values relate to a move to a ward with the same level of material deprivation, moves that lead to a change in ward level material deprivation will be considered next.

Figure 6.6: Predicted values from model 6.5 by level of ward deprivation, net equivalised household income, and whether moved ward in the period



(Low ward deprivation = Townsend score minus 5, high ward deprivation = Townsend score 10.)
(Low household income £200 per month, high household income £10,000 per month)

For the outcome of belonging to the neighbourhood, for individuals who have not moved ward in the study period, outcomes are most positive for those in wards with the lowest levels of material deprivation. This is the case for those in households with low income as much as it is for individuals in households with high incomes, therefore all income groups have high levels of belonging to neighbourhoods in neighbourhoods that are not materially deprived. The significant interaction effect, for this outcome, between ward level material deprivation and household income means that in wards with high levels of material deprivation those in households with high incomes have considerably higher levels of belonging than those in households with low levels of income. Therefore the group reporting the lowest levels of belonging to the neighbourhood are those in households with low income in wards with high levels of material deprivation, while those in households with high levels of income report only slightly lower levels of belonging when in wards with high material deprivation compared to wards with low material deprivation. In other words, the negative effects of ward level material deprivation are more negative for those in households with low income. The association between moving ward and belonging to the neighbourhood depends upon household income. If individuals in high income households move ward, then it doesn't lead to a decrease in belonging, and this is true for individuals in wards with high and low levels of material deprivation. Again this reflects a significant interaction effect in the final model for this outcome, whereby the negative effects of moving are less negative for those in households with high income and more negative for individuals in households with low income. So for those in households with high income it does not matter so much if they move within wards with high or low deprivation, they will continue to increase levels of belonging to the neighbourhood over the study period, however if individuals in households with low income move ward during the study period then their levels of belonging to the neighbourhood decrease over the study period.

In figure 6.3, which illustrates predicted values for different cohorts in households with low and high incomes, it was seen that the main effects of household income were small for the outcome of belonging to the neighbourhood for all cohorts. Figure 6.6 demonstrates that there is a larger effect of household income on the outcome of belonging but only for those in wards with high levels of material deprivation. Individuals in households with low incomes only have lower levels of belonging if they are in wards with high levels of material deprivation.

For the outcome of talking to neighbours, for individuals who do not move ward during the study period there is no difference by ward level material deprivation, only by household income. Those individuals in households with low incomes are more likely to talk to neighbours compared to those in households with high incomes, no matter the level of ward deprivation. Also all groups have flat trajectories over time, these household income differences do not lead to different trajectories. For those that moved ward once in the study period likelihood of talking to neighbours decreases slightly. This slight decrease is the same for all levels of ward material deprivation.

So far the analysis has considered the effects of moving within wards with the same levels of material deprivation, however it is also worth considering the effect of changes to the ward level material deprivation as a result of moving ward. It should be noted that change to ward level variables is much more likely for individuals that move ward, compared to individuals who do not, as shown in figure 6.7.

Figure 6.7: Change in ward level variables for individuals that moved ward and those that do not

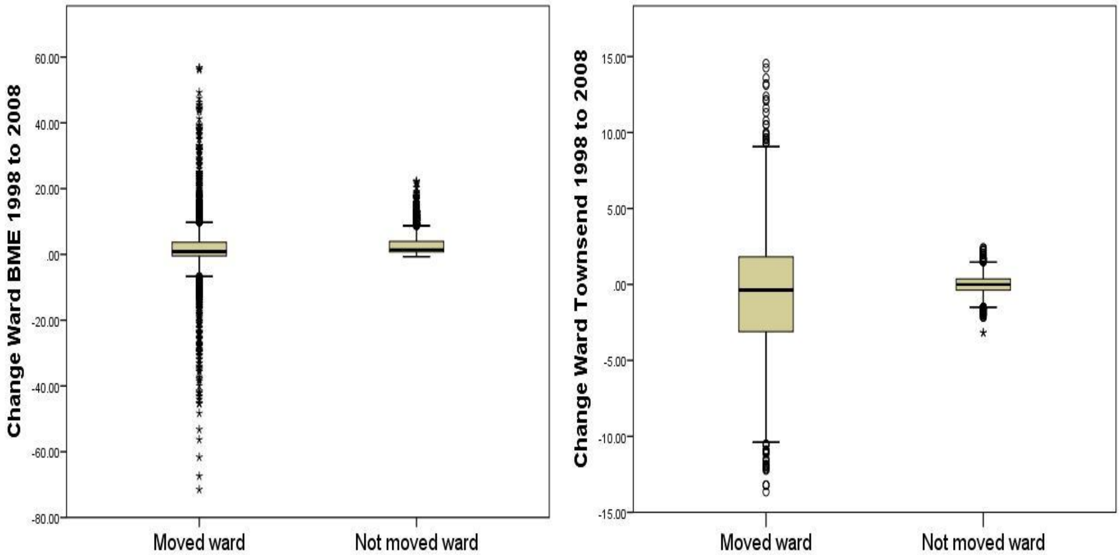
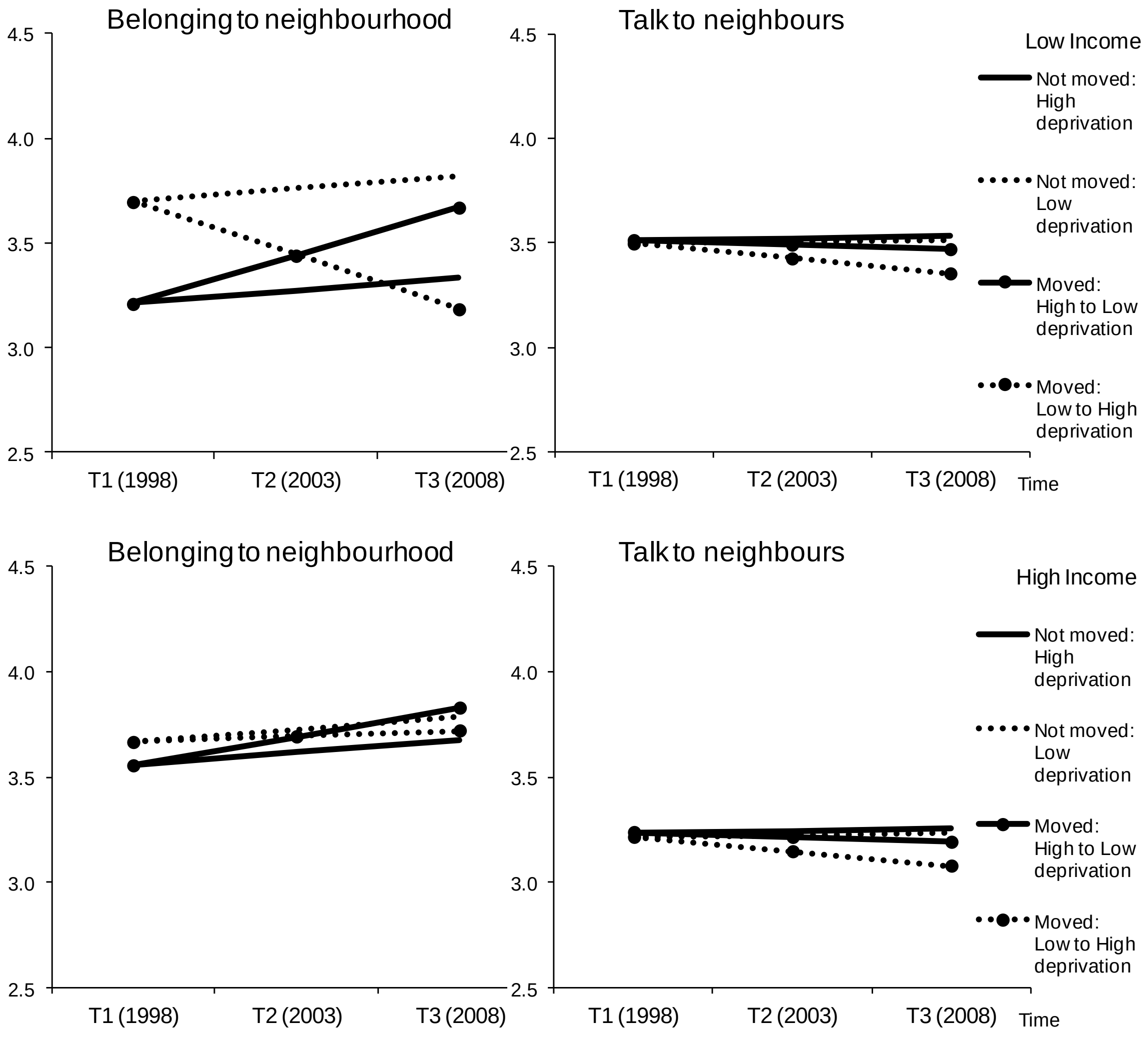


Figure 6.8 illustrates predicted outcomes for those who remain in wards with high and low levels of material deprivation, compared to those who move ward and who experience a change in the ward level material deprivation as a result. Predicted outcomes are shown for individuals in households with low and high incomes.

Figure 6.8: Predicted values from model 6.5 by values from final models by level of ward deprivation, net equivalised household income, and whether moved ward in the period and changed ward level material deprivation as a result



(Low ward deprivation = Townsend score minus 5, high ward deprivation = Townsend score 10.)
(Low household income £200 per month, high household income £10,000 per month)

From figure 6.8 it can be seen that the substantive effects of moving ward are greatest for the outcome of belonging to the neighbourhood for those individuals in households with low incomes. Indeed, for individuals in households with high levels of income the effects associated with moving ward on the outcome of belonging to the neighbourhood are very small. Also the effects of moving ward are very small for all income groups for the outcome of talking to neighbours. So, for the outcome of belonging to the neighbourhood, for individuals in households with low income, those that moved once in the study period from wards with low levels of material deprivation to wards with high levels of material deprivation experience a relatively large reduction in levels of belonging to the neighbourhood. Those, in households with low incomes, who remain in wards with high levels of material deprivation continue to have low levels of belonging, however if individuals in low income households move to wards with low levels of material deprivation then levels of belonging to the neighbourhood increase more over the study period. For individuals in households with high income there is little effect of moving ward, even when this results in a change in ward level material deprivation. For the outcome of talking to neighbours it can be seen that individuals in high and low household incomes have similar trajectories, while outcomes are overall lower for individuals in high income households. For this outcome moving ward, and changing levels of ward deprivation as a result, makes little difference to the likelihood of talking to neighbours over the period. Those who move from wards with low levels of material derivation to wards with high levels of material deprivation have the largest reduction in talking to neighbours over the period, this is the case whether individuals are in households with high or low income, but the effect size is substantively small.

Therefore, in general, the main effects of individual mobility between neighbourhoods can be understood as being negative on average for both outcomes. Those that move between wards generally have lower levels of belonging and lower levels of talking to neighbours compared to those that do not. However the effects of moving ward are substantively very small for the outcome of talking to neighbours, and for the outcome of belonging to the neighbourhood the effects are conditional, dependent upon household income and ward level material deprivation.

Moving ward has the greatest effect, by far, on levels of belonging to the neighbourhood, but only for individuals in households with low incomes. However, it is also the case that not moving ward, remaining in wards with high levels of material deprivation results in lower levels of belonging to the neighbourhood. Individuals in households with low incomes who move from wards with high levels of deprivation to wards with low levels of deprivation report relatively large increases in belonging to the neighbourhood. Therefore it is individuals in households with low incomes who either remain in wards with high deprivation, move within wards with high deprivation or move to wards with higher deprivation that have lower levels of belonging to the neighbourhood. For individuals in households with high incomes there is little effect of moving ward, or of ward level material deprivation, on individual belonging to the neighbourhood.

6.9 Testing hypothesis 4: the effects of ward level ethnic diversity

Hypothesis 4 contends that, after controlling for other neighbourhood level variables, higher levels of, or increases in, neighbourhood ethnic diversity are associated with higher levels of individual belonging to neighbourhoods and talking to neighbours.

As seen in figure 6.1, which illustrates the effect sizes of ward level variables, taking into account the range of values in these explanatory variables, once all ward level main effects are considered, as in model 6.4, the substantive size of the effect of ward level ethnic diversity is very small. Indeed removing ward level ethnic diversity from model 6.4 leads to a better model fit for both outcomes. Table 6.9 illustrates what happens to the size of the coefficient for ward level ethnic diversity when considered in a model as the only ward level variables, when considered in a model alongside ward level material deprivation, and when considered along with all main ward level effects, as in model 6.4. The coefficient represents the negative effects on both outcomes for each one percentage point increase in the ethnic minority population above the overall mean ward level. When considered alone this variables does improve the model fit, with increasing ward level ethnic diversity leading to more negative individual level outcomes. However once ward level material deprivation is introduced the size of this coefficient greatly reduces and once all ward level variables are considered together the effects of ward level ethnic diversity are no longer large enough to improve the model fit.

Table 6.9: Comparison of coefficient for Ward level ethnic diversity in models considering this effect in isolation and with other ward level variables

	Belong		Talk	
Model	Est.	S.E.	Est.	S.E.
Ward BME	-0.0087	0.0008	-0.0083	0.0009
Ward BME and Ward Townsend	-0.0022	0.0010	-0.0051	0.0011
All Ward variables (Model 6.4)	-0.0019	0.0011	-0.0022	0.0012

All models also with YOB, household income and whether moved ward.
All variables mean centred.

In model 6.4, with all main effects, there is no evidence to support the hypothesis that increased levels of ethnic diversity lead to more positive outcomes for individuals. In order to further investigate this hypothesis a number of interactions were considered, in the final model, model 6.5. For both outcomes there was a significant interaction between ward level ethnic diversity and ward level material deprivation. Therefore the main effect of ward level ethnic diversity is retained in the final models, model 6.5. The interpretation of such interactions, in the context of main effects, provides further evidence in relation to hypothesis 4.

Table 6.10 shows the estimated coefficients for the main ward level effects of material deprivation and ethnic diversity and the interaction effect. For the outcome of belonging the main effect of ward level ethnic diversity has now increased and is negative, however the interaction suggests that in wards with higher than average material deprivation the effects of increasing ethnic diversity are less negative. For the outcome of talking to neighbours the main effect of ward level material deprivation is no longer significant, however the interaction again suggests that in wards with higher than average material deprivation the effects of increasing ethnic diversity are less negative.

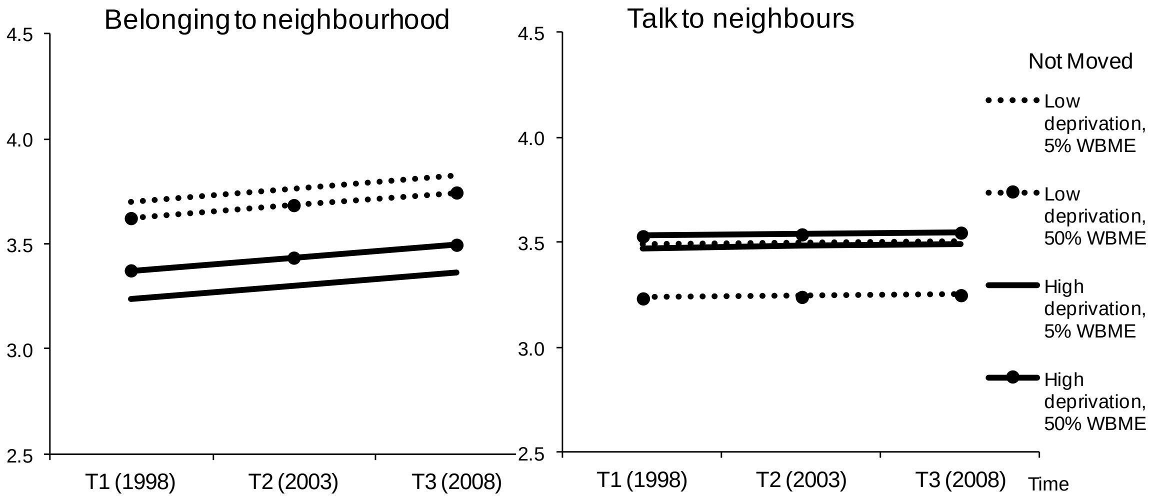
Table 6.10: Final model, model 6.5, Ward Townsend, Ward BME and interaction estimated coefficients

	Belong		Talk	
Model	Est.	S.E.	Est.	S.E.
Ward BME	-0.0060	0.0016	-0.0080	0.0018
Ward Townsend	-0.0300	0.0035	0.0001	0.0043
Ward Townsend * Ward BME	0.00032	0.00017	0.00046	0.00018

All variables mean centred.
Source data: BHPS, waves 1998, 2003 and 2008. Total n = 9,949

Figure 6.9 illustrates predicted outcomes for individuals in wards with high and low levels of material deprivation (Townsend score of 10 and -5 respectively), and with different levels of ethnic diversity.

Figure 6.9: Predicted values from model 6.5 by level of ward deprivation (high = 10, low = -5) and ward level ethnic diversity



(Low ward deprivation = Townsend score minus 5, high ward deprivation = Townsend score 10.)

From figure 6.9 it can be seen that all groups have increasing levels of belonging over time. The main effect size, for belonging, is ward level material deprivation, those in the most deprived wards have less positive outcomes. A key finding is that, due to the interaction effect, those in more materially deprived wards have higher levels of belonging in wards that have high ethnic diversity, compared to those in wards with high material deprivation and low levels of ethnic diversity. For those in the least material deprived wards the situation is reversed, with high levels of ethnic diversity leading to lower levels of belonging. It should be noted that the effect sizes for differences in ward level ethnic diversity are small. For the outcome of talking to neighbours there is a similar interaction effect between ward level material deprivation and ward level ethnic diversity. However, along with the main effects, this leads to small differences in predicted outcomes for those in the most materially deprived wards, where higher levels of ethnic diversity leads to very slightly higher levels of talking to neighbours compared to deprived wards with low levels of ethnic diversity. The effects of ethnic diversity vary more for less materially deprived wards, with high levels of ethnic diversity having a more negative effect in less deprived wards. Indeed it is only wards with low levels of material deprivation and high levels of ethnic diversity that have lower levels of talking to neighbours.

Therefore there is some evidence that in wards with high levels of material deprivation outcomes are more positive for wards that are also ethnically diverse, compared to deprived wards that have low levels of ethnic diversity. This difference is more noticeable for the outcome of belonging and substantively very small for the outcome of talking to neighbours. The models also predict negative effects of ward level ethnic diversity in the least deprived wards. However, as discussed in chapter 5, there is a particular relationship between material deprivation and ethnic diversity in the population of wards in England. Wards with high levels of ethnic diversity and low levels of material deprivation do not exist in the population of wards, or more precisely, the population of wards in the study period. Wards with high levels of ethnic diversity tend to be in wards with high levels of material deprivation, but wards with high levels of material deprivation were found to have both high and low levels of ethnic diversity. In terms of a substantive interpretation, the effects of ward level ethnic diversity are best understood in relation to materially deprived wards.

Also the ward level effects can be understood in terms of change. As well as the relationship between ward level material deprivation and ethnic diversity discussed above, it was also found that ward level material deprivation remained fairly constant over time, while wards with increased ethnic diversity over the period were also wards with predominantly high levels of material deprivation. Therefore the analysis considers whether living in wards with high levels of material deprivation and low levels of ethnic diversity leads to lower levels of belonging to neighbourhoods and talking to neighbours, compared to living in wards with high levels of material deprivation that experience increased ethnic diversity. In doing so it is also necessary to consider individual mobility, as this is related to experience of change in ward type.

As seen, the likelihood of an individual experiencing a change in ward level variables is greater for those that change ward through individual mobility. The relationship between change in ward level ethnic diversity, individual mobility and ward level material deprivation is illustrated in table 6.11. Here the relationship between ward level material deprivation and change in ward level ethnic diversity is considered by whether the change is a result of ward level change or the individual changing wards. Level of ward deprivation are grouped into quintiles, and change in ward deprivation for those that move is grouped into decreased deprivation (decrease of two or more quintiles), increased deprivation (increase of two or more quintiles) and little change (same quintile or change to adjacent quintile). Change in ward level ethnic diversity has been grouped into decrease (decrease of five percentage points or more), increase (increase of five percentage points or more) and no/ small change (no change or change of less than five percentage points).

By and large it is only those in the most deprived wards, or those that move ward, who experience of change in ward level ethnic diversity. Those that do not move are not likely to see much of an increase in ward level ethnic diversity unless they are in more materially deprived wards at time point 1. If individuals do move then they are likely to experience an increase in ward level ethnic diversity if they move to more deprived wards.

Table 6.11: Individual experience of change in ward level ethnic diversity by ward level material deprivation and individual mobility between wards

Not moved ward Ward deprivation at T1	Decrease	change in ward BME No/ small change	Increase	Total n (100%)
1: least deprived		99.6%	0.4%	1674
2		98.5%	1.5%	1610
3		95.3%	4.7%	1672
4		91.9%	8.1%	1575
5: most deprived		67.2%	32.8%	1397

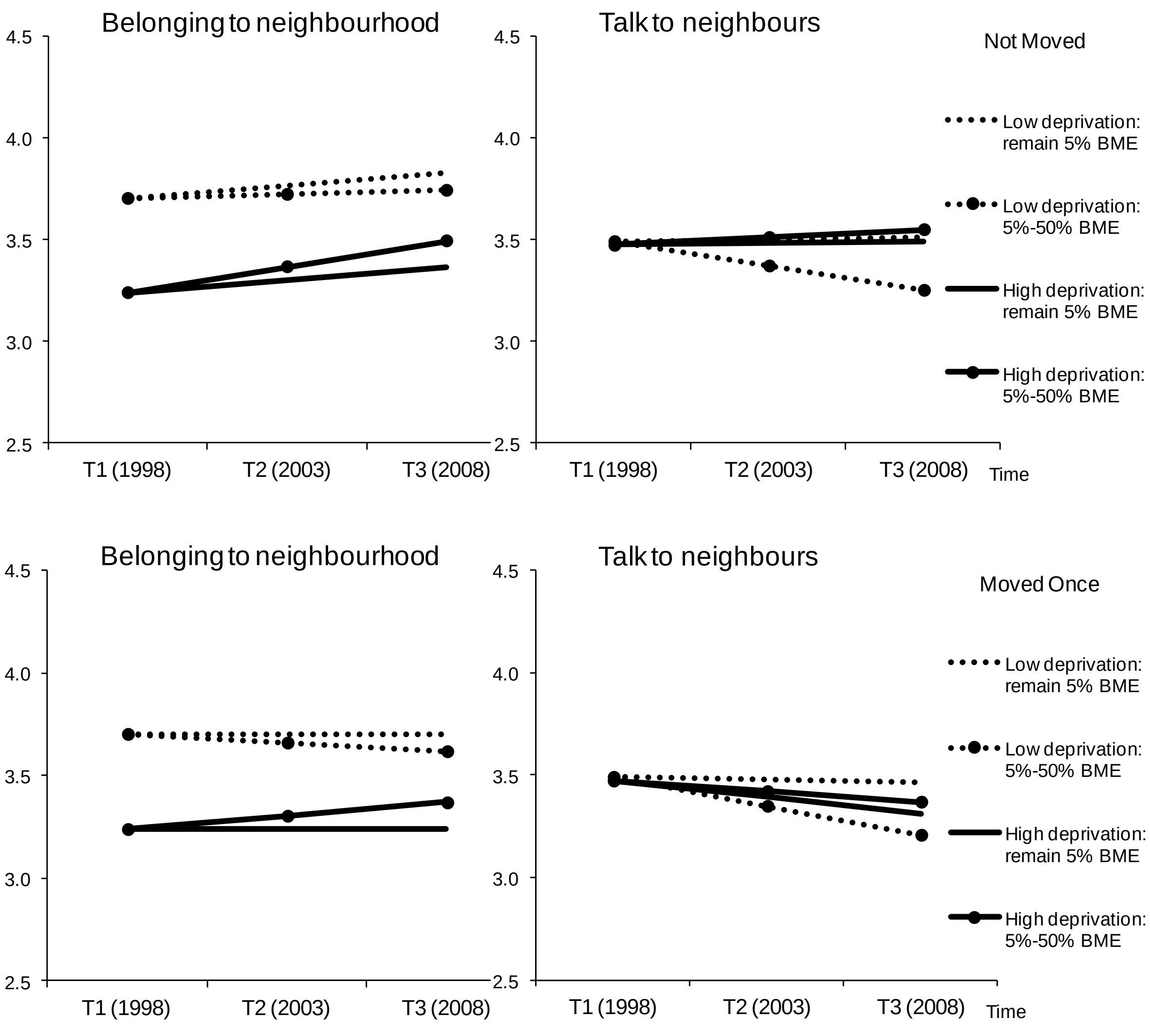
Moved ward Change ward deprivation	Decrease	change in ward BME No/ small change	Increase	Total n (100%)
Decreased deprivation	33.7%	64.8%	1.5%	472
Little change	13.9%	71.9%	15.0%	1472
Increased deprivation	0.6%	66.0%	33.4%	350

Source data: BHPS, waves 1998, 2003 and 2008. Total n = 9,949

Therefore it is important to consider change in ward level variables along with the effects of individual mobility between wards. Figure 6.10 shows predicted outcomes for individuals in wards with low levels of ethnic diversity that remain so over the period compared to wards that increase levels of ethnic diversity over the period. For illustrative purposes large increases are presented, and the effects are considered for wards with high levels of material deprivation (Townsend score of 10) and wards with low levels of material deprivation (Townsend score of -5). For the outcome of belonging the effects of increased ethnic diversity are positive for those in the most deprived wards and, to a lesser extent, negative in the least deprived wards. While there is a general negative effect of individual mobility the relationship between ward level deprivation and change in ward level ethnic diversity is the same whether individuals have moved ward or not.

