Title:

Making the case for Qualitative Comparative Analysis (QCA) in geographical research: a case study of health resilience

Authors:

Cairns JM[1], Wistow [1,2], Bambra C[1,3*]

[1] Fuse – the UKCRC Centre for Translational Research in Public Health, Institute of Health & Society, Newcastle University, Newcastle, NE2 4AX.

[2] School of Applied Social Sciences and Centre for Health and Inequalities Research, Durham University, 32 Old Elvet, Durham, DH1 3HN, UK.

[3] Department of Geography and Centre for Health and Inequalities Research, Durham University, South Road, Durham, DH1 3LE, UK.

(*Corresponding author: Professor Clare Bambra;clare.bambra@durham.ac.uk)

Abstract:

This paper discusses the utility of using Qualitative Comparative Analysis (QCA) in geographical research following the ‘complexity turn’. Although QCA methodology has increasingly been applied in other social science disciplines, it is not widely used by geographers. The major benefit of QCA is that it can handle complexity by exploring different pathways that generate the same outcome, which applies to much spatial research. Significantly, QCA is case - rather than variable - oriented which is hugely important when considering the significance of context. In this paper we illustrate how QCA can be applied in the discipline of geography through a case study of area-level health resilience. We argue that QCA can be usefully applied to such geographical questions as it aids our understanding of the complex processes that lead to spatial variations in health. Moreover, QCA enables geographical research to bridge the quantitative-qualitative divide. We conclude that QCA has great potential for exploring the complex, spatial factors that influence area-level health resilience by being context-sensitive and case-oriented. We make the case for applying this methodology in future geographical research.

Keywords:

QCA; quantitative-qualitative; geography; health resilience; complexity; England

Abstract word count: 180

Main text:

Introduction

This paper discusses the utility of using Qualitative Comparative Analysis (QCA) in geographical research following the 'complexity turn'. QCA is increasingly being used in the social sciences to address issues of causation, particularly by two disciplines: sociology and political science. Health geography has long been concerned with identifying causation and association, often via the multiple and complex pathways that contribute to spatial variations in health and access to health care. QCA could enable health geographers to identify complex pathways by allowing the examination of different combinations (or *configurations*) of conditions that generate the same outcome, rejecting the notion that there is one causal pathway leading to an outcome (a reductionist critique levied at quantitative statistical analysis techniques like regression analysis). The extent to which contextual explanations explain spatial variations in health outcomes has typically been examined through traditional statistical modelling techniques to tease out the relative contribution of 'context' compared to 'composition', which has been critiqued as being an oversimplification (Bernard et al 2007) and even suggested to be a 'false dualism' (Cummins et al 2007). Since QCA is a context-sensitive method, it therefore seems a very appropriate method for geographers to use, as it can consider context contextual information about place in relation to characteristics of human and organisation systems *and* be used to generate insights about variations in outcomes. Among others, Wistow et al (2015) argue that QCA encourages researchers to identify and interpret the complexity of social systems by providing systematic cross-case comparisons that are the basis for further qualitative deduction.

Recently, Rosenberg (2015) talks of a methodological divide within health geography between quantitative and qualitative methods stating that 'quantitative methods can provide the context for more in-depth qualitative research or, conversely, that qualitative research can be used to inform quantitative research' (p.1). In human geography, as is the case in the social sciences more generally, there is still though a strong methodological divide (Harvey 1997; Kwan 2004; Rosenberg 2015; Sui & DeLyser 2012), especially since the 'cultural turn' (the reorientation of human geography concerns towards the cultural studies – see Barnett 1998). We argue that QCA provides an approach that allows quantitative and qualitative data to be coded into a consistent format and analysed across cases. In so doing, Wistow et al (2015), and among others, argue that QCA encourages researchers to identify and interpret the complexity of social systems by providing systematic cross-case comparisons drawing on a range of data that are the basis for further qualitative deduction.

In this paper, we argue that QCA can be used to bridge the quantitative-qualitative divide in geographical research as both types of data can be included in a QCA and can be in the form of either binary data (crisp set) or ordinal (fuzzy set). The method thereby overcomes some of the limitations of traditional qualitative and quantitative research. We demonstrate the potential of QCA for health geography research (and indeed human geography more widely) by applying the methodology to a case study of 'health resilience'. This paper provides an overview of the QCA methodology and provides the first 'test' of its value in geographical research.

Theoretical frameworks

Complexity theory

Following the 'complexity turn' within the social sciences, health geographers have considered the application of complexity theory to understanding variations in health outcomes (Curtis and Riva 2010; Gatrell (2005)). Underlying complexity theory's assumptions is that causation is complex and non-linear. Non-linearity is the rejection of the proportionality of cause and effect (Blackman 2006). This is the idea that small changes in one part of the system can have large effects across the whole system (Kernick 2006). Complexity can arise with the interaction of elements within a complex system. As a result of this interaction it is not as simple as 'A causes B' (Blackman 2006). Instead, complexity arises when there is an 'interaction between many elements, such as the relationship between A and B depending on interactions with C, D or E' (Blackman 2006, 31). Complexity theory is characterised as being anti-reductionist. It is viewed as holistic as it acknowledges that a system must be analysed not just by the sum of its individual components but in terms of the interactions between these components (Cilliers 1998) and this is in aligned to the more contemporary notions of relational space as discussed by Cummins et al (2007) above. Complex systems are also path-dependent, so 'history matters' (Byrne 2005; O'Sullivan 2004) and this logic fits with health geographers' understanding that health and disease need to be considered within their broader political, social and economic contexts, which evolve over time and space (Curtis and Riva 2010) as well as being important for interpreting QCA configurations comprising different pathways to the same outcome. Joyce (2007) also adopts a relational approach by using complexity as a theoretical framework to address issues involved in public health decision-making. She argues that contemporary public health advocates a move away from traditional positivist and reductionist understandings of population health to a more complex, non-linear understanding of population health problems. She contends that the use of linear and reductionist approaches to explore public health problems can lead to 'misunderstanding and de-contextualisation' (Joyce 2