For the outcome of talking to neighbours, for those that do not move ward, there is no effect of increased ethnic diversity apart from in the least materially deprived wards, and as discussed, these are wards that do not exist in the population of wards during the study period. For this outcome figure 6.10 illustrates that moving ward also has a general negative effect, however the interaction between individual mobility and ward level material deprivation means that the negative effects of moving ward are more negative in more materially derived wards and less negative in the least materially deprived wards.

Figure 6.10: Predicted values from model 6.5 by level of ward deprivation (high = 10, low = -5) and ward level ethnic diversity, and whether moved ward in the period



(Low ward deprivation = Townsend score minus 5, high ward deprivation = Townsend score 10.)

6.10 Conclusions

This chapter aimed to build upon the previous empirical analysis presented in this thesis, by bringing together the longitudinal analysis presented in chapter 4, with the multilevel contextual analysis presented in chapter 5. The key objectives were, first, to consider whether the age and cohort effects found in chapter 4 remained once ward level context, then to fully address hypothesis 3, regarding the effects of moving ward in relation to household income and ward level material deprivation. Finally hypothesis 4, which is examined in chapter 5, is considered again in the context of change in ward context and individual mobility over time.

There are some challenges in developing the models required for the analysis presented in this chapter, the issues involved and the approach taken is set out in chapter 3. In short, the cross-classified models developed are capable of accommodating the imperfect hierarchies that arise from the dynamic nature of the data, where individuals can be nested within different wards at different time points. The cross-classified models, allow for this imperfect hierarchy caused by individual mobility, and, in doing so, enable the effects of mobility between wards and any resulting change in ward context to be considered.

Once the cross-classified models have been correctly specified this chapter then considered all main effects of variables considered in the two previous chapters, for the first time within a single model. For the outcome of belonging the largest substantive effect is age, with individuals increasing their levels of belonging to neighbourhoods as they get older. Ward level material deprivation has an equally large substantive effect on belonging to the neighbourhood, with lower belonging in wards with higher levels of material deprivation. There was no main effect of ward level ethnic diversity once other contextual variables were controlled for. Household income also has a relatively large substantive effect, with individuals in households with higher incomes having higher levels of belonging to the neighbourhood. For the outcome of talking to neighbours the largest substantive effects were cohort and household income. Older cohorts had higher levels of talking to neighbours than younger cohorts, particularly younger cohorts in household with high incomes. The effects of household income are similar in size for both outcomes, but in opposite directions. Those in households with high incomes belong more to the neighbourhood and talk less to neighbours. The average substantive effect of moving ward was relatively small for both outcomes.

Having established the main effects of contextual and individual level variables this chapter then developed final models that included a number of interaction terms specifically designed to test the hypotheses under study. Findings for each hypothesis were presented and discussed, these findings were illustrated with a range of predicted values for individuals in different situations. As this discussion was in-depth, and because in the next chapter overall conclusions from this thesis are considered for each hypothesis in turn, there is no need to repeat the detailed discussion of the findings here. In general though, in terms of the objectives of this chapter, it was found that the age and cohort effects, observed in the longitudinal models presented in chapter 4, remain once ward level context is taken into account. Therefore this chapter provides further evidence in support of hypothesis 1 for the outcome of talking to neighbours and, like previous analysis, finds no support for this hypothesis for the outcome of belonging to the neighbourhood. Older individuals talk more to neighbours as a result of cohort differences, while older individuals belong more to their neighbourhood as a result of belonging increasing as individuals age. This chapter also reinforced the previous findings regarding hypothesis 2. The cohort effects observed for the outcome of talking to neighbours were greater for higher income groups. Younger cohorts talk less to neighbours, but this is particularly so for high income younger cohorts, lower income groups experience less cohort change.

Hypothesis 3 contends that remaining in materially deprived neighbourhoods, or moving into materially deprived neighbourhoods, will act to reduce levels of belonging to neighbourhoods and talking to neighbours for low income groups. Previous chapters have only been able to partially address this hypothesis, the strength of the cross-classified models is that they can directly test hypothesis 3. Evidence was found to support this hypothesis for the outcome of belonging to the neighbourhood, but not for talking to neighbours. Individuals in low income households have lower levels of belonging to the neighbourhood, but only in wards with high material deprivation, while individuals in households with high incomes have higher levels of belonging regardless of the level of ward material deprivation. Therefore in wards with high material deprivation it is only low income groups that have lower levels of belonging, there is no negative effect on belonging for high income groups. Moving between wards does not reduce belonging for high income groups, and only reduces belonging for low income groups if the move results in staying in, or moving to wards with high material deprivation. For the outcome of talking to neighbours moving ward, and ward level material deprivation makes little difference, low income groups talk more to neighbours in all situations.

Finally this chapter considers hypothesis 4, that, after controlling for other neighbourhood level variables, higher levels of, or increases in, neighbourhood ethnic diversity are associated with higher levels of individual belonging to neighbourhoods and talking to neighbours, when compared to individuals in neighbourhoods that are not ethnically diverse, or do not experience an increase in neighbourhood ethnic diversity. This hypothesis was first tested in chapter 5, this chapter investigates this hypothesis again; the strength of the cross-classified models is that they enable this hypothesis to be examined taking into account change in ward context, and individual mobility between wards. The analysis in this chapter also considered those who are likely to experience change in ward level ethnic diversity, in relation to individual mobility and ward level material deprivation. The findings provide further evidence in support of this hypothesis, particularly the outcome of belonging to the neighbourhood. Those in wards with high material deprivation, or those that move into such wards, are most likely to experience increased ward level ethnic diversity. Crucially it is in these situations that individuals have higher levels of belonging and talking to neighbours, though the effect size for ethnic diversity is small.

In the following chapter conclusions are drawn together, and the evidence for each hypothesis considered in detail, bringing together findings from this and the previous two empirical chapters.

Chapter 7 Conclusions

7.1 Overview

The central aim of this thesis was to contribute towards the understanding of relationships between individuals and the neighbourhoods in which they live, and to consider ways in which such relationships change over time.

Within the social sciences there are longstanding concerns with the impact that modernity, globalisation and individualisation have on individual attachment to neighbourhoods and on neighbourhood based communities (Wirth 1938, Gans 1968 Relph 1976, Harvey 1982, Bauman 2001, Beck & Beck-Gernsheim 2002). There are strong arguments to suggest that individuals have transcended local place, and local place based communities (Nagel 1986, Entriken 1991, Coleman 1993, Szerszynski & Urry 2006), though it may be that this applies to more affluent individuals, with the poorest remaining localised (Massey 1991, Bauman 1998a, Castells: 1996, 1997, 1998). More recently it has been suggested that neighbourhood context is important (Wilson 1987, Gieryn 2000, van Ham et al 2012), and that increased ethnic diversity leads to weakened individual attachment to neighbourhoods and decreased interaction between individuals within neighbourhoods (Putnam 2007).

The research questions addressed in this thesis were about process and neighbourhood context. Are the processes associated with modernity, globalisation and individualisation leading to reduced individual belonging to neighbourhoods and likelihood of talking to neighbours? Does neighbourhood context, and change to neighbourhood context, have an independent effect on individual levels of belonging to neighbourhoods and likelihood of talking to neighbours? What role does individual mobility play? Does individual mobility lead to reduced belonging to neighbourhoods and likelihood of talking to neighbours, or are any associations with individual mobility dependent upon individual circumstances and neighbourhood context?

7.2 Summary of findings, contribution to knowledge and potential areas for future research

7.2.1 Evidence for the existence of generational change

This thesis addressed the fundamental question of generational change. If modernity, the processes of globalisation and individualisation are leading to weakened relationships between individuals and the neighbourhoods in which they live (Harvey 1982, Bauman 2001, Beck & Beck-Gernsheim 2002), then such generational change would lead to observable cohort differences. It would be expected that levels of belonging to the neighbourhood and talking to neighbours would decline with successive birth cohorts. It has been suggested that any such change is dependent upon individual socio-economic status, with poorer individuals remaining more localised (Massey 1991, Bauman 1998a, Castells: 1996, 1997, 1998).

Despite the longstanding concerns about the ways in which structural processes may have changed individual relationships with neighbourhood, weakening individual belonging to neighbourhoods and diminishing communities, there is little empirical evidence to support such theories. Largely this is due to a lack of longitudinal studies able to quantify population level change over time, and examine the nature of change within individuals. Cross-sectional studies generally report higher levels of belonging to neighbourhoods and likelihood of talking to neighbours for older individuals but cannot say whether this represents an effect of age of a difference by cohort (Trentelman 2009, Lewicka 2011, Scannell & Gifford 2014).

This thesis has attempted to find empirical evidence in support of these theories of structural change. In order to do so, two specific hypotheses were tested. Hypothesis 1 contends that younger cohorts will have lower levels of belonging to neighbourhoods and talking to neighbours, independent of any individual age related effects associated with life stage. In other words, the positive association between older age groups and both higher levels of belonging to the neighbourhood, and increased likelihood of talking to neighbours, that have been observed in cross-sectional studies to date, are partly a result of cohort differences, reflecting decreasing levels of belonging to neighbourhoods and talking to neighbours in younger generations. Hypothesis 2 contends that any reduction in levels of belonging to the neighbourhood and likelihood of talking to neighbours in younger cohorts, as a result of generational change, is greater for high income groups.

Evidence was found to support both hypothesis 1 and 2 for the outcome of talking to neighbours. While older individuals talk more to neighbours there is no systematic increase in this outcome within individuals over time. The process of time, of aging, does not lead to increased likelihood of talking to neighbours; the individual trajectories of change are, on average, flat. Older cohorts were found to talk more to neighbours, regardless of household income, but the reduction in talking to neighbours reported by younger cohorts is substantially larger for higher income groups. In other words, low income groups experience less cohort change in the likelihood of talking to neighbours.

However there was no support for hypothesis 1 or 2 for the outcome of belonging to the neighbourhood, all individuals, on average, increased levels of belonging over time, as they aged. Younger individuals increase belonging at a quicker rate than older individuals. As older individuals already have relatively high levels of belonging, this is consistent with the finding that belonging to the neighbourhood is associated with age, not cohort effects.

These results from two level growth trajectory models are discussed in chapter 4, and results from the three level cross-classified models are discussed in chapter 6. In essence, the findings from chapter 4 remain once neighbourhood level context is considered. The substantive interpretation of age and cohort effects does not change.

Belonging to the neighbourhood appears to increase systematically with age, and this tends to support the literature that views belonging as a human need (Maslow 1954). Also this lends support to the idea that individual belonging to neighbourhoods is important to individual identity (Fried 1963, Stedman 2002), and that belonging to the neighbourhood increases as individuals progress through their life course, accumulating biographical experience (Gieryn 2000, Trentelman 2009). Belonging is also more of an emotive measure, while talking to neighbours is more of a behavioural measure. Perhaps this suggests that any structural changes associated with globalisation and individualisation impact more on behaviour, and less on attitudes or emotions. This is an interesting question that would benefit from further research. Particularly there is more work that could be done to identify impacts of processes of individualisation on individual behaviour and on notions of community, making use of other longitudinal and cohort studies, and investigating longer time periods.

While the suggestion that structural changes may impact more on behaviours than attitudes is an interesting one, the available data cannot establish whether this is the case or not. It may be that the processes of individualisation and the changes to the very nature of local place as outlined in the literature review in chapter 2 represent the largest substantive impact on the potential for interactions between individuals in local neighbourhoods. However, no firm conclusions regarding this can be drawn from the data presented. To answer this question further research designed to test this hypothesis is required. The findings do suggest that such further research would be fruitful and could help in the understanding of the nature of generational changes resulting from structural processes.

It is important to critically consider the extent to which the outcome measures, and the models developed, capture the full extent of the relationships that may exist between individuals and the neighbourhoods in which they live. The outcomes may capture the degree of individual belonging to neighbourhoods and the likelihood of talking to neighbours, but may not provide much information about the form and quality of these relationships. Put simply, the outcome measures and models employed cannot capture the full extent of individual experience of neighbourhood. So while levels of talking to neighbours may have decreased over time and levels of belonging may be suppressed for low income individuals in materially deprived neighbourhoods, the available data cannot determine whether the quality of interactions or the form of belonging follows the same pattern.

One clear implication is that empirical studies investigating measures relating to neighbourhood or community should be careful about inferences made regarding associations with age. Unless longitudinal methods are employed there is no way to distinguish age and cohort effects.

7.2.2 Individual mobility, household income and neighbourhood deprivation

7.2.2.1 Research question and summary of findings

This thesis has looked to understand the relationship between household income and neighbourhood material deprivation, or more precisely, the ways in which household income and neighbourhood material deprivation interact in their association with individual belonging to neighbourhoods and talking to neighbours. Understanding these relationships required a consideration of individual mobility, and lack of mobility, between neighbourhoods.

Within the field of neighbourhood effects there is a general view that neighbourhoods with high levels of material deprivation are associated with a range of poorer outcomes for individuals (Wilson: 1987, 2013). The longitudinal, multilevel models presented in this thesis are able to consider change in neighbourhood level context and individual mobility between neighbourhoods.

So while there is general agreement that neighbourhood material deprivation reflects spatial disadvantage, and empirical work consistently identifies negative outcomes for individuals in neighbourhoods with high levels of material deprivation (Laurence & Heath 2008, Becares et al 2011, Bailey et al 2012), the relationships between mobility, household income and neighbourhood material deprivation are less well understood.

It has been suggested that increased individual mobility has contributed to reduced individual attachment to neighbourhood and reduced connections between individuals within neighbourhoods (Wellman 1998, David et al 2010). However, it has long been recognised that individual mobility is 'normal' behaviour (Rossi 1980, Rossi & Shlay 1982, Manning 2012). There are arguments that mobility has the potential to create connections between individuals (Urry 2012, Oishi et al 2013). However, empirical evidence for the effects of individual mobility is mixed (Nieuwenhuis et al 2013, Lewicka 2014). This may be because the effects of individual mobility are conditional, dependent upon individual circumstances and neighbourhood context.

This thesis attempted to address this current gap in understanding. The argument that this thesis developed was that processes of constraint, with poorer individuals constrained to more deprived neighbourhoods through their life course (Kelly 2013), may act to suppress levels of belonging to the neighbourhood and talking to neighbours. Therefore hypothesis 3 contends that remaining in materially deprived neighbourhoods, or moving into materially deprived neighbourhoods, will act to reduce levels of belonging to neighbourhoods and talking to neighbours for low income groups.

Findings in relation to the main effects and interactions between individual mobility, household income and neighbourhood material deprivation were presented in various chapters in this thesis, building up to a full consideration of hypothesis 3 in the three level cross-classified models in chapter 6. The findings are summarised below, followed by a discussion about the implications for current and future research.

Higher levels of household income were found to be associated with higher levels of individuals belonging to neighbourhoods but lower levels of talking to neighbours; this was consistent in all the models presented in this thesis. However, in line with previous research, high levels of neighbourhood material deprivation were associated with lower levels of individuals belonging to neighbourhoods and lower levels of talking to neighbours.

To explore this further an interaction between neighbourhood level material deprivation and household income is considered. It was found that in neighbourhoods with low levels of material deprivation all household income groups had relatively high levels of belonging to the neighbourhood. Higher levels of neighbourhood material deprivation are associated with lower levels of belonging to neighbourhoods for low income groups, but levels of neighbourhood material deprivation has little effect on high income groups. Therefore, levels of belonging to the neighbourhood are lowest for individuals in low income households who are also in more materially deprived neighbourhoods. For the outcome of talking to neighbours the relationship between neighbourhood level material deprivation and household income is different. Low income groups talk more to neighbours and it makes little difference whether they live in neighbourhoods with high or low material deprivation. Individuals in high income households talk less to neighbours, but particularly so in neighbourhoods with low levels of material deprivation. As neighbourhood level material deprivation increases high income groups talk more to neighbours.

For the outcome of belonging to the neighbourhood, there was a significant interaction between household income and moving neighbourhood. Moving neighbourhood was not associated with a change in levels of belonging for individuals in high income households, and moreover, there was no substantive effect of moving between neighbourhoods with different levels of material deprivation for individuals in high income households. However, for individuals in households with low incomes the situation is different. Individuals in low income households have lower levels of belonging if they remain in neighbourhoods with high deprivation or move between neighbourhoods with high deprivation. However a move to a neighbourhood with lower levels of material deprivation was associated with a large increase in belonging, just as a move to neighbourhoods with higher levels of material deprivation was associated with decrease in belonging to the neighbourhood. Therefore there is evidence in support of hypothesis 3 for the outcome of belonging to the neighbourhood. The effects of mobility are conditional, only having an effect on low income groups, and mobility can lead to an increase in belonging to the neighbourhood if that mobility results in a reduction in neighbourhood deprivation. For low income groups, remaining in, moving within, and particularly moving to, deprived neighbourhoods is associated with reduced belonging to the neighbourhood.

For the outcome of talking to neighbours the effects of moving neighbourhood and neighbourhood level material deprivation are substantively very small. The main difference remains that individuals in low income households talk more to neighbours, and that moving neighbourhood results in a very small decrease in this outcome for all income groups. There is no evidence to support hypothesis 3 for the outcome of talking to neighbours, which in general is influenced much less by neighbourhood context, compared to the outcome of belonging to the neighbourhood.

7.2.2.2 Implications for neighbourhood effects and understanding selection processes

Within the neighbourhood effects literature the contention is that neighbourhood has a separate, independent effect on individual outcomes (Wilson 1987, van Hamm et al 2012). Individuals with similar outcomes are clustered within similar types of neighbourhoods, and it is this clustering of individuals within neighbourhoods, which is what cross-sectional studies observe as neighbourhood effects. This clustering is generally seen as a potential problem for making causal inference about independent neighbourhood effects, regarded as selection bias, an 'endogenous group membership problem' (Hedman & van Ham 2012, van Ham et all 2013, Wilson 2013). But any clustering of individuals in neighbourhoods with high levels of material deprivation, observed in cross-sectional studies, is a mixture of individuals who are moving through such neighbourhoods and those who are more constrained. It has been suggested that neighbourhoods may be best understood as flows, rather than static entities (Bailey et al 2013) and that in poor neighbourhoods there may be a 'demographic conveyor' where many young people move into poor neighbourhoods and then move out again shortly after (van Ham et al 2013). Also there is evidence to suggest that poorer individuals are more constrained to neighbourhoods with higher levels of material deprivation throughout their life course (Kelly 2013). Therefore a cross-sectional study can only illuminate a static snapshot in time, and reveals little about process.

The longitudinal, multilevel models presented in this thesis are able to consider change in neighbourhood level context and individual mobility between neighbourhoods. It was found that individuals with the lowest levels of belonging, and the smallest increases over the period, are those with low incomes, in neighbourhoods with high material deprivation, who do not move, or who move to, or within, neighbourhoods with high material deprivation. This suggests that the processes of geographical constraint may be important in understanding how being trapped in neighbourhoods with high material deprivation acts to suppress belonging to the neighbourhood. High income groups belong more to he neighbourhood, regardless of neighbourhood deprivation or changes to neighbourhood deprivation as a result of mobility. The suggestion is that those with higher levels of belonging are those that are not constrained to neighbourhoods with high deprivation. So that living in neighbourhoods with high deprivation does not reduce belonging, only being unable to move from such neighbourhoods does so.

Therefore the 'neighbourhood effect' for belonging to the neighbourhood may be best understood as belonging being suppressed, for individuals in low income households who are constrained to neighbourhoods with high levels of material deprivation, through their life course. There were less neighbourhood contextual effects observed for the outcome of talking to neighbours.

Within the neighbourhood effects literature there has been recent interest in the nature of the selection mechanisms that lead to individuals living in particular neighbourhoods, and recognition of the need for more longitudinal studies (Hedman & van Ham 2012, Small & Feldman 2012, Hedman & Galster 2013, van Ham et al 2013, Wilson 2013). The results from this thesis suggest that further research into the ways that processes of constraint operate could prove beneficial, for understanding how neighbourhood is associated with individual life chances and a range of outcomes. The three level cross-classified models developed in this thesis offer potential for future longitudinal studies into neighbourhood effects as they accommodate the non perfect hierarchies that arise from individual mobility, and enable the modelling of these mobility processes.

7.2.3 Neighbourhood ethnic diversity

7.2.3.1 Research question and summary of findings

It has been suggested that increased ethnic diversity leads to weakened belonging to neighbourhoods and interactions between neighbours (Alisina 2003, Costa & Khan 2003, Putnam 2007). Empirical evidence is mixed (Laurence & Heath 2008, Letki 2008, Fieldhouse & Cutts 2010, Sturgis & Smith 2010, Twigg et al 2010, Becares et al 2011, Laurence 2011, Sturgis et al 2011). These conflicting results also reflect longstanding debates about attitudes to ethnic diversity and difference. Conflict theories (Blumer 1958, Blalock 1967, Tajfel 1982), and suggestions that ethnic diversity leads to social disorganisation (Sampson 1988, Keith 2005), are based on bounded, exclusive, competitive notions of identity and community. In contrast, contact theory (Allport 1954) suggests that interaction between different ethnic groups leads to better understandings and relationships between groups.

This thesis develops the argument that neighbourhood and community are essentially open, dynamic processes, consisting of hybrids of those living in any given neighbourhood at any given point in time (Massey 1991, Lipard 1997). It has been argued that as long as local identity is not exclusive, or based on involuntary segregation, then belonging to place is not only possible but an essential part of human well-being (Van Leeuwen 2013), that all identities can be considered as inevitably 'hybridised' new forms created by the coming together of difference (Bhabha 1990, Rose: 1995, 1999) and it is entirely possible that neighbourhoods evolve without the 'politics of polarity' (Young 1990). It has been noted that new and alternative cultures form from the coming together of individuals from different groups (Hall & Jefferson 1976, Gilroy: 1987, 2004). Diverse neighbourhoods can be thought of as a 'difference making machine' (Isin 2002), and this perspective that fits well with the idea of neighbourhoods as a process, an event always under construction.

The aim of this thesis was therefore to test for positive effects associated with higher neighbourhood ethnic diversity. In doing so the intention was to provide evidence that would support theories of neighbourhood as open, dynamic processes, rather than as fixed bounded entities, and provide evidence against the notion that increased neighbourhood ethnic diversity leads to individuals withdrawing from others in their neighbourhoods. Therefore this thesis looks to test hypothesis 4: that, after controlling for other neighbourhood level variables, higher levels of, or increases in, neighbourhood ethnic diversity are associated with higher levels of individual belonging to neighbourhoods and talking to neighbours, when compared to individuals in neighbourhoods that are not ethnically diverse, or do not experience an increase in neighbourhood ethnic diversity.

When considered alone, in cross-sectional multilevel models, individuals in neighbourhoods with higher levels of ethnic diversity were found to have lower levels of belonging to the neighbourhood and talking to neighbours. However once neighbourhood level material deprivation and other neighbourhood level variables are taken into account the relationship between neighbourhood level ethnic diversity and both outcomes becomes very small and non significant.

This suggests that any observed relationship between the outcomes and neighbourhood level ethnic diversity is spurious, due to the relationship between neighbourhood level ethnic diversity and other measures of neighbourhood level context, particularly neighbourhood level material deprivation. However there was no evidence of positive effects of neighbourhood ethnic diversity, until the interaction between neighbourhood level ethnic diversity and neighbourhood level material deprivation was introduced to the models.

The substantive interpretation of this interaction is that, in neighbourhoods with higher levels of material deprivation, individuals belong more to neighbourhoods that also have higher levels of ethnic diversity and belong less in neighbourhoods with lower levels of ethnic diversity. In neighbourhoods with lower levels of material deprivation this situation was reversed, higher levels of ethnic diversity were associated with lower levels of individual belonging. It should be noted, however, that the differences are relatively small. For the outcome of talking to neighbours the differences are even less marked, and the only negative effect of increased neighbourhood level ethnic diversity is observed for individuals in neighbourhoods with low levels of material deprivation.

This finding is potentially important, as it is individuals in neighbourhoods with high levels of material deprivation, or individuals who move neighbourhood, and move into neighbourhoods with higher levels of material deprivation, that are more likely experience increases in neighbourhood level ethnic diversity. The negative effects of neighbourhood level ethnic diversity predicted for neighbourhoods with low levels of material deprivation should be evaluated with an understanding that these neighbourhoods do not exist in the population of neighbourhoods during the time period, there are no neighbourhoods with low levels of material deprivation and high levels of ethnic diversity.

So there is some evidence of small positive associations between higher levels of neighbourhood ethnic diversity and higher levels of individual belonging to neighbourhoods and talking to neighbours. The effect size is small and the interaction that produces these results also predicts negative associations between increased ethnic diversity and the outcomes for individuals in neighbourhoods that are least deprived. Therefore the evidence for positive effects of neighbourhood ethnic diversity is not very strong, perhaps the most convincing interpretation from the findings is that there is no substantive association between neighbourhood ethnic diversity and the outcomes under study.

7.2.3.2 Academic considerations and policy implications

It may be that there is now enough evidence from a range of studies to reject the theories that there is a strong causal link between high neighbourhood ethnic diversity and negative individual outcomes (Putnam 2007). However it is likely that studies will continue in this area, and more than likely continue to produce contradictory results. This thesis has suggested that appropriate methodology is important and highlighted some of the confounding relationships observed. Future research would do well to concentrate on methodological and conceptual issues.

The suggestion that ethnic diversity leads to detrimental outcomes for individuals and local neighbourhoods also has serious conceptual problems. Given this, and the weight of empirical evidence it is puzzling why elements in academia continue to search for negative outcomes associated with ethnic diversity. Particularly as the weak evidence that does exist has been used, by governments, to promote policies that are, at best misdirected, and at worse, counter-productive (Amin & Parkinson 2002, Ben-Tovim 2002, Yuval-Davis et al 2005, Kalra & Kapoor 2009, Ratcliffe 2012, van Leeuwen 2013).

Current UK government policies are moving away from area based regeneration, abandoning existing programmes (Audit Commission 2011) and placing responsibility onto 'communities' (Communities and Local government 2011), leaving deprived neighbourhoods cut adrift to deal with their own inequalities with increasingly fewer resources (Brewer et al 2011, Dickens 2011). As governments have withdrawn from commitment to tackle material inequality they have moved into the arena of culture and values (Kalra & Kapoor 2009, Ratcliffe 2012) emphasising individual responsibility (Norman 2010). As part of this process, the community cohesion agenda in the UK marks a distinct shift away from addressing material disadvantage towards cultural explanations for lack of individual belonging and cohesion in neighbourhoods (Kymlicka 1999, Joppke 2004, Zetter et all 2006, Perry 2008, Pilkington 2008).

The findings from this thesis suggest that current UK policy is misdirected, and would be better focussing on, and tackling, issues of individual and spatial inequalities.

7.3 Review of methodological approach

The methodological approach taken in this thesis has been to develop longitudinal, multilevel models that are capable of investigating individual change over time and neighbourhood context. Many existing empirical studies looking at individual belonging to neighbourhood and likelihood of talking to neighbours do not take account of the clustering of individuals within neighbourhoods, and few consider change over time.

Without longitudinal analysis it would not be possible to distinguish between age and cohort related change over time. In cross-sectional studies all variation in outcomes is attributed to between individual difference. Any single cross-sectional snapshot will confound within person difference and between person differences. Longitudinal models are able to separate variation in outcomes into between individual and within individual difference, and so contribute towards understanding individual change over time. In this thesis the longitudinal models are able to distinguish between cohort and age differences in belonging to the neighbourhood and talking to neighbours.

Along with longitudinal models it was also necessary to consider neighbourhood context in multilevel models. Within the wider study of neighbourhood effects there is a recognised need for more longitudinal analysis (Trentelman 2009, Lewicka 2011, Scannell & Gifford 2014), but such analysis would need to accommodate imperfect hierarchies arising from individual mobility between neighbourhoods over time. One methodological contribution this thesis makes is the combination of longitudinal and multilevel models in cross-classified models that are able to do this. The cross-classified models not only enable change over time and neighbourhood context to be brought together in a single model, they also enable an investigation of individual mobility between neighbourhoods in relation to individual and neighbourhood context. Therefore such models offer potential in future longitudinal studies of neighbourhood effects.

It is important to also recognise limitations of the methodological approach used in this thesis. One such limitation is that the study period covers 11 years, it would have been better if there had been data for a longer time period. The data consists of three survey waves and three time points is the minimum required for longitudinal growth trajectory models, but more time points would have enabled the analysis to consider non-linear trajectories. The limitations of the data were also apparent when specifying the models. A decision was made to treat the outcomes, which are measured as five point Likert scales, as continuous, rather than converting to dichotomous outcomes. This was necessary due to the relatively small number of individuals in neighbourhoods within the sample. As discussed in chapter 3, multilevel models with dichotomous outcomes require larger numbers of cases per cluster than linear models, due to their increased complexity (Hox 2010, Snijders & Bosker 2012). The dichotomous models were found to inflate estimated variance at each level and also inflate estimates of coefficients. Linear models did not result in inflated estimates and so were preferred.

A decision was also made not to treat the household as a separate level. The clustering of individuals within households was accounted for by adjusting standard errors with a calculated design effect that accounts for the non-independence of individuals within the same household (Lohr 2010). Partly the data did not support another level between individual and neighbourhood; this would have reduced the number of individuals per neighbourhood which would cause problems for model convergence. Another reason for this decision is that individuals do not represent a sample of household members, as all household members are included in the survey. In addition, due to the very small number of individuals per household, and the large number of single person households, any estimated household variance would be shrunk towards the overall average, meaning there is little power in the estimation of household variance. As noted, the omission of a level, in multilevel models, results in any variance associated with that level being transferred to other levels in the model (Tranmer & Steel 2001a, van den Noortgate et al 2005, Snijders & Bosker 2012). Therefore, for these reasons, the inference made in this thesis draws on the estimates of coefficients, and concentrates on the substantive interpretation of these coefficients. Less inference is made regarding the variance estimates, and little substantive interpretation is offered, other than to recognise that variance exits at each level. Having more individuals per neighbourhood, and more measures of occasion for individuals, would enable variances at each level to be interpreted with more validity.

Also, as recognised in chapter 3, there are challenges in operationalising neighbourhood because of the modifiable areal unit problem, related to zoning and scale (Openshaw 1984, Tranmer & Steel 2001b, Swift et al 2008). There are limitations in relying on official administrative boundaries as definitions of neighbourhood. Given the data there is no alternative but to do so. This thesis looks to use the smallest possible geography as neighbourhood, which is standard ward. Another option would have been to use the smaller lower super output areas, however the sample does not contain sufficient individuals at this geographic level. Any definition of neighbourhood as a geographical unit larger than ward would give different results, because of the scaling problem, and such results would be less valid if based on geographies that are too large to be regarded as neighbourhoods.

Another limitation of the data is that there are insufficient individuals from ethnic minorities within the sample to include individual ethnicity in the analysis. It would have been useful to consider a cross level interaction between neighbourhood level ethnic diversity and individual ethnicity. This would enable the assessment of whether any effects associated with neighbourhood level ethnic diversity differed depending on individual ethnicity. However there were simply not enough cases in the sample to do so.

One assumption of the multilevel models employed in this thesis is that any unobserved variables are not correlated with the observed variables in the model. In other words, that the error terms in the model, the variance at each level is not correlated with the explanatory variables that are in the model. If unobserved variables are correlated with the error terms this means that there are unobserved variables associated with variation in the outcomes (Snijders & Bosker 2012). This is essentially the problem of omitted variable bias. It has been suggested that fixed effects models are able to get closer to the 'experimental ideal' by controlling for all possible, time invariant, confounding variables in order to remove omitted variable bias (Allison 2009). Fixed effects models treat each individual as their own control and consider the effect of change in explanatory variables in relation to only within person change in the outcome variables. Therefore all between person variation is discarded in the fixed effects approach.

The merits of a fixed effects approach were considered, however there are a number of reasons why such models were not thought to be the most appropriate in addressing the research question and testing the specific hypotheses. One reason is that by discarding the between person variance, differences between individuals, it is not possible to model the effects of time invariant explanatory variables, and this thesis is concerned with the effects of neighbourhood variables that do not change, as much as neighbourhood variables that do. With a fixed effects model, for example, it would not be possible to consider the effect of living in the same neighbourhood with constant, unchanging, high levels of deprivation. Also, crucially, fixed effects models do not enable inference to be made outside the sample, to wider populations. While discarding all between person difference, as in the fixed effects approach, may act as a control against omitted variable bias, and so could be thought of as a control for selection bias, this would be at the expense of being able to model differences between individuals or any effects associated with no change in neighbourhood context. There is a danger of 'over controlling' with fixed effects models, removing the effects that are of interest rather than seeking to model these effects (Plewis 2007).

7.4 Concluding comments

This thesis has sought to make a contribution to the understanding of relationships between individuals and local neighbourhoods, and the ways in which these may have changed over time.

The intention was to capture key aspects of this relationship by measuring individual belonging to neighbourhoods and the likelihood of individuals talking to neighbours. Longitudinal data was employed to enable an examination of process, and the clustering of individuals within neighbourhoods was taken into account, employing multilevel models to examine the effects associated with neighbourhood context.

Evidence was found for generational change in the likelihood of individuals talking to neighbours. Younger cohorts talk to neighbours less than older cohorts, and cohort differences were more pronounced for affluent groups. Therefore there is some evidence to support theories that structural processes are leading to weakened relationships between individuals within neighbourhoods. This would be an interesting area for future research, looking at processes of individualisation and associated individual outcomes, using longitudinal and cohort data over longer time periods.

There was no evidence of generation change in levels of individual belonging to neighbourhoods, which was found to increase within individuals over time as a result of aging. Neighbourhood context was also more important for the outcome of belonging to the neighbourhood than for the outcome of talking to neighbours. Levels of belonging to the neighbourhood were lower in neighbourhoods with higher levels of material deprivation, but this contextual effect was only apparent for low income groups. Higher income groups belonged more to neighbourhoods, regardless of neighbourhood deprivation, or a change in neighbourhood deprivation as a result of individual mobility. Low income groups had lower levels of belonging, but only in neighbourhoods with high levels of material deprivation. For low income groups remaining in deprived neighbourhoods, or moving within deprived neighbourhoods, was associated with lower levels of belonging to the neighbourhood. Low income groups who moved into less deprived neighbourhoods increased their levels of belonging to the neighbourhood. Taken together these findings suggest that neighbourhood effects are closely associated with processes of geographical constraint for the outcome of individual belonging to neighbourhoods. Within the neighbourhood effects literature there is emerging interest in the selection mechanisms that lead to clustering of individuals with similar outcomes in certain types of neighbourhood. The findings from this thesis suggest future longitudinal research into the relationship between selection mechanisms and neighbourhood effects could be useful.

This thesis found some evidence of small positive associations between higher levels of neighbourhood ethnic diversity and higher levels of individual belonging to neighbourhoods and likelihood of talking to neighbours. This was only in neighbourhoods with higher levels of material deprivation, which was interesting as the population of neighbourhoods with high, or increasing, levels of ethnic diversity are also more materially deprived neighbourhoods. These effects were small, and more research, perhaps with more detailed contextual measures, may be needed to identify situations where increased ethnic diversity leads to higher levels of individual belonging to neighbourhoods and talking to neighbours. However the findings add weight to the body of evidence that rejects the theories that increased neighbourhood ethnic diversity is associated with reduced individual belonging to neighbourhoods and reduced interactions between neighbours.

Bibliography

Ackroyd, P. (2000) *London: The Biography.* London: Vintage.

Agnew, J. A. (1987) *Place and Politics.* Boston: Allen and Unwin.

Agnew, J. A. (1989) 'The Devaluation of Place in Social Science' in Agnew, J. A. and Duncan, J. S. (eds) *The Power of Place: Bringing Together Geographical and Sociological Imaginations.* Boston: Unwin Hyman.

Alesina, A. *and* Ferrara, E. L. *(*2000*)* 'Participation in Heterogeneous Communities.' *Quarterly Journal of Economics* 115 847-904.

Alesina, A. and La Ferrara, E. (2002) 'Who Trusts Others?' *Journal of Public Economics* 85 207–234.

Alesina, A., Devleeschauwer, A., Easterly, W., Kurlat, S. and Wacziarg, R. (2003) 'Fractionalization.' *Journal of Economic Growth* 8 155–194.

Alker, H. A. Jnr. (1969) 'A Typology of Ecological Fallacies' in Dogan, M. Rokkan, S. (eds) *Quantitative Ecological Analysis.* Cambridge, Massachusetts: Massachusetts Institute of Technology.

Allison, P. D. (2009) *Fixed Effects Regression Models.* London: Sage.

Allport, G. W. (1954) *The Nature of Prejudice.* Cambridge, MA: Perseus Books.

Amin, A. and Parkinson, M (2002) 'Ethnicity and the Multicultural City: Living With Diversity'. *Environment and planning A,* 34 (6) 959-980.

Anant, S. S. (1966) 'The Need to Belong' *Canada's Mental Health* 14 21-27.

Audit Commission (2011) *Housing Market Renewal: Housing Programme Review.* London: Audit Commission.

Auge, M (1995) *Non-places. An Introduction to Supermodernity.* London: Verso

Back, L., Keith, M., Khan, A., Shukra, K., and Solomos, J. (2002) 'New Labour's White heart: Politics, Multiculturalism and the Return of Assimilation.' *The Political Quarterly* 73 (4) 445-454.

Bailey, N. and Livingston, M. (2007) *Population Turnover and Area Deprivation.* Bristol: Policy Press.

Bailey, N. and Livingston, M. (2008) 'Selective Migration and Neighbourhood Deprivation: Evidence from 2001 Census Migration Data for England and Scotland.' *Urban Studies* 45 (4) 943-961.

Bailey, N., Kearns, A., and Livingston, M. (2012) 'Place Attachment in Deprived Neighbourhoods: The Impacts of Population Turnover and Social Mix.' *Housing Studies* 27 (2) 208-231.

Bailey, N., Barnes, H., Livingston, M. and McLennan, D. (2013) 'Understanding Neighbourhood Population Dynamics for Neighbourhood Effects Research: A Review of Recent Evidence and Data Source Developments' in Van Ham, M., Manley, D., Bailey, N., Simpson, L. and Maclennan, D. (eds) *Understanding Neighbourhood Dynamics: New Insights for Neighbourhood Effects Research.* London: Springer.

Bamber, D., & van Santen, J. P. H. (2000) 'How to Assess a Model's Testability and Identifiability.' *Journal of Mathematical Psychology* 44 20-40.

Bauder, H. (2002) 'Neighbourhood Effects and Cultural Exclusion.' *Urban Studies* 39 (1) 85-93.

Baudrillard, J. (1994) [1981] *Simulacra and Simulation.* Translated S.F. Fraser and A. Arbor. Michigan: University of Michigan Press.

Bauman, Z. (1998a) 'On glocalisation: or globalisation for some, localisation for others'. *Thesis Eleven* 54 37-49.

Bauman, Z. (1998b) *Globalisation: The Human Consequences.* Cambridge: Polity Press.

Bauman, Z. (2000) *Liquid Modernity.* Cambridge: Polity Press.

Bauman, Z. (2001) *The Individualized Society.* Cambridge: Polity Press.

Beatley, T. (2004) *Native to Nowhere: Sustaining Home and Community in a Global Age.* Washington: Island Press.

Beatty, C., Lawless, P., Pearson, S. and Wilson, I. (2009) *Residential Mobility and Outcome Change in Deprived Areas, Evidence from the New Deal for Communities Programme.* Centre for Regional Economic and Social Research, Sheffield Hallam University, Department for Communities and Local Government.

Becares, L., Stafford, M., Laurence, J. and Nazroo, J. (2011) 'Composition, Concentration and Deprivation: Exploring Their Association With Social Cohesion Among Different Ethnic Groups in the UK.' *Urban Studies* 48 (13) 2771-2787.

Beck, U. (1999) *World Risk Society.* Cambridge: Polity Press

Beck, U. and Beck-Gernsheim, E. (2002) *Individualization: Institutionalized Individualization and it's Social and Political Consequences.* London: Sage Publications

Ben-Tovim, G. (2002) 'Community Cohesion and Racial Exclusion: A Critical Review of the Cantle Report.' *Renewal* 10 (2) 43-48.

Berkeley, R., Khan, O. and Ambikaipaker, M. (2005) *What Is New About the New Immigrants in 21st Century Britain?* York : Joseph Rowntree Foundation.

Berry, B. and Kasarda, J. (1977) *Contemporary Urban Ecology.* New York: Macmillan.

Bhabha, H. K. (1990) *Nation and Narration.* London and New York: Routledge.

Blalock, H. M. (1967) *Towards a Theory of Minority Group Relations.* New York: Wiley.

Blumer, H. (1958) 'Race Prejudice as a Sense of Group Position.' *Pacific Sociology Review* 1 (1) 3-7.

Brady, D. (2009) *Rich Democracies, Poor People: How Politics Explains Poverty.* Oxford: Oxford University Press

Brewer, M., Browne, J. and Joyce, R. (2011) *Child and working-age poverty from 2010 to 2020. IFS Commentary C121.* London: Institute for Fiscal Studies.

Brown, B., Perkins, D. D. and Brown, G. (2003) 'Place Attachment in a Revitalizing Neighbourhood: Individual and Block Levels of Analysis.' *Journal of Environmental Psychology* 23 259-271.

Browne, W.J. (2012) *MCMC Estimation in MLwiN, v2.26*. Centre for Multilevel Modelling, University of Bristol.

Browne, W.J., Goldstein, H. & Rasbash, J. (2001) 'Multiple Membership Multiple Classification (MMMC) Models.' *Statistical Modelling* 1(2) 103-124.

Browne, W. J. and Goldstein, H. (2010) 'MCMC Sampling for a Multilevel Model with Non-independent Residuals Within and Between Cluster Units.' *Journal of Educational and Behavioural Statistics* 35 (4) 453-473.

Browning,C.R.,Feinberg, S. L., and Dietz, R. (2004) 'The Paradox of Social Organization: Networks, Collective Efficacy, and Violent Crime in Urban Neighborhoods.' *Social Forces* 83(2) 503–534.

Buttel, F. H., Martinson, O. B. and Wilkening, E. A. (1979) 'Size of Place and Community Attachment: A Reconsideration.' *Social Indicators Research* 6 475-485.

Cameron, D. (2011) Speech at Munich Security Conference
Cabinet Office and Prime Minister's Office, 10 Downing Street . https://www.gov.uk/government/speeches/pms-speech-at-munich-security-conference. Accessed 7 November 2011.

Cantle, T. (2001) *Community Cohesion: a report of the independent review team.* London: Home Office.

Casey, E. (1997) 'How To Get From Space To Place in a Fairly Short Stretch of Time' in S. Feld and K. H. Basso (eds) *Senses of Place.* Santa Fe: New Mexico: School of American Research Press.

Castells, M. (1977) *The Urban Question: a Marxist Approach.* London: Edward Arnold.

Castells, M. (1996) *The Information Age: Economy, Society and Culture; Vol. 1: The Rise of the Network Society.* Oxford: Blackwell.

Castells, M. (1997) *The Information Age: Economy, Society and Culture; Vol. 2: The Power of Identity.* Oxford: Blackwell.

Castells, M. (1998) *The Information Age: Economy, Society and Culture; Vol. 3: End of Millennium.* Oxford: Blackwell.

Catney, G. (2013) *Has Neighbourhood Ethnic Segregation Decreased?* Centre on Dynamics of Ethnicity (CoDE) briefing, Manchester: The University of Manchester.

Cheshire, P. (2012) 'Are Mixed Community Policies Evidence Based? A Review of the Research on Neighbourhood Effects' in M. van Ham, D. Manley, N. Bailey, L. Simpson and D. Maclennan (eds.) *Neighbourhood Effects Research: New Perspectives.* London: Springer.

Cheong, P. H., Edwards, R., Goulbourne, H., and Solomos, J. (2007) 'Immigration, Social Cohesion and Social Capital: A Critical Review.' *Critical Social Policy* 27(1) 24-49.

Clampet-Lundquist, S., and Douglas S. Massey, D. S. (2008) 'Neighborhood Effects on Economic Self-Sufficiency: A Reconsideration of the Moving to Opportunity Experiment.' *American Journal of Sociology* 114 (1) 107-143.

Claeskens, G. and Hjort, N.L. (2008) *Model Selection and Model Averaging.* Cambridge: Cambridge University Press.

Coleman, J. S. (1986) *Individual Interests and Collective Action: Selected Essays.* Cambridge: Cambridge University Press.

Coleman, J. S. (1993) 'The Rational Reconstruction of Society.' *American Sociological Review* 58 1-15.

Commission on Integration and Cohesion (2007) *Our Shared Future.* London: Department for Communities and Local Government.

Communities and Local Government (2011) *Regeneration to Enable Growth: What the Government is Doing in Support of Community-led Regeneration.* London: Communities and Local Government.

Cornforth, M. (1968) *Dialectical Materialism, An Introduction. Volume 1: Materialism and the Dialectical Method.* London: Lawrence and Wishart.

Costa, D. L. and Khan, M. E. (2003) 'Civic Engagement and Community Heterogeneity: An Economists Perspective.' *Perspectives on Politics* 1, 103-111.

Coulton, C. J., Horbin, J., Chan, T. and Su, M. (2001) 'Mapping Residents Perceptions of Neighbourhood Boundaries: A Methodological Note.' *American Journal of Community Psychology* 29 (2) 371-383.

Cribb, J., Joyce, R. and Phillip, D. (2012) *Living standards, poverty and inequality in the UK: 2012. Institute of Fiscal Studies Commentary C124.* London: Institute of Fiscal Studies.

Cuba, L. and Hummon, D. M. (1993) 'A Place To Call Home: Identification With Dwelling, Community and Region.' *The Sociological Quarterly* 34 (1) 111-131.

Cunningham, H. (2004) 'Nations Rebound?: Crossing Borders in a Gated Globe.' *Identities: Global Studies in Culture and Power* 11 329–350.

Danziger, S. (1996) 'Comment on “The Age of Extremes": Concentrated Affluence and Poverty in the Twenty-first Century.' *Demography* 33 (4) 413-416.

David, Q., Janiak, A., Wasmer, E. (2010) 'Local Social Capital and Geographical Mobility. ' *Journal of Urban Economics* 68 (2) 191-204.

Davidson, W. B. and Cotter, P. R. (1991) 'The Relationship Between Sense of Community and Subjective Well-being: A First Look. ' *Journal of Community Psychology* 19 246–253.

Debord, G. (1994) [1967] *The Society of the Spectacle.* New York: Zone Books.

Deleuze, G. (1997) [1975] *Essays Critical and Clinical.* Translated: D. Polan Minneapolis: University of Minneapolis Press.

Dickens R (2011) 'Child Poverty in Britain: Past Lessons and Future Prospects.' *National Institute Economic Review* 218 (1) R7-R19.

Diggle, P. J., Heagerty, P., Liang, K. Y., & Zeger, S. L. (2002) *Analysis of Longitudinal Data (2nd Edition).* Oxford: Oxford University Press.

Dorling, D. (2011) *Injustice: Why Social Inequality Persists.* Bristol: The Policy Press.

Dorling, D., Rigby, J., Wheeler, B., Ballas, D., Thomas, B., Fahmy, E., Gordon, D. and Lupton, R. (2007). *Poverty, Wealth and Place in Britain, 1968-2005.* Bristol: The Policy Press.

Dorling, D. and Ballas, D. (2008) 'Spatial Divisions of Poverty and Wealth' in T. Ridge and S. Wright (Eds) *Understanding Poverty, Wealth and Inequality: Policies and Prospects*. Bristol: Policy Press.

Emsley, C., Hitchcock, T. and Shoemaker, R. (2013) *London History - a Population History of London.* Old Bailey Proceedings Online (www.oldbaileyonline.org, version 7.0, accessed 31st October 2013).

Entriken, J. N. (1991) The Betweeness of Place: *Towards a Geography of Modernity.* London: Macmillan Education Ltd.

Evans M and Williams L (2009) *A Generation of Change, A Lifetime of Difference? Social policy in Britain since 1979.* Bristol: The Policy Press.

Fieldhouse, E. and Cutts, D. (2010) 'Does Diversity Damage Social Capital? A Comparative Study of Neighbourhood Diversity and Social Capital in the US and Britain.' *Canadian Journal of Political Science* 43 (2) 289-318.

Fielding, A. and Goldstein, H. (2006) *Cross-classified and Multiple Membership Structures in Multilevel Models: An Introduction and Review Research Report 791.* Birmingham: University of Birmingham.

Findlay A.M, and Nowok B. (2012). *The Uneven Impact of Different Life Domains on the Well-being of Migrants. CPC Working Paper 26.* Southampton: ESRC Centre for Population Change.

Finney, N. and Simpson, L. (2009) *Sleepwalking into Segregation? Challenging Myths About Race and Immigration.* Bristol: The Policy Press.

Finney, N. and Jivraj, S. (2013) 'Ethnic Group Population Change and Neighbourhood Belonging' *Urban Studies* 50 (16) 3323-3341.

Firebaugh, G. (1997) *Analysing Repeated Surveys.* Sage University Paper Series on Quantitative Applications in the Social Sciences, No 115. Beverley Hills: Sage.

Firebaugh, G. (2001) 'Ecological Fallacy, Statistics of' in Smelser, N. J., Baltes, P. B. (eds) *International Encyclopaedia of the Social and Behavioural Sciences.* Oxford UK: Elsevier Science Ltd. pp4023-4026

Fischer, C. S. (1973) 'On Urban Alienation and Anomie: Powerless and Social Isolation.' *American Sociological Review* 38 311-326.

Fischer, C. S. (2005) 'Bowling Alone: What's the Score?' *Social Networks* 27 155–167.

Forrest, R., & Kearns, A. (1999). *Joined-up places?: Social Cohesion and Neighbourhood Regeneration.* York: YPS for the Joseph Rowntree Foundation.

Forrest, R., & Kearns, A. (2001) 'Social Cohesion, Social Capital and the Neighbourhood.' *Urban Studies* 38 (12) 2125-2143.

Foucault, M. (1980) *Power/ Knowledge: Selected Interviews and Other Writings, 1972 - 1977.* Brighton: Harvester.

Fried, M. (1963) 'Grieving For a Lost Home' in Duhl, L. J. (Ed) *The Urban Condition.* New York: Basic Books.

Galster, G. C. (2012) 'The Mechanism(s) of Neighbourhood Effects: Theory, Evidence and Policy Implications' in M. van Ham, D. Manley, N. Bailey, L. Simpson and D. Maclennan (eds.) *Neighbourhood Effects Research: New Perspectives.* London: Springer.

Galtung, J. (1967) *Theory and Methods of Social Research.* New York, NY: Columbia University Press.

Gans, H. (1968) 'Urbanism and Suburbanism as Ways of Life: A Re-evaluation of Definitions' i*n* R. E. Pahl (ed.) *Readings in Urban Sociology.* Oxford*:* Pergamon.

Gerson, K., Steuve, C. A. and C. S. Fischer, C. S. (1977) 'Attachment to Place' in E. F. Fischer (ed.) *Networks and Places: Social Relations in Urban Settings.* New York: Free Press.

Gibson, C. J. and Lennon, E. (1999) *Historical Census Statistics on the Foreign-born Population of the United States: 1850-1990. Working Paper Series No. 29.* Washington D. C.: U.S. Bureau of the Census, Population Division.

Gibson, C. J. and Jung, K. (2002) *Historical Census Statistics on Population Totals By Race, 1790 to 1990, and By Hispanic Origin, 1970 to 1990, For The United States, Regions, Divisions, and States. Working Paper Series No. 56.* Washington D. C.: U.S. Bureau of the Census, Population Division.

Gieryn, T. F. (2000) 'A Space for Place in Sociology.' *Annual Review of Sociology* 26 463–496.

Gilks, W. R., Richardson, S. and Spiegelhalter, D. J. (1996) *Markov Chain Monte Carlo in Practice.* London, Chapman and Hall:

Gilleard, C., Hyde, M. and Higgs, P. (2007) 'The Impact of Age, Place, Aging in Place, and Attachment to Place on the Well Being of over 50's in England.' *Research on Aging* 29 (6) 590-605.

Gilroy, P. (1987) *There Ain't No Black in the Union Jack: The Cultural Politics of Race and Nation.* London: Routledge .

Gilroy, P. (2004) *After Empire: Melancholia or Convivial Culture.* Oxfordshire: Routledge.

Giuliani, M. V. and Feldman, R. (1993) 'Place Attachment in a Developmental and Cultural Context.' *Journal of Environmental Psychology* 13 267-274.

Glenn, N. D. (1976) 'Cohort Analysts' Futile Quest: Statistical Attempts to Separate Age, Period and Cohort Effects.' *American Sociological Review* 41 (5) 900-904 .

Goldstein, H. (1968) 'Longitudinal Studies and the Measurement of Change.' *Journal of the Royal Statistical Society. Series D (The Statistician)* 18 (2) 93-117.

Goldstein, H. (1979) 'Age, Period And Cohort Effects, A Confounded Confusion.' *Journal of Applied Statistics* 6 (1) 19-24.

Goldstein, H. (2011) *Multilevel Statistical Models 4th edition.* Chichester: John Wiley and Sons.

Goldstein, H. and Sammons, P., (1997) 'The Influence of Secondary and Junior Schools on Sixteen Year Examination Performance: A Cross-classified Multilevel Analysis.' *School Effectiveness and School Improvement* 159 (3) 505-513.

Goldstein, H., Burgess, S. and McConnell, B. (2007) 'Modelling the Effect of Pupil Mobility on School Differences in Educational Achievement.' *Journal of the Royal Statistical Society: Series A (Statistics in Society)* 170 (4) 941–954.

Greif, M. J. (2009) 'Neighborhood Attachment in the Multiethnic Metropolis.' *City & Community* 8 27–45.

Guest, A. M. *and* Lee, B. A. (1984*) '*How Urbanites Define Their Neighborhoods*.' Population and Environment* 7 32-56.

Guest, A. M., & Wierzbicki, S. K. (1999). 'Social Ties at the Neighborhood Level, Two Decades of GSS Evidence.' *Urban Affairs Review* 35(1) 92-111.

Hacker, J. S. and Pierson, P. (2010) 'Winner-Take-All Politics: Public Policy, Political Organization, and the Precipitous Rise of Top Incomes in the United States.' *Politics & Society* 38 (2) 152-204.

Hagenaars, A. J. M., De Vos, K. and M. A. Zaidi, M. A. (1994) *Poverty Statistics in the Late 1980s: Research Based on Micro-data,*
Study carried out for Eurostat, Office for Official Publications of the European Community, Luxembourg.

Hall, S. And Jefferson, T. (1976) (eds) *Resistance Through Rituals: Youth Subcultures in Post-war Britain.* London: Hutchinson.

Halpern, D (2006) *Social Capital.* Cambridge: Polity Press

Haney, W. G. and Knowles, E. S. (1978) 'Perception of Neighborhoods by City and Suburban Residents.' *Human Ecology* 6 (2) 201- 214.

Harding, D. J. (2009). 'Recent Advances in Age-Period-Cohort Analysis. A Commentary on Dregan and Armstrong, and on Reither, Hauser and Yang.' *Social Science & Medicine 69 (*10), 1449-1451.

Harvey, D. (1973) *Social Justice and the City.* London: Arnold.

Harvey, D. (1982) *The Limits to Capital.* Oxford: Basil Blackwell.

Harvey, D. (1990) *The Condition of Postmodernity: An Enquiry into the Origins of Cultural Change.* Cambridge, MA: Blackwell, 1990.

Harvey, D. (1996) *Justice, Nature and the Geography of Difference.* Cambridge M. A.: Blackwell Publishers.

Hatton, T. J. and Williamson, J. G. (1994) *Migration and the International Labour Market, 1850 - 1939.* London: Routledge.

Hawsbawn, E. J. (1991) *The Age of Revolution 1789 - 1848.* London: Sage.

Hawkins, C. (1811) *Observations on the Tin Trade of the Ancients in Cornwall.* London: J. J. Stockdale.

Heckman, J. and Robb, R. (1985) 'Using Longitudinal Data to Estimate Age, Period and Cohort Effects in Earnings Equations' In W. M. Mason and S. E. Fienberg (eds.) *Cohort Analysis in Social Research.* New York: Spinger-Verlag.

Hedman, L. and van Ham, M. (2012) 'Understanding Neighbourhood Effects; Selection Bias and Residential Mobility' in M. van Ham, D. Manley, N. Bailey, L. Simpson and D. Maclennan (eds.) *Neighbourhood Effects Research: New Perspectives.* London: Springer.

Hedman, L., & Galster, G. (2013) 'Neighbourhood Income Sorting and the Effects of Neighbourhood Income Mix on Income: A Holistic Empirical Exploration.' *Urban Studies* 50 (1) 107-127.

Helliwell, J. F., & Putnam, R. D. (2004) 'The social context of well-being. *Philosophical Transactions -Royal Society of London Series B* 329 (1449) 1435-1446.

Hernandez, B., Hidalgo, M.C. and Ruiz, C. (2014) 'Theoretical and Methodological Aspects of Research on Place Attachment' in L. C. Manzo & P. Devine-Wright (eds.) *Place Attachment; Advances in Theory, Methods and Applications.* Abingdon, Oxon : Routledge.

Hershberger, S. L. (2005) *Saturated Model.* Encyclopaedia of Statistics in Behavioural Science.

Hickman, M. J., Mai, N. and Crowley, H. (2012) *Migration and Social Cohesion in the UK.* New York: Palgrave Macmillan.

Hidalgo, M. C. and Hernandez, B. (2001) 'Place Attachment, Conceptual and Empirical Questions.' *Journal of Environmental Psychology* 21 273-281.

Hobcraft, J., Menken, J. and Preston, S. (1982) 'Age, Period, and Cohort Effects in Demography: A Review.' *Population Index* 48 4–43.

Hoffman, L. (2012) 'Considering Alternative Metrics of Time: Does Anybody Really Know What “Time” is ?' in J. Harring & G. Hancock (eds.) *Advances in Longitudinal Methods in the Social and Behavioral Sciences.* Charlotte, NC: Information Age Publishing.

Holt, D., Steel, D. G., Tranmer, M. and Wrigley, N. (1996) 'Aggregation and Ecological Effects in Geographically Based Data.' *Geographical Analysis* 28 (3) 244-261.

Homans, G. C. (1974) *Social Behaviour.* New York: Harcourt Brace Jovanovich.

Home Office (2004) *Strength in Diversity: Towards a Community Cohesion and Race Equality Strategy.* London: Home Office.

Hox, J. J. (2010) *Multilevel Analysis: Techniques and Applications 2nd edition.* Hove, East Sussex: Routledge.

Irvin, G. (2008) *Super Rich. The Rise of Inequality in Britain and the United States.* Cambridge: Polity Press.

Isin, E. F. (2002) 'City as a Difference Machine' in E. F. Isin *Being Political: Genealogies of Citizenship.* Minneapolis: University of Minnesota Press

Jameson, F. (1991) *Postmodernism, or, the Cultural Logic of Late Capitalism.* Durham: Duke University Press.

Jameson, F. (2004) 'The politics of Utopia.' *New Left Review* (25) 35-54.

Jencks, C. and Mayer, S. (1990) 'The Social Consequences of Growing Up in Poor Neighbourhoods' in L. Lynn and M. McGreary (eds.) *Inner City Poverty in the United States.* Washington D. C.: National Academy Press.

Joppke, C. (2004) 'The Retreat of Multiculturalism in the Liberal State: Theory and Practice.' *The British Journal of Sociology* 55 (2) 237 - 257.

Joshi, H. (2001) '*Is There a Place For Area- Based Initiatives?' Environment and Planning* 33 (8) 1349-1352.

Kalra, V. S. and Kapoor, N. (2009) 'Interrogating Segregation, Integration and the Community Cohesion Agenda.' *Journal of Ethnic and Migrant Studies* 35 (9) 1397-1415.

Kasarda, J. and Janowitz, M. (1974) 'Community Attachment in Mass Society.' *American Sociological Review* 39 328–339.

Keith, M. 2005 *After the Cosmopolitan? Multicultural Cities and the Future of Racism.* London: Routledge.

Kelly, B. (2013) *The Process of Socio-economic Constraint on Geographical Mobility: England 1991 to 2008.* Manchester: University of Manchester, CCSR Working Paper 2013-08.

Kosloski, K (1986) 'Isolating Age, Period, and Cohort Effects in Developmental Research. A Critical Review.' *Research on Aging* 8 (4) 460-479.

Kundnani, A. (2007) 'Integrationism: The Politics of Anti-Muslim Racism.' *Race and Class* 48 (4) 24-44.

Kyambi, S. (2005) *New Immigrant Communities: New Integration Challenges?* London: Institute for Public Policy Research.

Kymlicka, W. (1999) 'Comments on Shacherand Spinner-Halev' in C. Joppke and S Lukes (eds.) *Multicultural Questions.* Oxford: Oxford University Press.

Laird and Ware (1982) 'Random Effects Models for Longitudinal Data.' *Biometrics* 38 963-974.

Lash, S. and Urry, J. (1994) *Economies of Signs and Space.* London: Sage.

Laurence, J. (2011) 'The Effects of Ethnic Diversity and Community Disadvantage on Social Cohesion: A Multilevel Analysis of Social Capital and Interethnic Relations in UK Communities.' *European Sociological Review* 27 70-89.

Laurence, J. (2013) '"Hunkering Down or Hunkering Away?" The Effect of Community Ethnic Diversity on Residents' Social Networks.' *Journal of Elections, Public Opinion & Parties* 23(3) 255-278.

Laurence, J. and Heath, A. (2008) *Predictors of Community Cohesion: a Multilevel Modelling of the 2005 Citizenship Survey*. London: Communities and Local Government.

Leckie, G., (2009) 'The Complexity of School and Neighbourhood Effects and Movements of Pupils on School Differences in Models of Educational Achievement.' *Journal of the Royal Statistical Society, Series A* 172(3) 537-554.

Lefebvre, H. (1976) [1973] *The Survival of Capitalism.* Translated: F. Bryant. London: Allison and Busby.

Lefebvre, H. (1991) [1974] *The Production of Space.* Trans. N. Donaldson-Smith. Oxford: Basil Blackwell.

Lefebvre, H. (1995) [1962] *Introduction to Modernity.* Translated J. Moore. London: Verso.

Letki, N. (2008) 'Does Diversity Erode Social Cohesion? Social Capital and Race in British Neighbourhoods.' *Political Studies* 56 99-126.

LeVine, R. A. and Campbell, D. T. (1972) *Ethnocentrism.* New York: John Wiley.

Lewicka, M. (2011) 'Place Attachment: How Far Have We Come in the Last 40 Years?' *Journal of Environmental Psychology* 31(3) 207-230.

Lewicka, M. (2014) 'In Search of Roots: Memory as Enabler of Place Attachment' in L. C. Manzo & P. Devine-Wright (Eds.) *Place Attachment; Advances in Theory, Methods and Applications.* Abingdon, Oxon: Routledge.

Li, Y., Pickles, A. and , M. (2005) 'Social Capital and Social Trust in Britain the late 1990s.' *European Sociological Review* 21 109-23.

Lippard, L. (1997) *The Lure of the Local: Senses of Place in a Multicentred Society.* New York: New Press.

Lohr, S. L. (2010) *Sampling: Design and Analysis 2nd edition*. Boston: Brooks/ Cole.

Low, S. (2006) 'How Private Interests Take Over Public Space: Zoning Taxes, and Incorporation of Gated Communities' in S. Low and N. Smith (eds.) *The Politics of Public Space.* New York: Routledge.

Low, S.M. and Altman, I. (1992) 'Place Attachment: A Conceptual Inquiry' in Altman, I. and Low, S.M. (eds.) Human Behavior and Environment. New York: Plenum.

Low, S. and Smith, N . (2006) *The Politics of Public Space.* New York: Routledge.

Ludwig, J., Liebman, J. B., Kling, J. R., Duncan, G. J., Katz, L. F., Kessler, R. C. and Sanbonmatsu, L. (2008) 'What Can We Learn about Neighborhood Effects from the Moving to Opportunity Experiment?' *American Journal of Sociology* 114 (1) 144-188.

Malpas, J. E. (1999) *Place and Experience: A Philosophical Topography.* Cambridge: Cambridge University Press.

Madanipour, A., Cars, G., & Allen, J. (Eds.). (1998). *Social Exclusion in European Cities: Processes, Experiences, and Responses.* London: Jessica Kingsley.

Manning, P. (2012) (ed) *Migration in World History, 2nd edition.* London: Routledge.

Marx, K. (1977) [1844] *Economic and Philosophical Manuscripts of 1844.* London: Lawrence and Wishart.

Maslow, A. (1954) Motivation and Personality. New York: Harper.

Mason, K. O., Mason, W. M., Winsborough, H. H. and Poole, W. K. (1973) 'Some Methodological Issues in the Cohort Analysis of Archival Data.' *American Sociological Review* 38 242-251.

Massey, D. (1991) 'A Global Sense of Place' Marxism Today, June 1991, 24-29.

Massey (1992) 'Politics and Space/ Time.' New Left Review I 196 November/ December 1992.

Massey, D. (1999) 'Space-Time, 'Science' and the Relationship Between Physical Geography and Human Geography.' *Transactions of the Institute of British Geographers* 24 261-76.

Massey, D. (2004) 'Geographies of Responsibility.' *Geografiska Annaler: Series B, Human Geography* 86 (1) 5-18.

Massey, D. (2005) *For Space.* London: Sage.

Massey, D. S. (1996) 'The Age of Extremes: Concentrated Affluence and Poverty in the Twenty-first Century.' *Demography* 33 (4) 395-412.

McCulloch, A. (2001) 'Ward-level Deprivation and Individual Social and Economic Outcomes in the British Household Panel Study.' *Environment and Planning A* 33 667-684.

Miyazaki, Y. and Raudenbush, S. W. (2000) 'Tests for Linkage of Multiple Cohorts in an Accelerated Longitudinal Design.' *Psychological Methods* 5 (1) 44-63.

McLean, S. L., Schultz, D. A., Steger, M. B. (2002) 'Analysis of Social Capital' in McLean, S. L., Schultz, D. A., Steger, M. B. (eds.) *Social Capital: Critical Perspectives on Community and Bowling Alone.* New York, New York University Press, pp. 21-49.

Moerbeek, M. (2004) 'The Consequences of Ignoring a Level of Nesting in Multilevel Analysis.' *Multivariate Behavioural Research* 39 129-149.

Murphy, M., (1996) 'The Dynamic Household as a Logical Concept and its use in Demography. ' *European Journal of Population* 12 363–381.

Nagel, T. (1986) *The View From Nowhere.* New York: Oxford University Press.

Norman J (2010) *The Big Society: The Anatomy of the New Politics.* Buckingham: University of Buckingham Press.

Nowok B, van Ham M, Findlay A.M., Gayle V. (2013) 'Does Migration Make You Happy? A longitudinal Study of Internal Migration and Subjective Well-being.' *Environment and Planning A* 45 (4) 986–1002.

Nieuwenhuis, J., Völker, B., and Flap, H. (2013) '"A Bad Neighbour Is as Great a Plague as a Good One Is a Great Blessing": On Negative Relationships between Neighbours.' *Urban Studies* 50 (14) 2904-2921.

ODPM (2005) *Sustainable Communities: People, Places, Prosperity.* London: The Stationary Office.

Oishi, S., Kesebir, S., Miao, F. F., Talhelm, T., Endo, Y., Uchida, Y., Shibani, Y. and Norasakkunit, V. (2013) 'Residential Mobility Increases Motivation to Expand Social Networks: But Why?' *Journal of Experimental Social Psychology* 49 217 – 223.

Oliver, J. E. (2010) *The Paradoxes of Integration: Race, Neighbourhood and Civic Life in Multiethnic America.* Chicago: University of Chicago Press.

Oliver, J. E. *and* Wong, J. *(*2003*)* 'Intergroup Prejudice in Multiethnic Settings.' *American Journal of Political Science* 47 *(*4*)* 567–82.

ONS. (2006). *A Guide to Comparing 1991 and 2001 Census Ethnic Group Data.* Titchfield: Office for National Statistics.

ONS (2012) *Ethnicity and National Identity in England and Wales 2011.* Titchfield: Office for National Statistics.

ONS (2013) *The Effect of Taxes and Benefits on Household Income.* ONS July 2013.

Openshaw, S. (1984) *The Modifiable Areal Unit Problem* Concepts and Techniques in Modern Geography, Issue 38. Norwich: Geobooks.

Openshaw, S. and Taylor, P.J. (1979) 'A Million or so Correlation Coefficients: Three Experiments on the Modifiable Areal Unit Problem' in: N. Wrigley (ed.) *Statistical Methods in the Spatial Sciences.* London: Pion

Palmer G, MacInnes T and Kenway P (2008) *Monitoring Poverty and Social Exclusion.* York: Joseph Rowntree Foundation.

Palmore (1978) 'When Can Age, Period, and Cohort be Separated?' *Social Forces* 57 (1) 282-295.

Peach, C. (1996) 'Does Britain Have Ghettos?' *Transactions of the Institute of British Geographers* 21 216-235.

Peach, C. (2008) *Slippery Slope: Discovering or Manufacturing Ghettos.* Institute of Social Change Working Paper. Manchester: University of Manchester

Perry J (2008) *The Housing and Neighbourhood Impact of Britain's Changing Ethnic Mix.* York: JRF.

Phillips, T. (2005) *After 7/7: Sleepwalking to Segregation.* Speech given by Trevor Phillips at the Manchester Council for Community Relations. 22nd September 2005.

Pilkington A (2008) 'From Institutional Racism to Community Cohesion: The Changing Nature of Racial Discourse in Britain.' *Sociological Research Online* 13 (3) 6.

Plewis, I. (1994) 'Longitudinal Multilevel Models' in A. Davis and R.B. Davies (eds.) *Analyzing Social and Political Change.* London: Sage.

Plewis, I. (2007) *Predictions, Explanations and Causal Effects from Longitudinal Data.* London: Institute of Education, University of London.

Portes A. (1998) 'Social Capital: Its Origins and Applications in Modern Sociology.' *Annual Review of Sociology* 24 1-24.

Poulson, M. (2005) 'The New Geography of Ethnicity in Britain? London: *Unpublished paper delivered to the Annual Conference of the Institute of British Geogrpahers and the Royal Geographical Society* 31st Aug – 2nd Sept.

Poulson, M. and Johnston, R. (2006) 'Ethnic Residential Segregation in England: Getting The Right Message Across.' *Environment and Planning A* 38 (12) 2195-9.

Putnam, R. D., Leonardi, R. & Nanetti, R. Y. (1993) *Making Democracy Work: Civic traditions in Modern Italy.* Princeton, NJ: Princeton University Press.

Putnum, R. D. (1995) 'Bowling Alone: The Strange Disappearance of Civic America.' *Journal of Democracy* 6 65-78.

Putnum, R. D. (2000) *Bowling Alone: The Collapse and Revival of American Community.* New York: Simon & Schuster.

Putnam, R. D. (2007) 'E Pluribus Unum: Diversity and Community in the Twenty-first Century. The 2006 Johan Skytte Prize Lecture.' *Scandinavian Political Studies* 30 (2) 137-174.

Raphael, D., Renwick, R., Brown, I., Steinmetz, B., Sehdev, H., & Phillips, S. (2001). 'Making The Links Between Community Structure and Individual Well-being: Community Quality of Life in Riverdale, Toronto, Canada.' *Health & Place* 7 (3) 179-196.

Rasbash, J. and Browne, W. J. (2001) 'Modelling Non-hierarchical Structures' in A. H. Leyland and H. Goldstein (eds.) *Multilevel Modelling of Health Statistics*. Chichester: Wiley.

Rasbash, J., Charlton, C., Browne, W.J., Healy, M. and Cameron, B. (2005) MLwiN Version 2.02. Centre for Multilevel Modelling, University of Bristol.

Rasbash, J. and Goldstein, H. (1994) 'Efficient Analysis of Mixed Hierarchical and Cross Classified Random Structures Using a Multilevel Model.' *Journal of Educational and Behavioural Statistics* 19 337-350.

Rasbash, J., Leckie, G.B., Jenkins, J. and Pillinger, R.J., (2000) 'Children's Educational Progress: Partitioning Family, School and Area Effects.' *Journal of the Royal Statistical Society: Series A* 173 (3) 657-682.

Rasbash, J., Steele, F., Browne, W.J. and Goldstein, H. (2012) A User's Guide to MLwiN, v2.26. Centre for Multilevel Modelling, University of Bristol.

Ratcliffe, P. (2012) 'Community Cohesion': Reflections on a Flawed Paradigm.' *Critical Social Policy* 32 (2) 262-281.

Raudenbush, S.W. (1993) 'A Crossed Random Effects Model for Unbalanced Data With Applications in Cross-sectional and Longitudinal Research.' *Journal of Education Statistics* 18 321-350.

Raudenbush, S. W. and Chan, W.S. (1992) 'Growth Curve Analysis in Accelerated Longitudinal Designs.' *Journal of Research in Crime and Delinquency* 29 (4) 387-411.

Raudenbush, S. W. and Chan, W.S. (1993) 'Application of a Hierarchical Linear Model to the Study of Adolescent Deviance in an Overlapping Cohort Design.' *Journal of Consulting and Clinical Psychology* 61 (6) 941-951.

Relph, E. C. (1976) *Place and Placelessness.* London: Pion Limited.

Riley, M. W. (1963) *Sociological Research: 1 A Case Approach.* New York: Harcourt, Brace and World.

Robinson, W. S. (1950) 'Ecological Correlations and the Behaviour of Individuals.' *American Sociological Review* 15 351-357.

Robinson, R. V. and Jackson, E. F. (2001) 'Is Trust in Others Declining in America? An Age–Period–Cohort Analysis.' *Social Science Research* 30 117–145.

Robinson, D. and Reeve, K. (2005) *The Experiences and Consequences of New Immigration at the Neighbourhood Level: Reflections From the Evidence Base.* York : Joseph Rowntree Foundation.

Rogosa, D.R. & Willett, J.B., (1985) 'Understanding Correlates of Change by Modelling Individual Differences in Growth.' *Psychometrika* 50 203-228.

Rollero, C. and DePiccoli, N. (2010) 'Does Place Attachment Affect Social Well-being?' 'Est-ce que l'attachement à l'environnement conditionne le bien-être social ?' *Revue Européenne de Psychologie Appliquée* 60 233–238.

Rose, G. (1995) 'The Interstitial Perspective: A Review Essay of Homi Bhabha's 'The Location of Culture' *Environment and Planning D: Society and Space* 13 365 - 373.

Rose, N. (1999) *Powers of Freedom: Reframing Political Thought.* Cambridge: Cambridge University Press.

Rossi, P.H. (1980) *Why Families Move (2nd Edition).* Beverley Hills: Sage Publications.

Rossi, P.H. and Shlay, A.B. (1982) 'Residential Mobility and Public Policy Issues: "Why Families Move" Revisited.' *Journal of Social Issues* 38 (3) 21 - 34.

Ryder, N. B. (1965) 'The Cohort as a Concept in the Study of Social Change.' *American Sociological Review* 30 843–861.

Sampson, R. J. (1988) 'Local Friendship Ties and Community Attachment in Mass Society: A Multilevel Systematic Model.' *American Sociological Review* 766-779.

Sampson, R. J., Raudenbush, S. W., & Earls, F. (1997) 'Neighborhoods and Violent Crime: A Multilevel Study of Collective Efficacy. ' *Science* 277(5328) 918-924.

Savage, M. (2010) 'The Politics of Elective Belonging.' *Housing, Theory and Society* 27 (2) 115-161.

Scannell, L. & Gifford, R. (2014) 'Comparing The Theories of Interpersonal and Place Attachment' in L. C. Manzo & P. Devine-Wright (eds.) *Place Attachment; Advances in Theory, Methods and Applications.* Abingdon, Oxon: Routledge.

Schaie, K. W. *(*1965) 'A General Model For The Study of Developmental Problems.' *Psychological Bulletin* 64 92-107*.*

Scheuch, E. K. (1969) 'Social context and Individual Behaviour' in Dogan, M. and Rokkan, S (eds.) *Quantitative Ecological Analysis in the Social Science.* Cambridge: MIT Press

Selvin H C (1958) ‘Durkheim’s Suicide and Problems of Empirical Research.’ *American Journal of Sociology* 63 607-19.

Senior, M. (2002) 'Deprivation Indicators' in Rees, P., Martin, D. and Williamson, P. (eds.) *The Census Data System.* Chichester: Wiley.

Sennett, R. (2012) *Together: The Rituals, Pleasures and Politics of Cooperation.* New Haven: Yale University Press.

Sharkey, P. (2012) 'Residential Mobility and the Reproduction of Unequal Neighborhoods.' *Cityscape: A Journal of Policy Development and Research* 14 (3) 9-31.

Shamir, R. (2005) 'Without Borders? Notes on Globalization as a Mobility Regime' *Sociological Theory* 23 (2) 197-217.

Shumaker, S. A. and Taylor, R. B. (1983) 'Toward a Clarification of People-place Relationships: A Model of Attachment to Place' in N. R. Feimer and E. S. Geller (eds.) *Environmental Psychology: Directions and Perspectives.* New York: Praeger.

Silver, N. (2012) *The signal and the noise: The art and science of prediction.* London: Allen Lane.

Simpson, L. (2007) 'Ghettos Of The Mind: The Empirical Behaviour of Indices of Segregation and Diversity.' *Journal of the Royal Statistical Society: Series A (Statistics in Society)* 170 (2) 405-24.

Simpson, L., & Akinwale, B. (2007) 'Quantifying Stability and Change in Ethnic Group.' *Journal of Official Statistics* 23 (2) 185–208.

Singer, J. D. and Willett, J. B. (2003) *Applied Longitudinal Data Analysis: Modelling Change and Event Occurrence.* Oxford: Oxford University Press.

Slater, T. (2013) 'Your Life Chances Affect Where You Live: A Critique of the ‘Cottage Industry’ of Neighbourhood Effects Research.' *International Journal of Urban and Regional Research* 37 (2) 367-387.

Small, M. L. and Feldman, J. (2012) 'Ethnographic Evidence, Heterogeneity, and Neighbourhood Effects after Moving to Opportunity' in M. van Ham, D. Manley, N. Bailey, L. Simpson and D. Maclennan (eds.) *Neighbourhood Effects Research: New Perspectives.* London: Springer.

Small, M. L. and Newman, K. (2001) 'Urban Poverty after The Truly Disadvantaged: The Rediscovery of the Family, the Neighborhood, and Culture.' *Annual Review of Sociology* 27 23-45 .

Snijders, T. (1996) 'Analysis of Longitudinal Data Using the Hierarchical Linear Model.' *Quality & Quantity* 30 405-426.

Snijders, T. A. B. and Boskers, R. J. (2012) *Multilevel Analysis: An Introduction to Basic and Advanced Multilevel Modelling 2nd edition.* London: Sage.

Soja (1980) 'The Socio-spatial Dialectic.' *Annuls of the Association of American Geographers* (70) 207-222.

Soja E. W. (2010) *Seeking Spatial Justice.* Minnesota: University of Minnesota Press.

Spiegelhalter, D. J., Best, N. G., Carlin, B. P. and van der Linde, A. (2002) 'Bayesian Measures of Model Complexity and Fit.' *Journal of the Royal Statistical Society Series B* 64 (4) 583-639.

Stack, C. (1974) *All Our Kin.* New York: Harper and Row.

Stedman, R. C. (2002) 'Toward a Social Psychology of Place: Predicting Behaviour From Place-based Cognitions, Attitude and Identity.' *Environment and Behaviour* 34 (5) 561–581.

Steele, F. (2008) 'Multilevel Models For Longitudinal Data.' *Journal of Royal Statistical Society A* 171 (1) 5-19.

Sternio, J.L.F.,Weisberg, H.I. and Bryk, A.S.(1983) 'Empirical Bayes Estimation of Individual Growth Curves Parameters and Their Relationship to Covariates.' *Biometrics* 39 71-86.

Stokols, D. & Shumaker, S. A. (1982) 'The Psychological Context of Residential Mobility and Well-being.' *Journal of Social Issues* 83 149-171.

Stokols, D., Shumaker, S. A. & Martinez, J. (1983) 'Residential Mobility and Personal Well-being.' *Journal of Environmental Psychology* 3 5-19.

Sturgis, P. and Smith, P. (2010) 'Assessing The Validity of Generalised Trust Questions: What Kind of Trust Are We Measuring?' *International Journal of Public Opinion Research* 22 74-92.

Sturgis, P., Brunton-Smith, I., Read, S. and Allum, N. (2011) 'Does Ethnic Diversity Erode Trust? Putnams Hunkering Down Thesis Reconsidered.' *British Journal of Political Science* 41 (1) 57-82.

Subramanian, S. V. (2004) 'The Relevance of Multilevel Statistical Methods For Identifying Causal Neighborhood Effects.' *Science and Medicine* 58 1961-1967.

Swift, A., Liu, L., and Uber, J. (2008) 'Reducing MAUP Bias of Correlation Statistics Between Water Quality and GI Illness.' *Computers, Environment and Urban Systems* 32 134–148.

Szerszynski, B. and Urry, J. (2006) 'Visuality, Mobility and the Cosmopolitan: Inhabiting the World From Afar.' *British Journal of Sociology* 57 (1) 113-131.

Tajfel, H. (1982) 'Social Psychology of Intergroup Relations.' *Annual Review of Psychology* 33 1-39.

Taylor, M (1980) 'Combating The Social Exclusion of Housing Estates.' *Housing Studies* 13 (6) 819-832.

Taylor, M. F. (ed). Brice, J., Buck, N. and Prentice-Lane, E. (2010) *British Household Panel Survey User Manual Volume A: Introduction, Technical Report and Appendices.* Colchester: University of Essex.

Taylor, P. J. (1982) 'A Materialist Framework For Political Geography.' *Transactions of the Institute of British Geographers* NS 7 (1) 15-34.

Taylor, R. B., Gottfredson, S. D. and Brower, S. (1985) 'Attachment To Place: Discriminant Validity, and Impacts of Disorder and Diversity.' *American Journal of Community Psychology* 13 (5) 525-542.

Theodori, G. L. (2000) 'Levels of Analysis and Conceptual Clarification in Community Attachment and Satisfaction Research: Connections to Community Development.' *Community Development* 31(1) 33–58.

Theodori, G. L. (2001) 'Examining The Effects of Community Satisfaction and Attachment on Individual Well-Being.' *Rural Sociology* 66 618–628.

Tienda, M. (1991) 'Poor People and Poor Areas: Deciphering Neighbourhood Effects in Poverty Outcomes' in J. Harber (ed.) *Macro-micro Linkages in Sociology.* Newbury Park: Sage.

Townsend, P., Phillimore, P. and Beattie, A. (1988) *Health and Deprivation: Inequality and the North.* London: Routledge.

Tranmer, M. and Steel, D. (2001a) 'Ignoring a Level in a Multilevel Model: Evidence from UK Census Data.' *Environment and Planning A* 33 941-948.

Tranmer, M. and Steel, D. (2001b) 'Using Local Census Data to Investigate Scale Effect' in N. J. Tate and P. M. Atkinson (eds.) *Modelling Scale in Geographical Information Science.* London: John Wiley & Sons.

Trentelman, C. K. (2009) 'Place Attachment and Community Attachment: A Primer Grounded in the Lived Experience of a Community Sociologist.' *Society & Natural Resources* 22 (3) 191-210.

Trigilia, C. (2001) 'Social Capital and Local Development.' *European Journal of Social Theory* 4 427–442.

Tuan, Y. (1977) *Space and Place: The Perspective of Experience.* Minneapolis: University of Minnesota Press.

Turner, B. S. (2007) 'The Enclave Society: Towards a Sociology of Immobility.' *European Journal of Social Theory* 10 (2) 287-304.

Twigg, L., Taylor, J. and Mohan, J. (2010) 'Diversity or Disadvantage? Putnam, Goodhart, Ethnic Heterogeneity, and Collective Efficacy.' *Environment and Planning A* 42 (6) 1421–1438.

Uhrig, S. C. N. (2008) T*he Nature and Causes of Attrition in the British Household Panel Survey*. Essex: ISER Working Paper 2008-05, University of Essex

Urry, J. (2000a) 'Mobile Sociology.' *The British Journal of Sociology* 51 (1) 185-203.

Urry, J. (2000b) *Sociology Beyond Societies: Mobilities for the Twenty-first Century.* London: Routledge.

Urry, J. (2012) 'Social Networks, Mobile Lives and Social Inequalities.' *Journal of Transport Geography* 21 24-30.

Uslaner, E. M. (2012) *Segregation and Mistrust: Diversity, Isolation, and Social Cohesion.* Cambridge: Cambridge University Press.

Vaisey, S. (2007) 'Structure, Culture, and Community: The Search for Belonging in 50 Urban Communes.' *American Sociological Review* 72 (6) 851-873.

Van den Noortgate, W., Opendenakker, M. C. and Onghena, P. (2005) 'The Effects of Ignoring a Level in Multilevel Analysis.' *School Effectiveness and Social Improvement* 16 281-303.

van Ham, M., Manley, D., Bailey, N., Simpson, L. and Maclennan, D. (2012) *Neighbourhood Effects Research: New Perspectives.* London: Springer.

van Ham, M., Manley, D., Bailey, N., Simpson, L. and Maclennan, D. (2013) *Understanding Neighbourhood Dynamics: New Insights for Neighbourhood Effects Research.* London: Springer.

van Leeuwen, B. (2013) 'Urban Civility or Urban Community? A False Opposition in Richard Sennett's Conception of Public Ethos.' *European Journal of Social Theory* 17 (1) 3-23.

Vertovec, S. (2006) *The Emergence of Super-Diversity in Britain.* Centre on Migration, Policy and Society Working Papers, 25. Oxford: Oxford University.

Vertovec, S. (2007) 'Super-diversity and its Implications.' *Ethnic and Racial Studies* 29 (6) 1024-1054.

Wacquant, L. (2008) *Urban Outcasts: A Comparative Sociology of Advanced Marginality.* Cambridge: Polity.

Wagner, H. R. (1964) 'Displacement Of Scope: A Problem of the Relationship Between Small-scale and Large-scale Sociological Theories. ' *American Journal of Sociology* 69 571-584.

Walker, A. and Walker, C. (1997) *Britain divided? The growth of social exclusion in the 1980s and 1990s.* London: Child Poverty Action Group

Wasserman, I. M (1982) 'Size of Place in Relation to Community Attachment and Satisfaction with Community Services.' *Social Indicators Research* 11 (4) 421-43.

Watt, P. (2010) 'Unravelling the Narratives and Politics of Belonging to Place.' *Housing, Theory and Society* 27 (2) 153-159.

Wellman, B. (1988) 'The Community Question Re-evaluated' in M. P. Smith (ed.) *Power, Community and the City.* New Bruswick N. J.: Transaction Books.

Wellman, B. and Leighton, B. (1979) 'Networks, Neighbourhoods and Communities.' *Urban Affairs Review* 14 (3) 363-390.

Wilkinson, R. and Pickett, K. (2010) *The Spirit Level: Why Equality is Better for Everyone.* London: Penguin Books Ltd.

Wilson, W. J. (1987) *The Truly Disadvantaged.* Chicago: University of Chicago Press.

Wilson, W. J. (2013) 'Combating Concentrated Poverty in Urban Neighborhoods.' *Journal of Applied Social Science* 7 (2) 135-143.

Winship, C. and Harding D. J. (2008) 'A General Strategy for the Identification of Age, Period, Cohort Models: A Mechanism Based Approach.' *Sociological Methods and Research* 36 362 - 401.

Wirth, L (1938) 'Urbanism as a Way of Life.' *American Journal of Sociology* 44 1-24.

Wright, E. O. (2010) *Envisioning Real Utopias.* London and New York: Verso.

Wright, E. O. (2012) 'Transforming Capitalism Through Real Utopias (2012 American Sociological Association presidential address).' *American Sociological Review* 78 (1) 1 - 25.

Yang, Y. and Land, K. C. (2006) 'A Mixed Methods Approach to Age-Period-Cohort Analysis of Repeated Cross-sectional Surveys: Trends in Verbal Test Scores.' *Sociological Methodology* 36 75-97.

Young, I. M. (1990) *Justice and the Politics of Difference.* Princeton: Princeton University Press.

Yuval-Davis, N., Anthias, F. and Kofman, E. (2005) 'Secure Borders and Safe Haven and the Gendered Politics of Belonging: Beyond Social Cohesion.' *Ethnic and Racial Studies* 28 (3) 513–35.

Zetter R, Griffiths D, Sigona N, Flynn D, Pasha T, Benyon R (2006) *Immigration, Social Cohesion and Social Capital: What are the Links?* York: JRF.

Appendix 1: Further notes on the selection of linear or dichotomous models

This appendix evaluates the choice of model selection. The reason for the model choice is guided by the performance of models, as evaluated here, though the concern over model performance is related to sample size, particularly the number of cases per cluster. First models were considered as dichotomous. However these models produced some worrying results. The issue was with the apparent inflation of the estimated mean and higher level variance when models extended from single to multiple levels. This can be seen in table A1 and A2, which compare results when moving from single to two level models, looking at models used in this thesis treated as dichotomous and linear. For brevity results are shown for the outcome of belonging to the neighbourhood, though results for the outcome of talking to neighbours are the same. It is noticeable that the estimated intercept increases when models add an additional level in the MCMC estimation of dichotomous outcomes. This does not happen when dichotomous models are estimated using maximum likelihood. Though maximum likelihood estimation with dichotomous outcomes does not produce -2 log likelihood statistics that enable the evaluation of model fit. Also this apparent inflation of estimated intercept does not occur in linear models, whether estimated using MCMC or maximum likelihood. As well as apparent inflation of the estimated intercept the same inflation appears in the estimated higher level variance.

Table A.1: comparing linear and dichotomous (probit) models for empty single and longitudinal models (model 4.1 and 4.2 in the thesis).

1 level: occasion and individual	Linear MCMC		Linear IGLS		Probit IGLS		Probit MCMC	
Belong	Est.	S.E.	Est.	S.E.	Est.	S.E.	Est.	S.E.
Constant (β_0)	3.725	0.006	3.725	0.006	0.508	0.009	0.507	0.009
σ^2_{e0}	0.799	0.008	0.799	0.008				

2 level: occasion and individual	Linear MCMC		Linear IGLS		Probit IGLS		Probit MCMC	
Belong	Est.	S.E.	Est.	S.E.	Est.	S.E.	Est.	S.E.
Constant (β_0)	3.700	0.008	3.700	0.008	0.493	0.011	0.742	0.019
σ^2_{u0}	0.362	0.009	0.362	0.009	0.349	0.016	1.401	0.073
σ^2_{e0}	0.452	0.006	0.452	0.006				
VPC (individual)	44.5%		44.5%		25.9%		58.4%	

Table A.2: comparing linear and dichotomous (probit) models for empty single and multilevel models (model 5.1 and 5.2 in the thesis).

1 level: individual and ward 2003	Linear MCMC		Linear IGLS		Probit IGLS		Probit MCMC	
Belong	Est.	S.E.	Est.	S.E.	Est.	S.E.	Est.	S.E.
Constant (β_0)	3.712	0.011	3.712	0.011	0.481	0.015	0.481	0.015
σ^2_{e0}	0.791	0.013	0.791	0.013				

2 level: individual and ward 2003	Linear MCMC		Linear IGLS		Probit IGLS		Probit MCMC	
Belong	Est.	S.E.	Est.	S.E.	Est.	S.E.	Est.	S.E.
Constant (β_0)	3.673	0.012	3.673	0.012	0.458	0.017	0.529	0.022
σ^2_{u0}	0.230	0.018	0.230	0.015	0.146	0.023	0.497	0.069
σ^2_{e0}	0.576	0.015	0.576	0.014				
VPC (individual)	28.5%		28.5%		12.7%		33.2%	

It is noticeable that this apparent inflation seems to be greater in the models considering the data as longitudinal, occasions and individuals, compared to models that consider individuals and wards. If the reason for this inflation is the poor performance of models due to low numbers of cases per cluster, as assumed (see other notes on sample size), then this would explain why the observed apparent inflation is greater in the longitudinal context as there are fewer average cases per cluster, compared to the individual per ward context.

Also the estimates of coefficients for explanatory variables are larger in MCMC dichotomous outcomes compared to estimates with dichotomous outcomes estimated using maximum likelihood. This can be seen in table A.3 and A.4. which shows the comparison of final longitudinal models presented in chapter 4 and chapter 5. (This is less marked in chapter 5, possibly due to slightly higher cases per cluster).

Table A.3: comparing linear and dichotomous (probit) models for models presented in chapter 4.

2 level: occasion and individual Belong	Linear MCMC Est.	S.E.	Linear IGLS Est.	S.E.	Probit IGLS Est.	S.E.	Probit MCMC Est.	S.E.
Constant (β_0)	3.755	0.008	3.755	0.008	0.613	0.013	0.882	0.021
β_1 Time $_{ij}$	0.0079	0.0015	0.0079	0.0015	0.0120	0.0029	0.0172	0.0038
β_2 YOB $_j$	-0.0106	0.0005	-0.0106	0.0005	-0.0161	0.0008	-0.0241	0.0011
β_3 Moved Ward $_{ij}$	-0.1220	0.0147	-0.1220	0.0145	-0.2548	0.0267	-0.3195	0.0341
β_4 Time*Moved Ward $_{ij}$	0.0181	0.0031	0.0182	0.0031	0.0203	0.0055	0.0334	0.0071
β_5 YOB*Moved Ward $_{ij}$	-0.0020	0.0008	-0.0020	0.0008	-0.0015	0.0015	-0.0030	0.0020
β_6 Household income $_{ij}$	0.0026	0.0006	0.0026	0.0006	0.0027	0.0010	0.0031	0.0013
σ^2_{u0}	0.309	0.008	0.310	0.008	0.335	0.017	1.1812	0.0624
σ^2_{u1}	0.0021	0.0003	0.0022	0.0003	0.0000	0.0000	0.0001	0.0000
σ_{u01}	-0.0059	0.0008	-0.0059	0.0008	0.0000	0.0000	0.0046	0.0025
σ^2_{e0}	0.396	0.008	0.395	0.008				
VPC (level 2)	44.0%		44.1%		25.1%		54.2%	

Table A.4: comparing linear and dichotomous (probit) models for models presented in chapter 5.

2 level: individual and ward 2003 Belong	Linear MCMC Est.	S.E.	Linear IGLS Est.	S.E.	Probit IGLS Est.	S.E.	Probit MCMC Est.	S.E.
Constant (β_0)	3.767	0.014	3.767	0.014	0.616	0.021	0.666	0.032
β_1 Age	0.0097	0.0006	0.0097	0.0006	0.0144	0.0010	0.0156	0.0012
β_2 Household Income	0.0055	0.0010	0.0055	0.0010	0.0046	0.0017	0.0050	0.0019
β_3 Moved	-0.229	0.025	-0.229	0.024	-0.362	0.037	-0.389	0.041
β_4 Ward Townsend	-0.0238	0.0044	-0.0238	0.0044	-0.0326	0.0067	-0.0359	0.0075
β_5 Ward BME	-0.0019	0.0012	-0.0019	0.0012	-0.0020	0.0018	-0.0023	0.0020
β_6 Ward Density	-0.0003	0.0006	-0.0003	0.0006	-0.0002	0.0009	-0.0001	0.0010
β_7 Ward Migration	-0.0698	0.0226	-0.0699	0.0226	-0.0957	0.0343	-0.1034	0.0372
σ^2_{u0}	0.145	0.015	0.145	0.013	0.096	0.023	0.194	0.105
σ^2_{e0}	0.571	0.015	0.570	0.014				
VPC (level 2)	20.3%		20.3%		8.8%		16.3%	

Sensitivity analysis was carried out to consider the substantive interpretation of dichotomous models and linear models. This analysis confirmed that the substantive interpretation of effect sizes was similar, the main difference remains the larger variance observed in dichotomous models. Another option would have been to could have considered ordered logit models. Again, these were considered alongside dichotomous models, and, similarly, substantive interpretation was similar but variances appeared inflated.

As the results from dichotomous and ordered logit models were substantively the same as in the linear models, linear models were chose for two main reasons. Firstly linear models ease interpretation. Secondly, and most importantly, dichotomous and ordered logit multilevel models require more cases per cluster than linear models (Hox 2010, Snijders & Bosker 2012). There are concerns that the data available does not contain sufficient cases per cluster to make non linear analysis viable.

Appendix 2: Further notes on the selection of IGLS or MCMC estimation procedures

There is a decision to be made about whether to estimate these linear models using maximum likelihood or MCMC methods. The tables above contain the comparison between these two approaches in the models employed in chapter 4 and 5. The conclusion from these models is that there is no difference in the estimates produced from each estimation method. This may suggest that maximum likelihood should be preferred on the grounds of simplicity, though the favouring of frequentist or Bayesian approaches can also be driven by more philosophical concerns.

On a practical level there are differences in the model estimates using different estimation methods once the models are considered as cross classified. These issues are addressed below, prior to the final decision on appropriate estimation technique.

A comparison of the cross classified models, employed in chapter 6, are shown below. The table below shows the comparison between models estimated using MCMC methods where the models are cross classified and where they are not cross classified. The models that are not cross classified are incorrectly specified, although the software allows these models to be estimated. These are compared to models using maximum likelihood methods where the models have been set up as cross classified in MCMC and then estimated using maximum likelihood. This is described at an attempt to cross classify as it is not certain whether this simply equates to a change in notation, and not an actual cross classification. These comparisons show that the maximum likelihood estimation is the same as MCMC not cross classified. The same results are observed in the final models presented in chapter 6.

Therefore if using cross classified linear models, the conclusion is that this should be estimated using MCMC methods.

Table A.5: Comparison of cross-classified models with non cross-classified models, as empty models (Model 6.1 in thesis).

3 level: belong (1) occasion/ (2) individual/ (3) ward.	Cross Classified Linear MCMC Est.	 S.E.	Not Cross Classified Linear MCMC Est.	 S.E.	Attempt Cross Classified Linear IGLS Est.	 S.E.
Constant (β_0)	3.623	0.012	3.603	0.009	3.603	0.009
$\sigma^2_u{}^{(3)}$ / (σ^2_v)	0.164	0.010	0.261	0.015	0.260	0.013
$\sigma^2_u{}^{(2)}$ / (σ^2_u)	0.290	0.009	0.247	0.011	0.248	0.010
σ^2_e	0.401	0.006	0.346	0.005	0.346	0.005
VPC (level 3)	19.2%		30.6%		30.5%	
VPC (level 2)	33.9%		28.9%		29.0%	

3 level: talk (1) occasion/ (2) individual/ (3) ward.	Cross Classified Linear MCMC Est.	 S.E.	Not Cross Classified Linear MCMC Est.	 S.E.	Attempt Cross Classified Linear IGLS Est.	 S.E.
Constant (β_0)	3.581	0.012	3.568	0.009	3.568	0.009
$\sigma^2_u{}^{(3)}$ / (σ^2_v)	0.143	0.010	0.206	0.018	0.205	0.015
$\sigma^2_u{}^{(2)}$ / (σ^2_u)	0.368	0.011	0.360	0.015	0.359	0.014
σ^2_e	0.505	0.007	0.447	0.007	0.448	0.007
VPC (level 3)	14.1%		20.3%		20.3%	
VPC (level 2)	36.2%		35.5%		35.5%	

Appendix 3: Notes on the shrinkage factor (Empirical Bayes estimate)

Given the basic multilevel model, as represented as a two level empty model, as in equation 1, where unit i, level 1, is clustered with units j, level 2.

$$y_{ij} = \beta_{oij} cons$$
$$\beta_{oij} = \beta_o + u_j + e_{ij}$$

$$[u_j] \sim N(0,\Omega_u) : \Omega_u = [\sigma^2_u]$$
$$[e_{ij}] \sim N(0,\Omega_e) : \Omega_e = [\sigma^2_e] \quad (1)$$

The residuals are calculated as follows. First, as in standard OLS regression, the residual for a level 1unit is calculated as the observed value minus the predicted value. This we can call the raw total residual, r_{ij}, and is calculated as in equation 2. This raw total residual, r_{ij}, is the combined estimated u_j and e_{ij}. Next, the raw residuals for the separate level 2 units, r_j, can be calculated as the average r_{ij}, in any given level 2 unit, as in equation 3.

$$r_{ij} = y_{ij} - \hat{y}_{ij} \qquad (2)$$

$$r_{j\ (for\ j=1)} = \frac{\Sigma r_{ij\ (for\ j=1)}}{n_{j\ (for\ j=1)}} \qquad (3)$$

The assumption is that level 2 units are drawn from an underlying normally distributed population of level 2 units, therefore, that there is heterogeneity between level 2 units. As can be seen in equation 3, this heterogeneity between level 2 units is initially estimated from the observed e_{ij} for the level 2 unit. In other words, the observed homogeneity within level 2 units gives rise to the observed heterogeneity between level 2 units.

However, the observed r_j are estimates of the actual level 2 unit population average. Estimated r_j based on small numbers of cases per level 2 unit are less reliable than estimates based on large number of cases per level 2 unit. Calculated r_j are unbiased but may be imprecise, if based on small numbers of cases in the level 2 unit. In this situation information is borrowed from other level 2 units to gain precision. That is, when estimated r_j are not a reliable estimate of uj then weighting the estimate of uj towards the overall average (average of uj - which is exactly same as average eij - which is 0). Therefore shrinking the estimate of uj towards the average borrows information from other level 2 units. There is a gain in precision but the introduction of bias.

The weighting of r_j depends on two things. One is n_j ,the number of level 1 units in the level 2 unit, and the other is the intra-cluster correlation (ICC). The ICC is an approximation of Rho, see Kish (1965) who defined Rho and described this as 'the rate of homogeneity'.

Both of these are used to calculate the reliability of the r_j, this reliability is λ, calculated as in equation 4.

$$\lambda_{(for\ j=1)} = \frac{\sigma^2_u}{\sigma^2_u + \left(\frac{\sigma^2_e}{n_{j\ (for\ j=1)}}\right)} \qquad (4)$$

Then the estimate of uj is a weighted average, weighted by the reliability of rj (which is λ). Therefore estimated between the rj and the Bo, where Bo is zero. So the estimate of uj for a level two unit, is calculated as equation 5.

$$\hat{u}_{j\ (for\ j=1)} = r_{ij\ (for\ j=1)} * \lambda_{(for\ j=1)} \qquad (5)$$

Then it follows then that the estimate of eij is for level 1 units within level 2 units is as equation 6. The estimated eij equals the observed yij minus the estimated uj

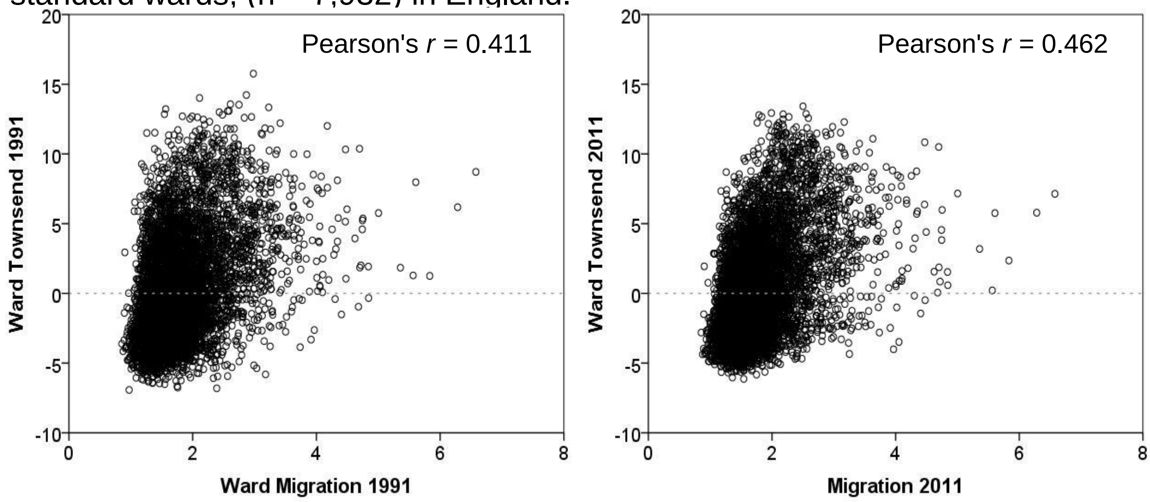
$$\hat{e}_{ij\ (for\ e=1,\ in\ j=1)} = y_{ij\ (for\ e=1,\ in\ j=1)} - \hat{u}_{j\ (for\ j=1)} \qquad (6)$$

And then the total variance is estimate of uj plus the estimate of eij, (the key reason that assumption of independence of residuals at level 1 and level 2, that they are not correlated, is in order that variance at leach level can be considered as additive) so that for an individual the estimates are as in equation 1.

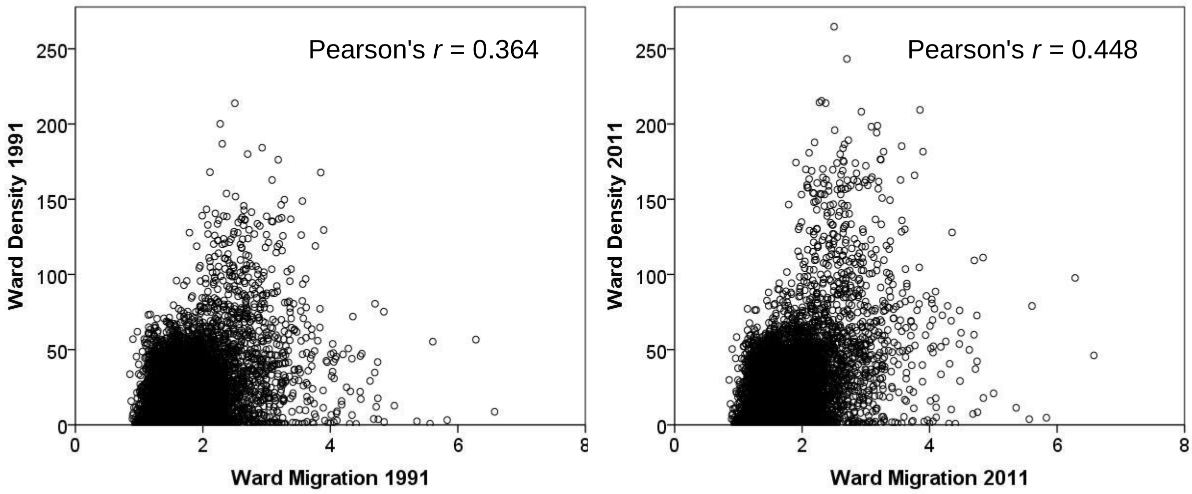
Note that these equations (5 to 7) based on null, empty models, would be the same but slightly different equations when explanatory variables are added. As the y_{ij} would be determined not just by B_o but by $B_{1\text{-}k}$

Appendix 4 : Additional scatterplots of the relationship between ward level measures for all England wards 1991 and 2011

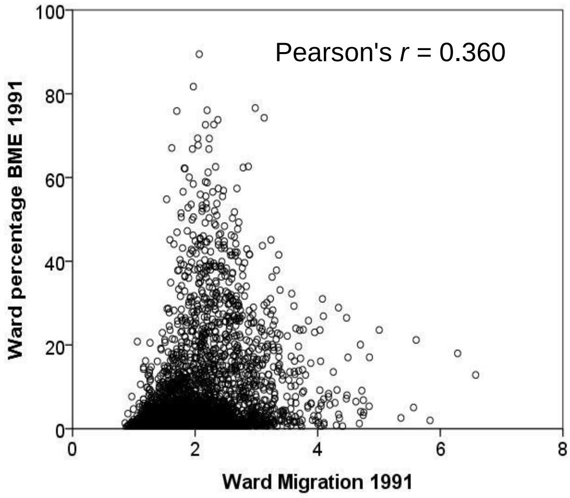
The relationship between Townsend index and gross migration rate for standard wards, (n = 7,932) in England.

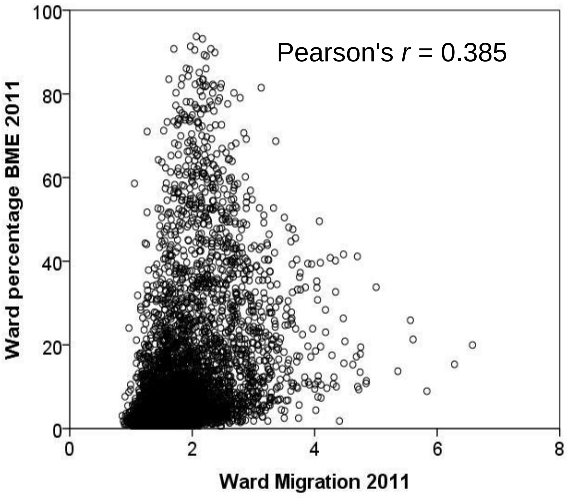


The relationship between population density and gross migration rate for standard wards, (n = 7,932) in England.



The relationship between percentage BME and gross migration rate for standard wards, (n = 7,932) in England.





Appendix 5: Comparison of models 5.1 and 5.2 with the addition of household level **p1**

Models presented in chapter 3 considered empty models with single individual level and multilevel ward and individual levels.

This appendix presents further sensitivity analysis to consider the impact of considering household as an additional level. This is important to consider as Within the data there is also an additional level of clustering of individuals within households. This is something that tends not to be addressed in existing empirical studies, (McCulloch 2001), however failing to account for this level of clustering and treating individuals within households as independent within a multilevel model will result in the household variance being transferred to variance at other levels (Tranmer & Steel 2001a, van den Noortgate et al 2005, Snijders & Bosker 2012).

Below are tables that compare empty models 5.1 and 5.2 presented in the thesis with empty models that also have a household level incorporated (models for the single wave of 1998 have been presented for brevity).

Belonging to neighbourhood	Just individual level (as model 5.1)		Individual and household levels		Individual and ward levels (as model 5.2)		All three levels	
1998	Est.	S.E.	Est.	S.E.	Est.	S.E.	Est.	S.E.
Constant (β_0)	3.671	0.010	3.653	0.011	3.616	0.012	3.627	0.012
σ^2_v Between ward variance					0.214	0.016	0.198	0.016
σ^2_u Between household variance			0.198	0.016			0.153	0.020
σ^2_e Between individual variance	0.879	0.013	0.683	0.013	0.680	0.014	0.541	0.013
Total variance	0.879		0.881		0.894		0.892	

Appendix 5: Comparison of models 5.1 and 5.2 with the addition of household level p2

Talk to neighbours 1998	Just individual level (as model 5.1)		Individual and household levels		Individual and ward levels (as model 5.2)		All three levels	
	Est.	S.E.	Est.	S.E.	Est.	S.E.	Est.	S.E.
Constant (β_0)	3.675	0.011	3.667	0.012	3.640	0.013	6.652	0.012
σ^2_v Between ward variance					0.176	0.018	0.170	0.015
σ^2_u Between household variance			0.168	0.018			0.116	0.022
σ^2_e Between individual variance	0.994	0.015	0.827	0.018	0.832	0.018	0.711	0.018
Total variance	0.994		0.995		1.008		0.997	

After consideration a decision was made not to include household as an additional level in the models. This was because the survey included all members of the household and so cannot be conceived of as a sample from a wider population of possible household members. Also the number of individuals per household is bounded by a low number.

However, the results presented in this appendix confirm that variance is transferred to levels not included in the model, once that level has been included. This is a further reason to treat the estimated variance for each level in the models presented with some caution.

Appendix 6a: Full results at each wave for model 5.8

Belonging **Model 8**	1998 Est.	1998 S.E.	2003 Est.	2003 S.E.	2008 Est.	2008 S.E.
Constant (β_0)	3.717	0.014	3.767	0.014	3.764	0.013
β_1 Age	0.0100	0.0010	0.0100	0.0010	0.0090	0.0010
β_2 Household Income	0.0020	0.0010	0.0060	0.0010	0.0000	0.0010
β_3 Moved	-0.235	0.024	-0.229	0.024	-0.148	0.026
β_4 Ward Townsend	-0.0310	0.0042	-0.0238	0.0045	-0.0332	0.0047
β_5 Ward BME	-0.0016	0.0013	-0.0031	0.0012	0.0007	0.0012
β_6 Ward Density	0.0007	0.0006	-0.0003	0.0006	-0.0005	0.0006
β_7 Ward Migration	-0.1408	0.0236	-0.0701	0.0227	-0.0594	0.0243
β_8 WTNSD*HHincome	0.00038	0.00020	0.00050	0.00021	0.00040	0.00020
σ^2_{u0}	0.135	0.013	0.146	0.016	0.174	0.017
σ^2_{e0}	0.664	0.014	0.570	0.015	0.511	0.015
DIC:	22578.9		17513.2		15643.2	
% variance ward	16.9%		20.4%		25.4%	
% variance individual	83.1%		79.6%		74.6%	

Talk **Model 8**	1998 Est.	1998 S.E.	2003 Est.	2003 S.E.	2008 Est.	2008 S.E.
Constant (β_0)	3.729	0.014	3.618	0.015	3.629	0.015
β_1 Age	0.0080	0.0010	0.0090	0.0010	0.0100	0.0010
β_2 Household Income	-0.0040	0.0010	-0.0020	0.0010	-0.0030	0.0010
β_3 Moved	-0.227	0.026	-0.143	0.028	-0.139	0.030
β_4 Ward Townsend	0.0004	0.0044	0.0032	0.0050	-0.0127	0.0054
β_5 Ward BME	-0.0001	0.0013	-0.0034	0.0014	-0.0006	0.0014
β_6 Ward Density	-0.0027	0.0007	-0.0025	0.0007	-0.0017	0.0007
β_7 Ward Migration	-0.1282	0.0247	-0.0865	0.0252	-0.1125	0.0280
β_8 WTNSD*HHincome	0.00020	0.00018	0.00041	0.00019	0.00048	0.00020
σ^2_{u0}	0.115	0.015	0.125	0.018	0.163	0.022
σ^2_{e0}	0.828	0.017	0.811	0.020	0.780	0.022
DIC:	24275.3		19700.9			
% variance ward	12.2%		13.3%		17.2%	
% variance individual	87.8%		86.7%		82.8%	

Appendix 6b: Full results at each wave for model 5.9

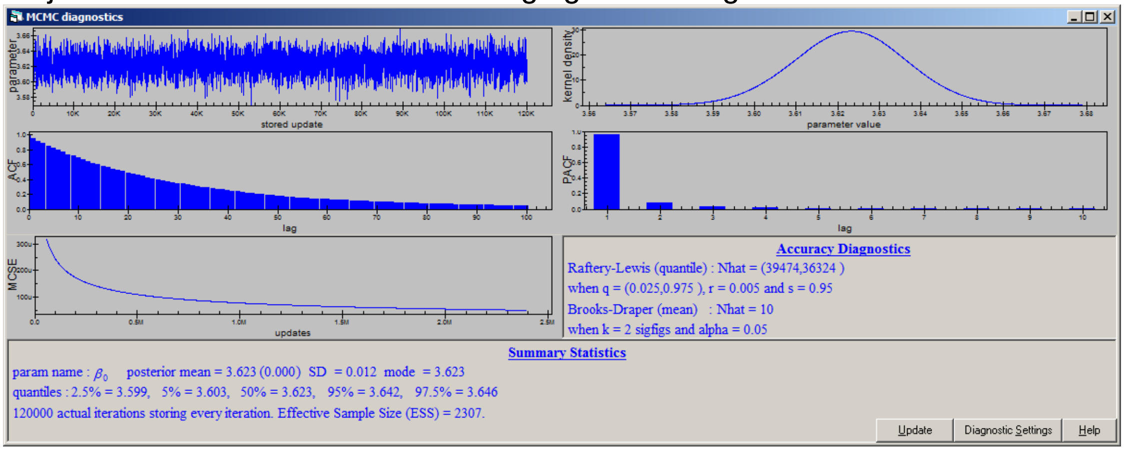
Belonging	1998		2003		2008	
Model 9	Est.	S.E.	Est.	S.E.	Est.	S.E.
Constant (β_0)	3.714	0.015	3.753	0.015	3.745	0.015
β_1 Age	0.0100	0.0010	0.0100	0.0010	0.0090	0.0010
β_2 Household Income	0.0017	0.0011	0.0056	0.0010	0.0005	0.0008
β_3 Moved	-0.235	0.024	-0.228	0.024	-0.144	0.026
β_4 Ward Townsend	-0.0310	0.0042	-0.0238	0.0045	-0.0334	0.0047
β_5 Ward BME	-0.0025	0.0021	-0.0062	0.0019	-0.0024	0.0018
β_6 Ward Density	0.0008	0.0006	-0.0002	0.0006	-0.0004	0.0006
β_7 Ward Migration	-0.1394	0.0238	-0.0665	0.0227	-0.0541	0.0243
β_8 WTNSD*WBME	0.00020	0.00030	0.00050	0.00030	0.00050	0.00020
σ^2_{u0}	0.135	0.013	0.146	0.016	0.174	0.016
σ^2_{e0}	0.664	0.014	0.570	0.015	0.511	0.015
DIC:	22578.2		17509.0		15641.3	
% variance ward	16.9%		20.4%		25.4%	
% variance individual	83.1%		79.6%		74.6%	

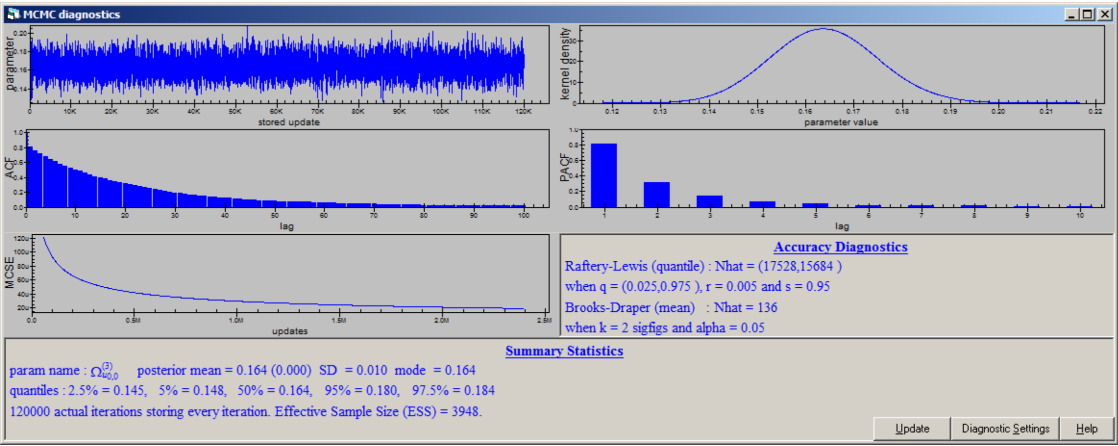
Talk	1998		2003		2008	
Model 9	Est.	S.E.	Est.	S.E.	Est.	S.E.
Constant (β_0)	3.719	0.016	3.602	0.017	3.598	0.017
β_1 Age	0.0070	0.0010	0.0090	0.0010	0.0100	0.0010
β_2 Household Income	-0.0039	0.0011	-0.0020	0.0012	-0.0032	0.0010
β_3 Moved	-0.228	0.026	-0.142	0.028	-0.135	0.030
β_4 Ward Townsend	0.0005	0.0044	0.0032	0.0049	-0.0128	0.0054
β_5 Ward BME	-0.0027	0.0022	-0.0069	0.0021	-0.0059	0.0021
β_6 Ward Density	-0.0026	0.0007	-0.0024	0.0007	-0.0014	0.0007
β_7 Ward Migration	-0.1241	0.0249	-0.0826	0.0253	-0.1040	0.0281
β_8 WTNSD*WBME	0.00050	0.00030	0.00060	0.00030	0.00090	0.00030
σ^2_{u0}	0.115	0.015	0.125	0.018	0.161	0.022
σ^2_{e0}	0.828	0.017	0.810	0.020	0.780	0.022
DIC:	24273.7		19695.5		18026.5	
% variance ward	12.2%		13.4%		17.1%	
% variance individual	87.8%		86.6%		82.9%	

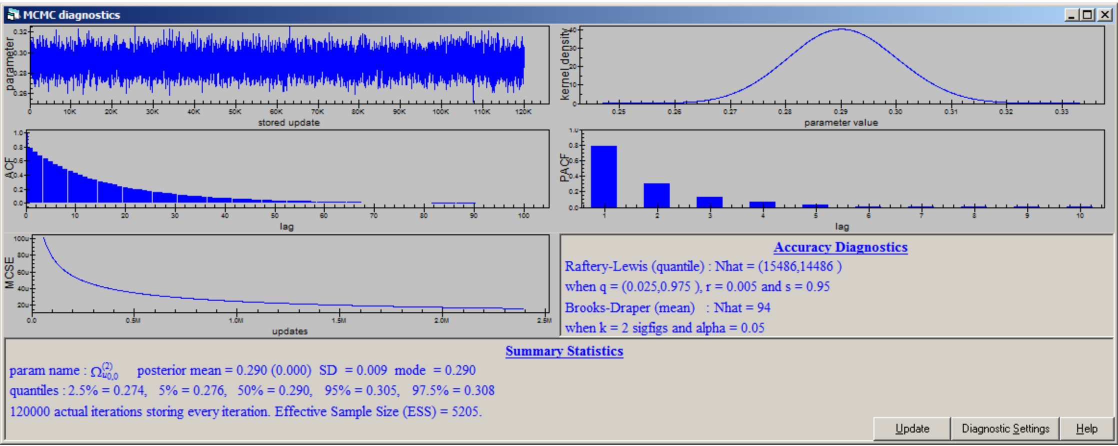
Appendix 7. Trajectories and residuals from empty three level empty cross classified model, model 6.1 p1.

Output screenshots produced using MLWiN software (Rasbash et al 2005)

Trajectories for the outcome of belonging to the neighbourhood.



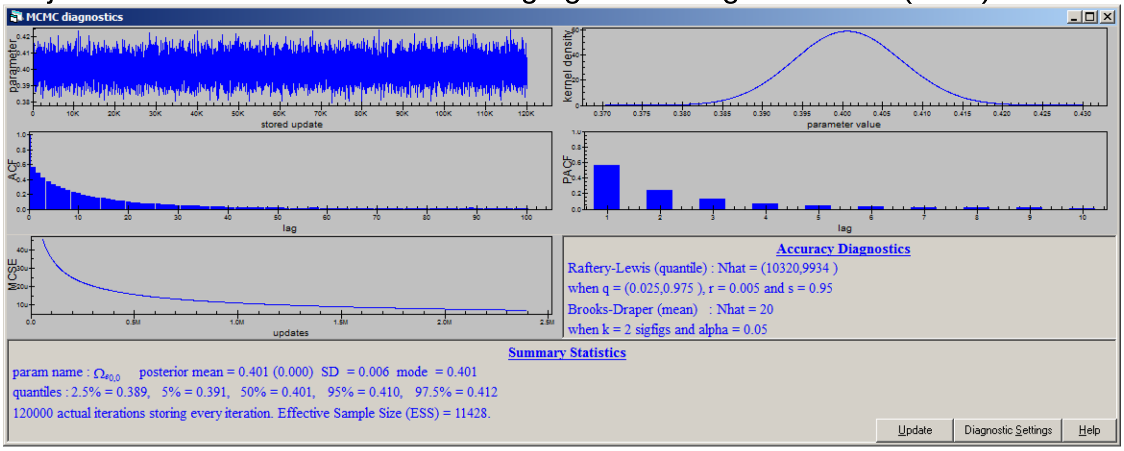




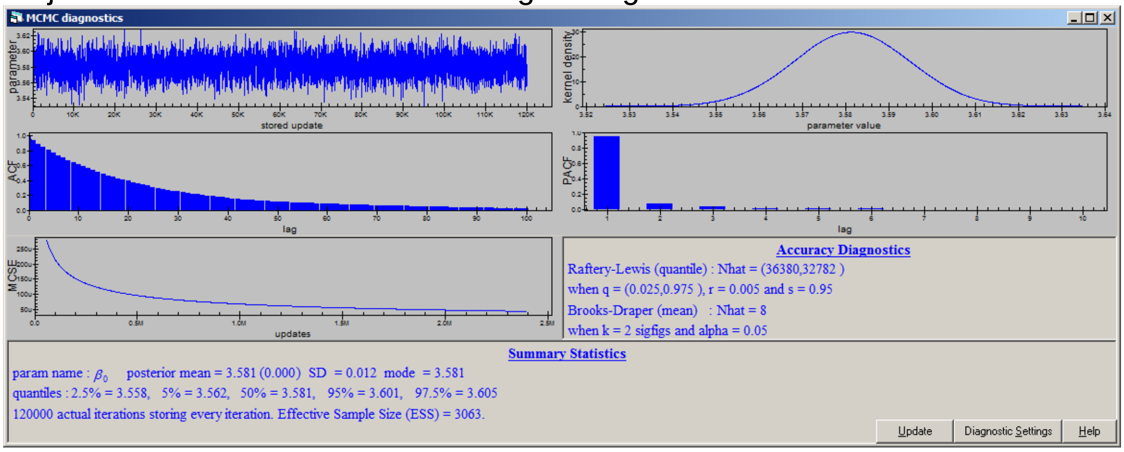
<u>**Appendix 7. Trajectories and residuals from empty three level empty cross classified model, model 6.1 p2.**</u>

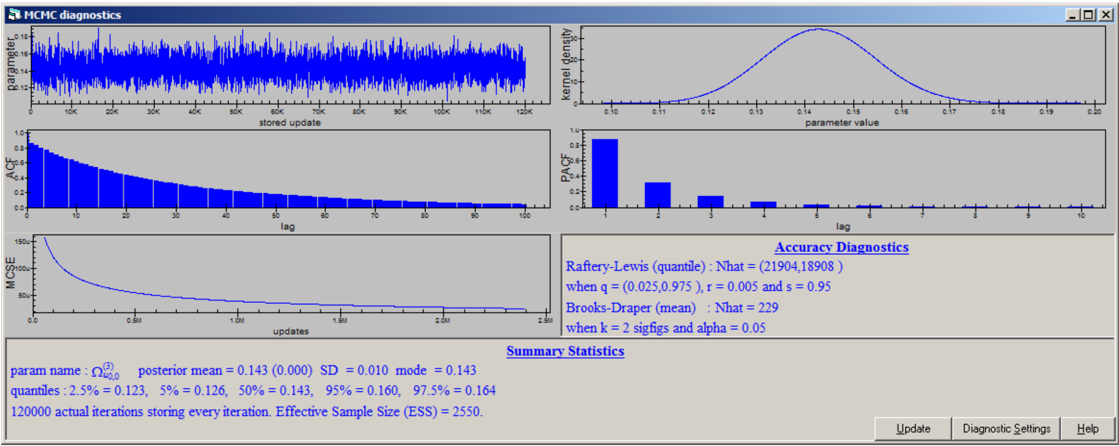
Output screenshots produced using MLWiN software (Rasbash et al 2005)

Trajectories for the outcome of belonging to the neighbourhood (cont.)



Trajectories for the outcome of talking to neighbours.

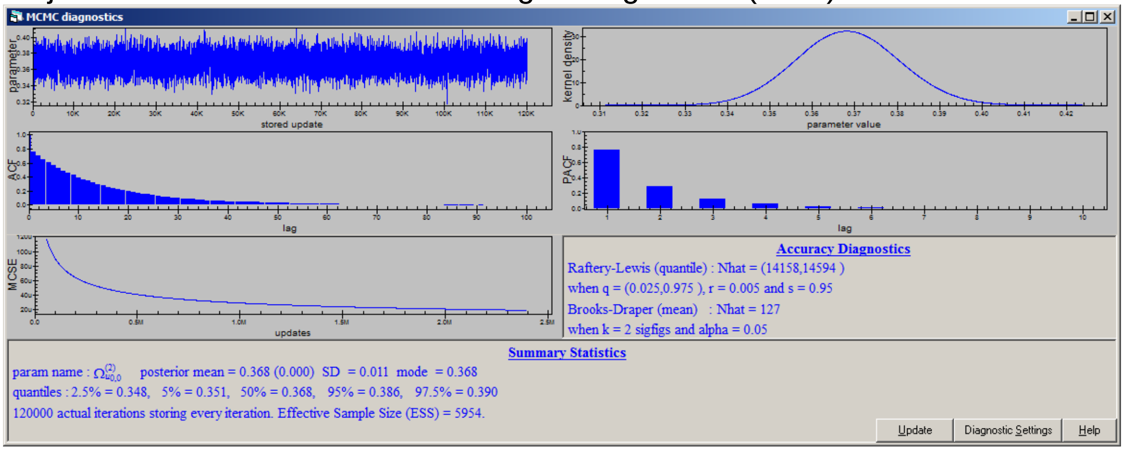


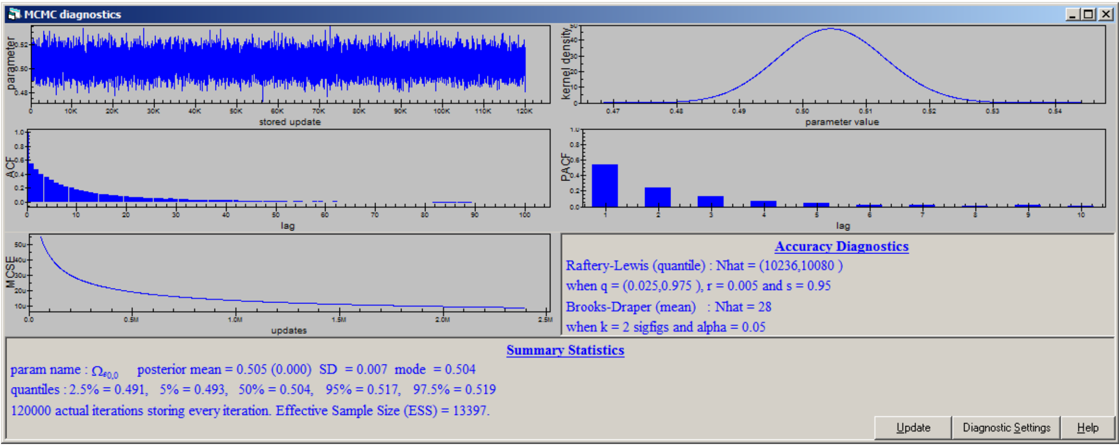


Appendix 7. Trajectories and residuals from empty three level empty cross classified model, model 6.1 p3.

Output screenshots produced using MLWiN software (Rasbash et al 2005)

Trajectories for the outcome of talking to neighbours (cont.).



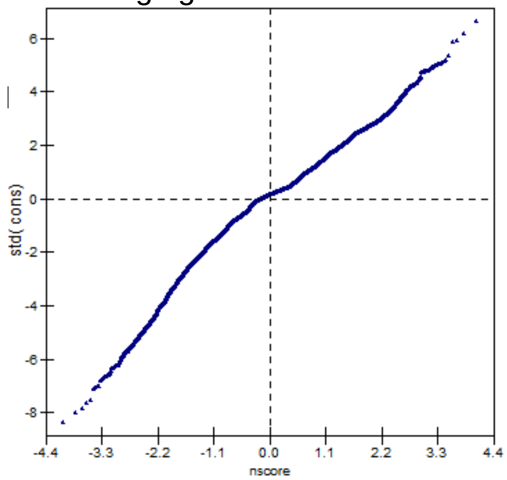


Appendix 7. Trajectories and residuals from empty three level empty cross classified model, model 6.1 **p4.**

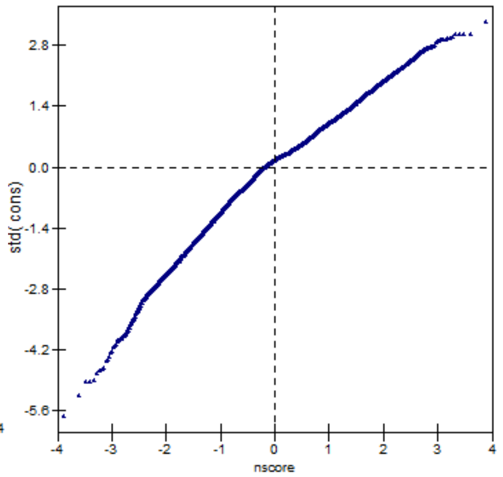
Output screenshots produced using MLWiN software (Rasbash et al 2005)

Residuals

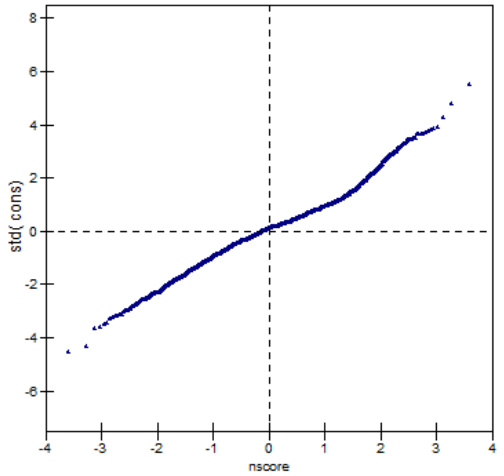
Belonging: Level 1 Occasion



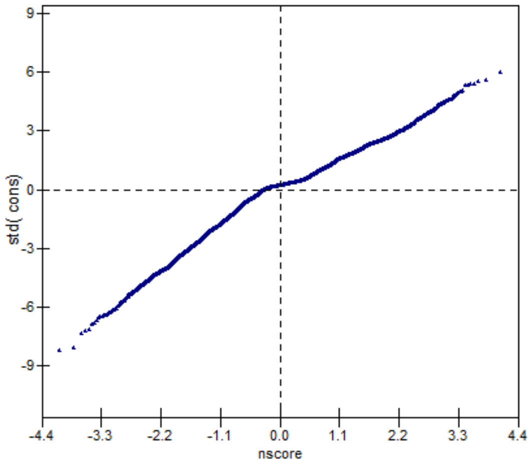
Belonging: Level 2: Individual



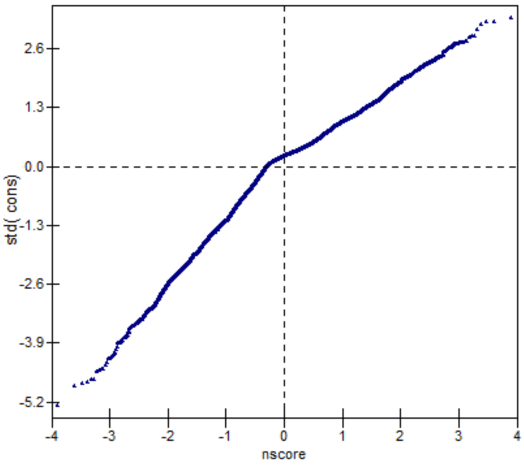
Belonging: Level 3: Ward



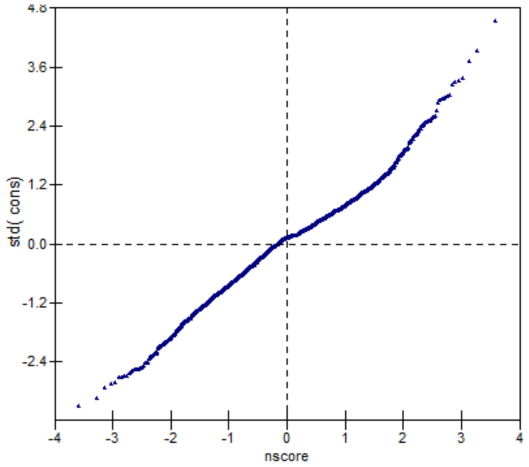
Talk: Level 1 Occasion



Talk: Level 2 Individual



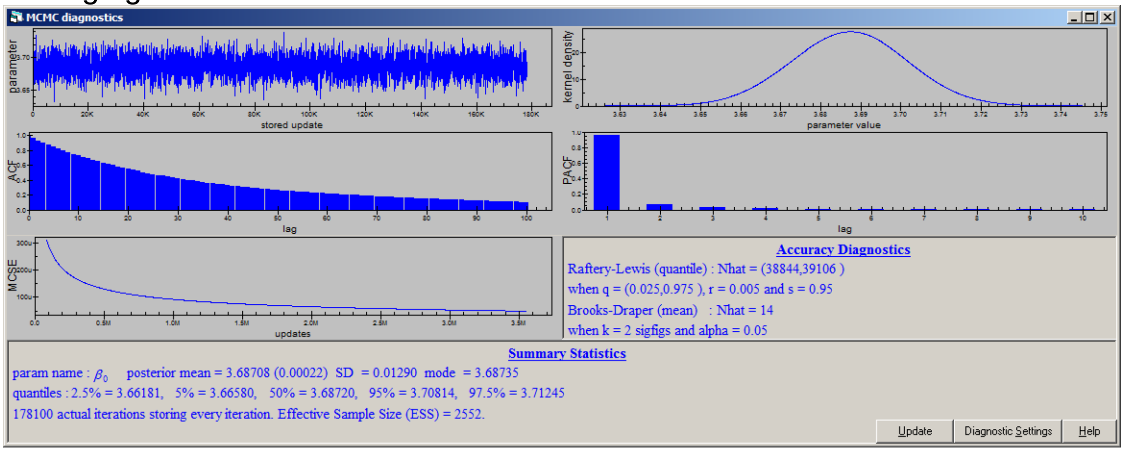
Talk: Level 3 Ward

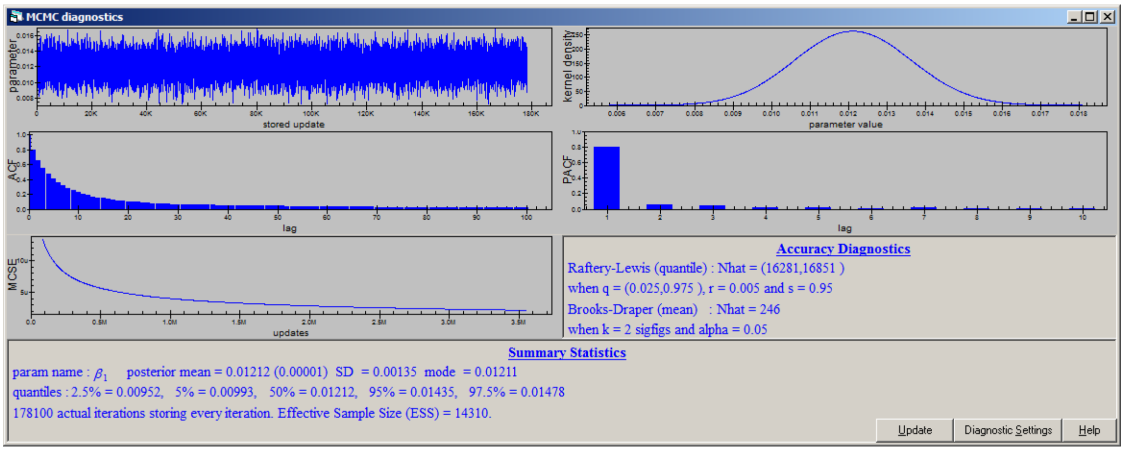


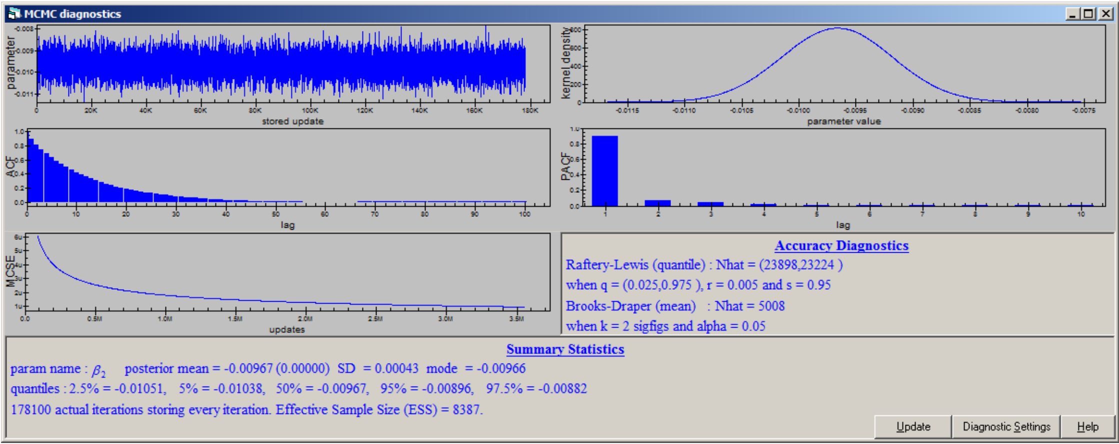
Appendix 8. Trajectories and residuals from final three level empty cross classified model, model 6.5 p1.

Output screenshots produced using MLWiN software (Rasbash et al 2005)

Belonging Final Model:



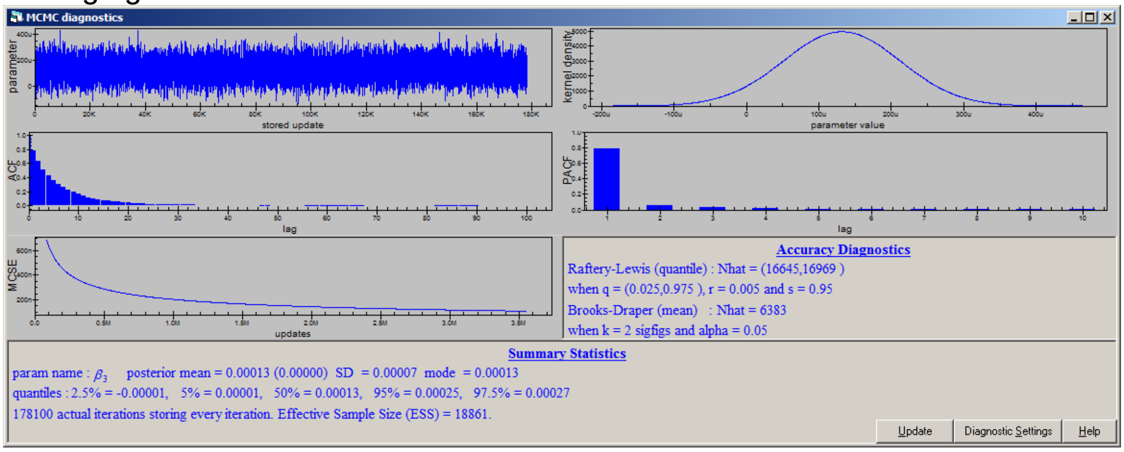


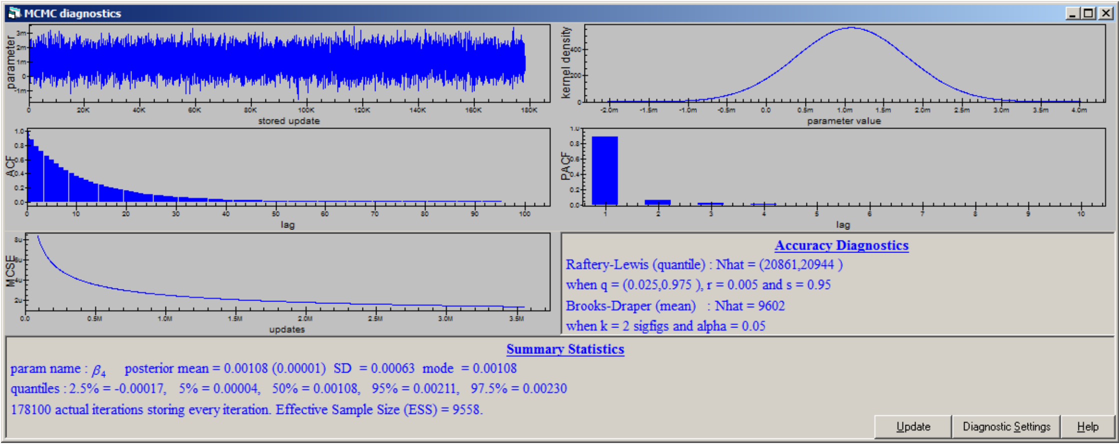


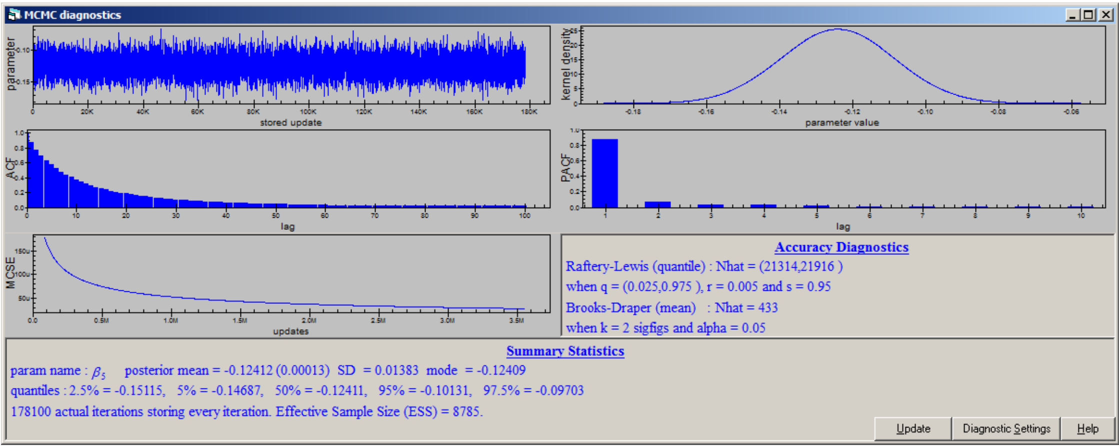
Appendix 8. Trajectories and residuals from final three level empty cross classified model, model 6.5 p2.

Output screenshots produced using MLWiN software (Rasbash et al 2005)

Belonging Final Model:



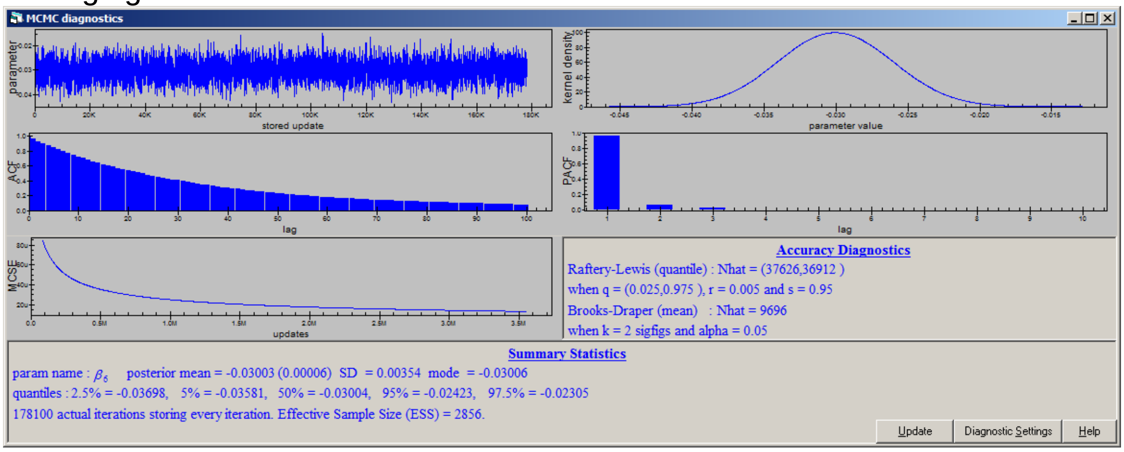


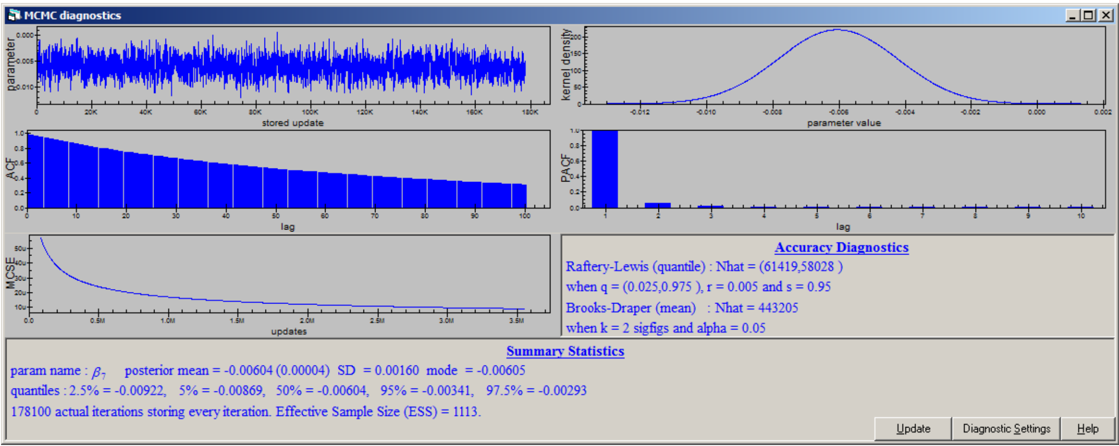


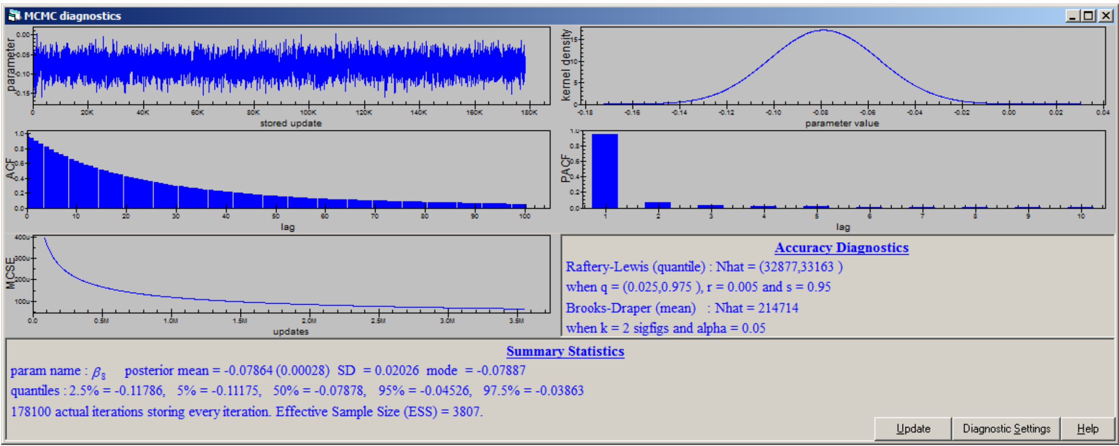
Appendix 8. Trajectories and residuals from final three level empty cross classified model, model 6.5 p3.

Output screenshots produced using MLWiN software (Rasbash et al 2005)

Belonging Final Model:



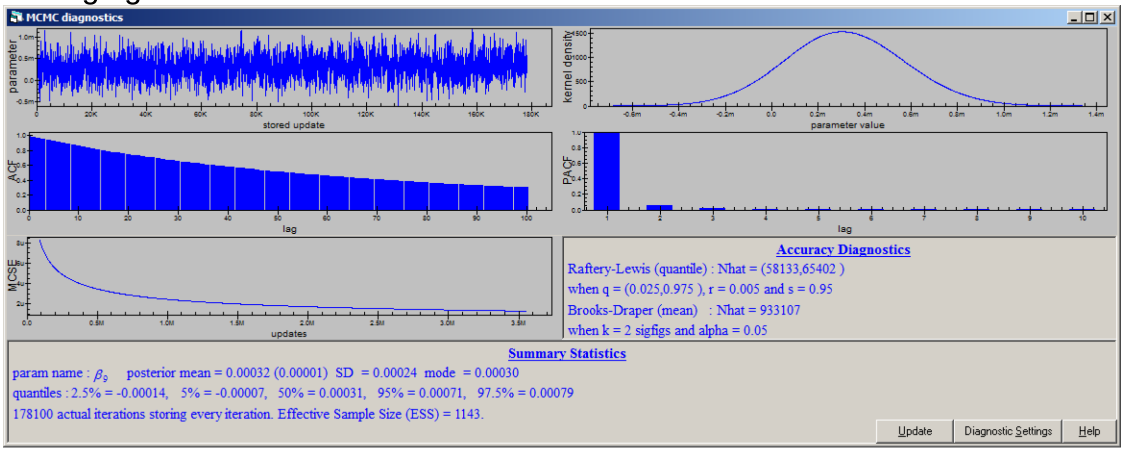


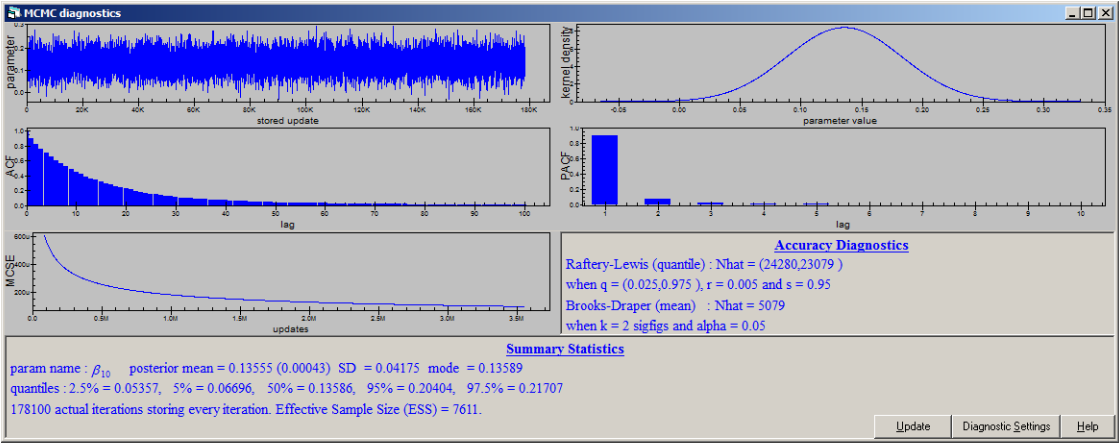


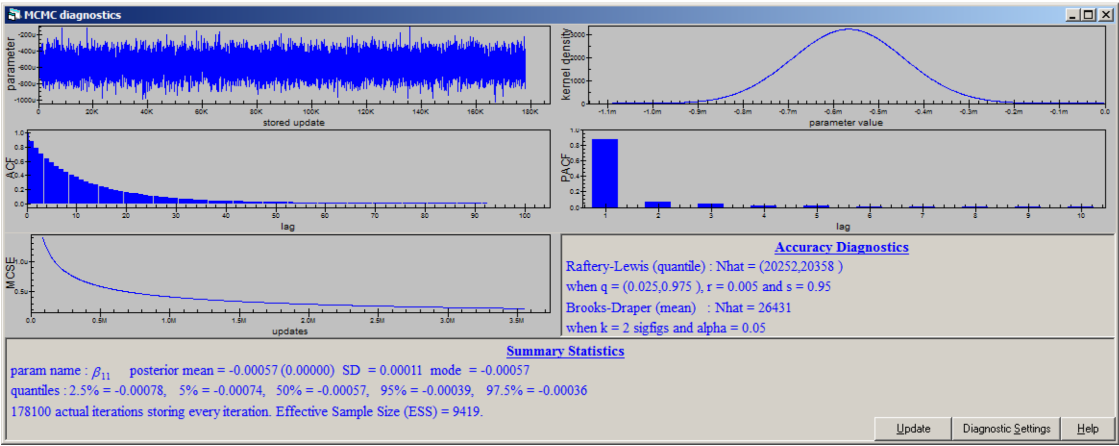
Appendix 8. Trajectories and residuals from final three level empty cross classified model, model 6.5 p4.

Output screenshots produced using MLWiN software (Rasbash et al 2005)

Belonging Final Model:



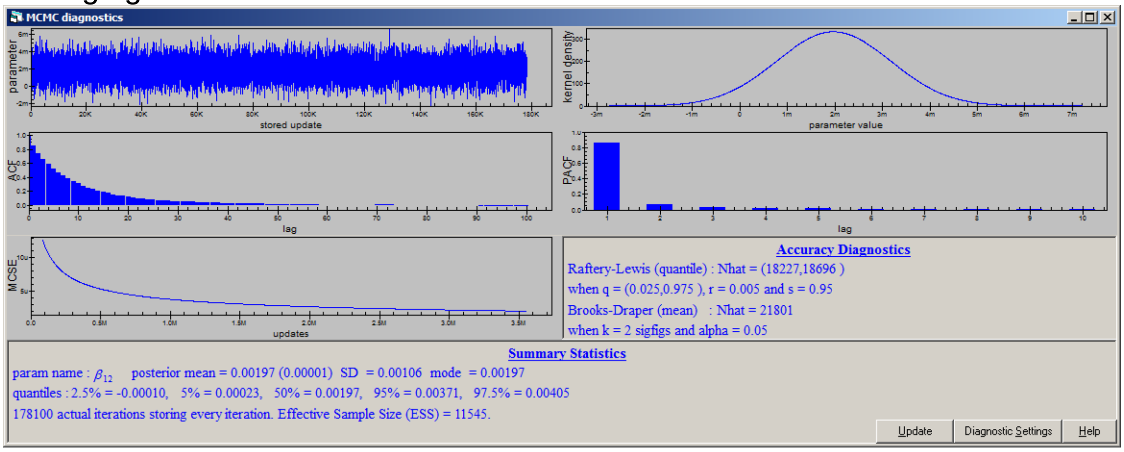


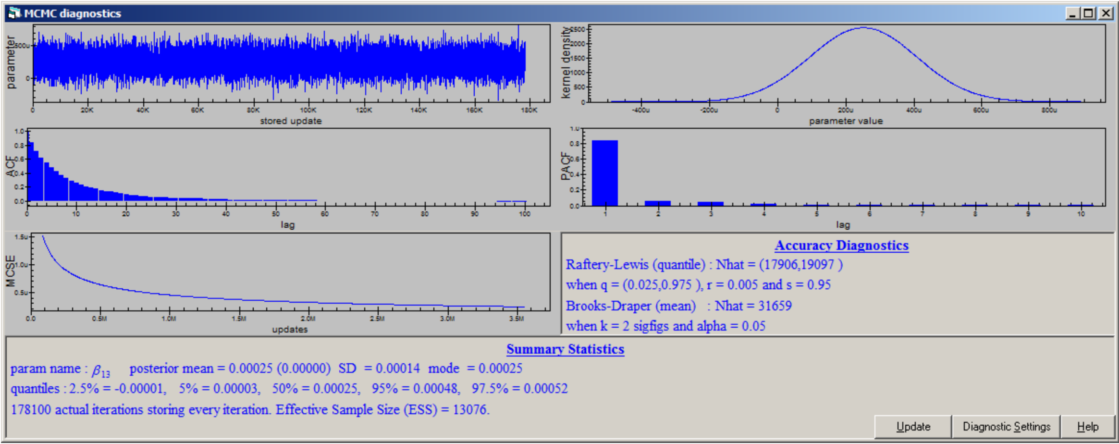


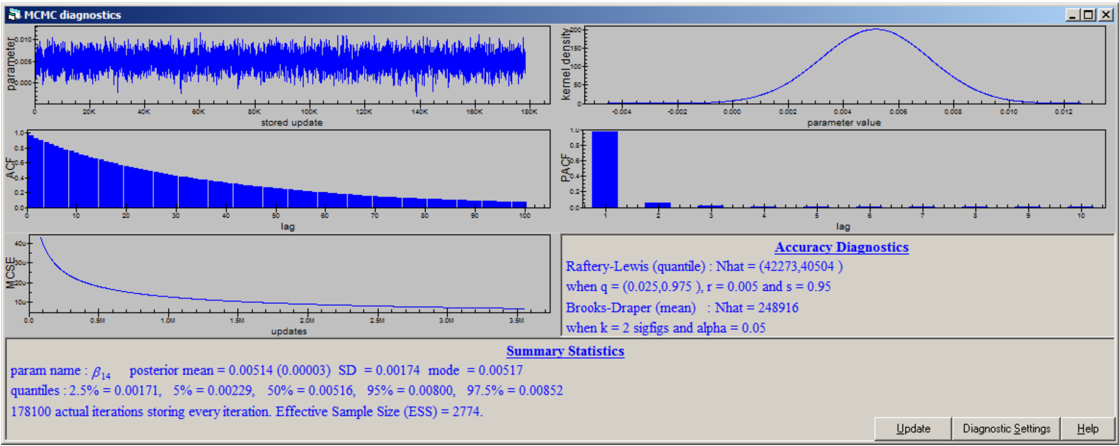
Appendix 8. Trajectories and residuals from final three level empty cross classified model, model 6.5 p5.

Output screenshots produced using MLWiN software (Rasbash et al 2005)

Belonging Final Model:



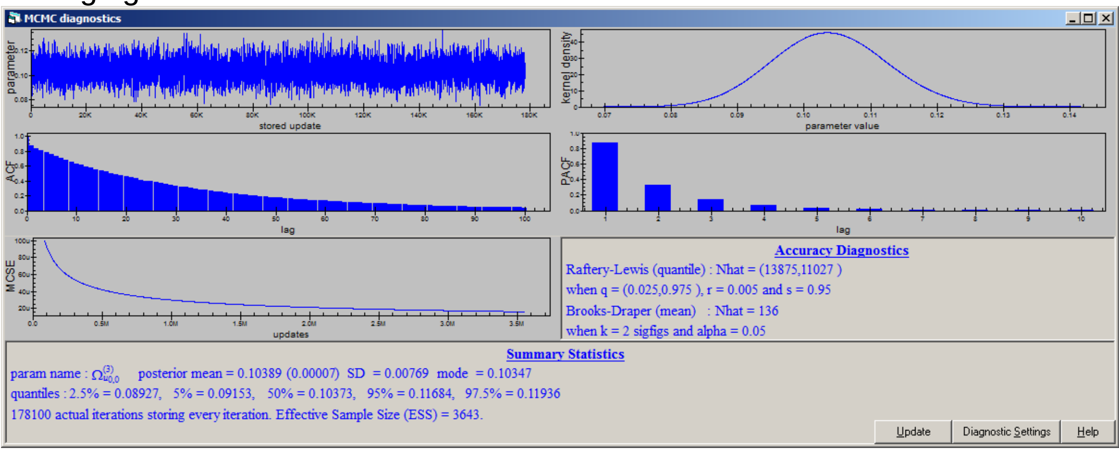


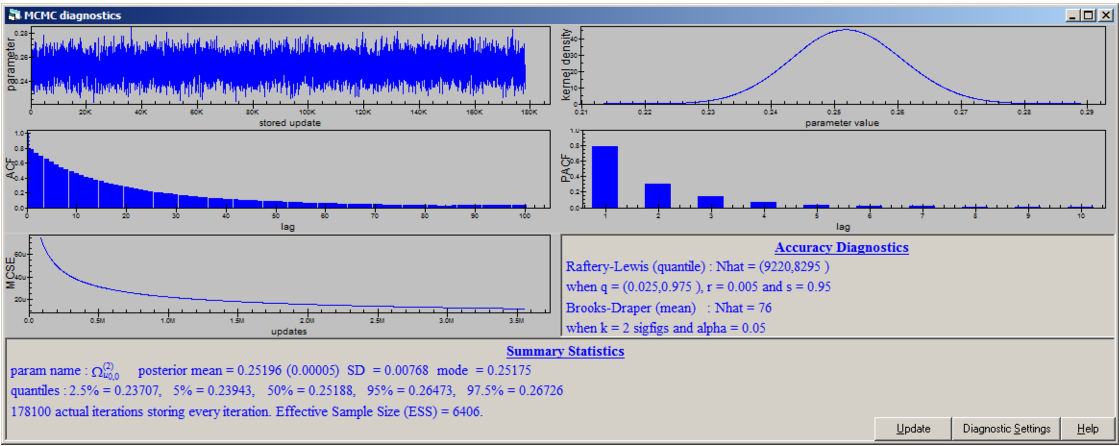


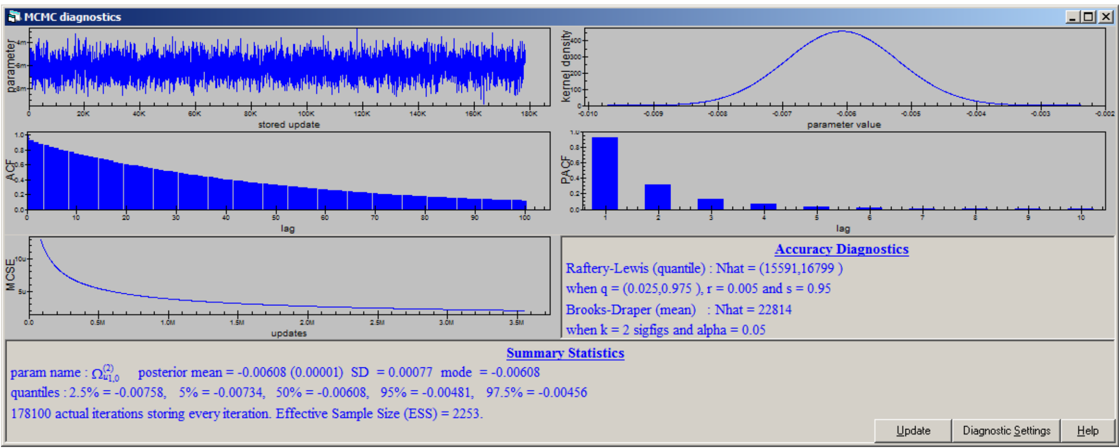
Appendix 8. Trajectories and residuals from final three level empty cross classified model, model 6.5 **p6.**

Output screenshots produced using MLWiN software (Rasbash et al 2005)

Belonging Final Model:



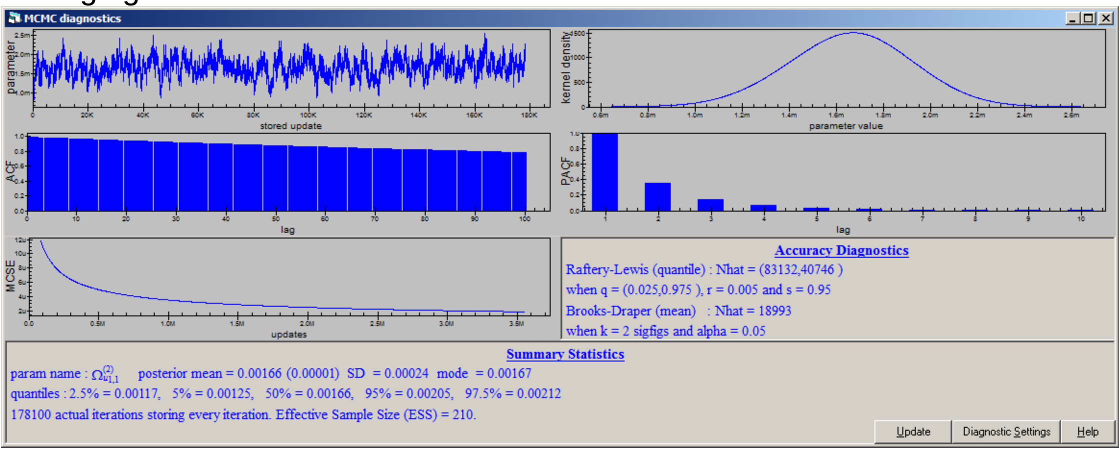


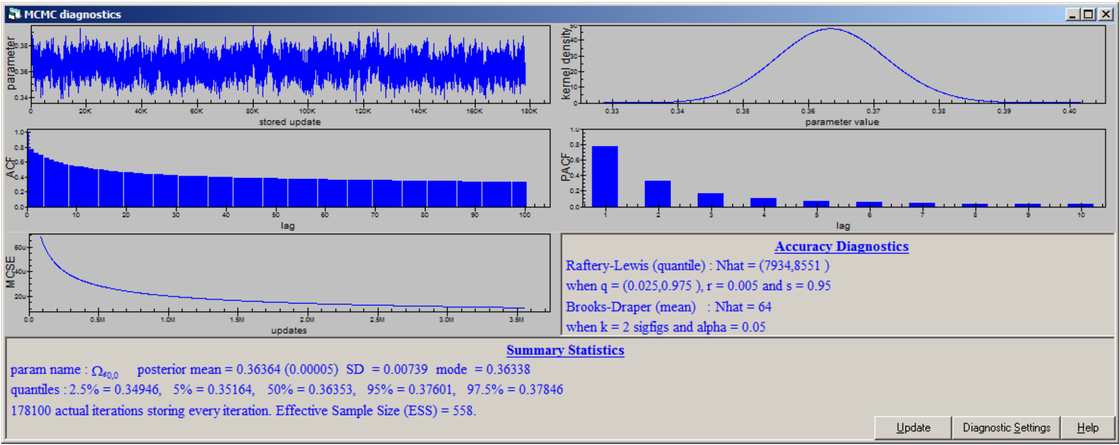


Appendix 8. Trajectories and residuals from final three level empty cross classified model, model 6.5 p7.

Output screenshots produced using MLWiN software (Rasbash et al 2005)

Belonging Final Model:

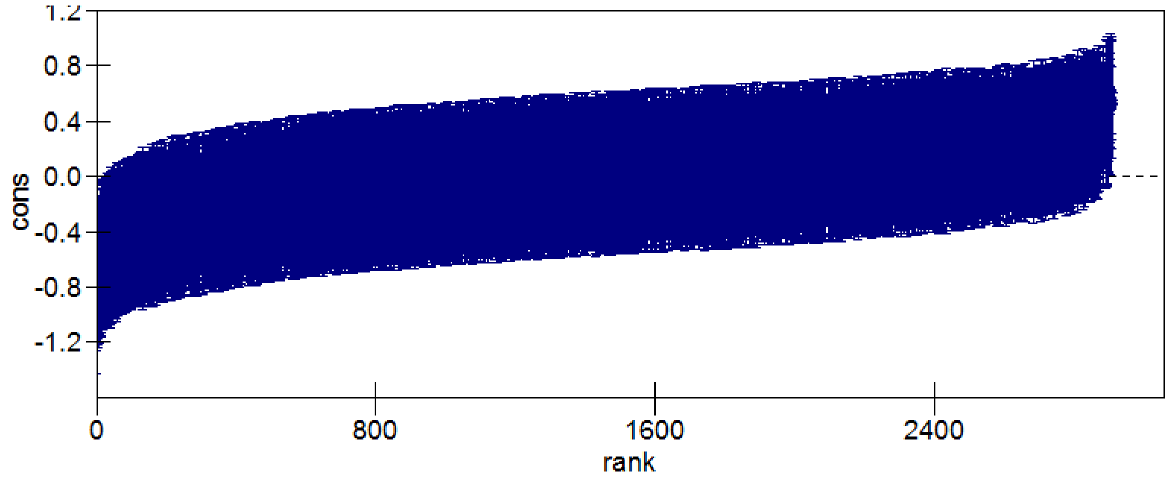


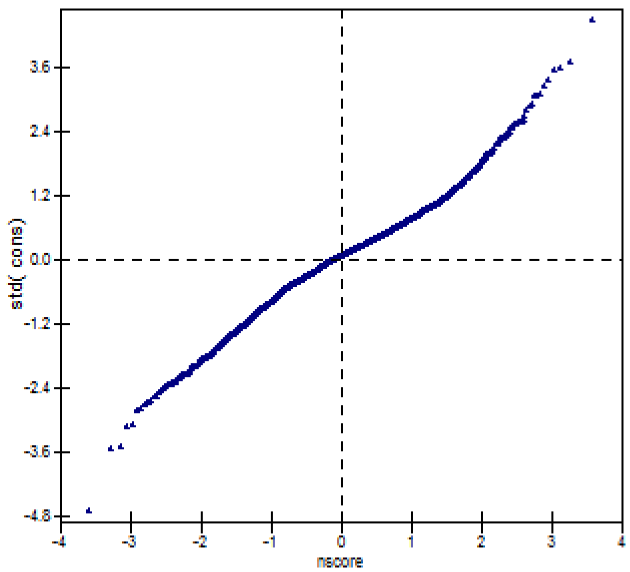


Appendix 8. Trajectories and residuals from final three level empty cross classified model, model 6.5 **p8.**

Output screenshots produced using MLWiN software (Rasbash et al 2005)

Belonging Final Model: Residuals
Level 3 - Ward



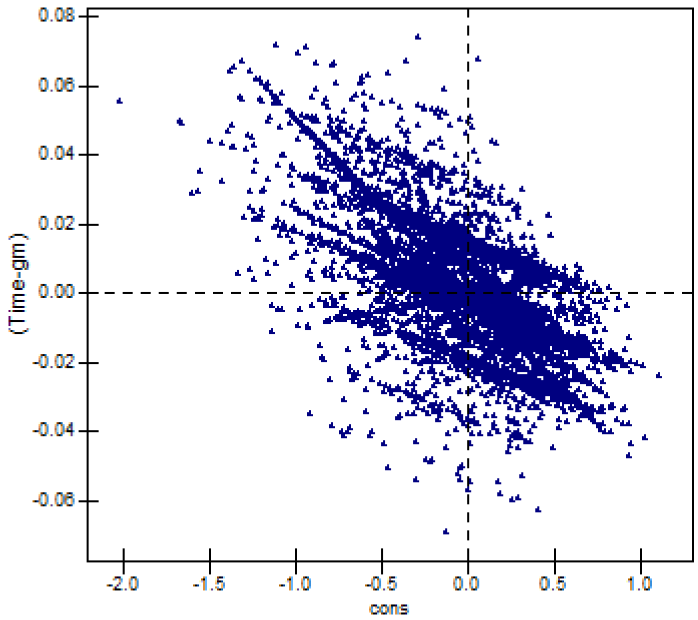


Appendix 8. Trajectories and residuals from final three level empty cross classified model, model 6.5 **p9.**

Output screenshots produced using MLWiN software (Rasbash et al 2005)

Belonging Final Model: Residuals
Level 3: Individual

Pair wise residuals random intercept and random slope



Belonging Final Model: Residuals
Level 1: Occasion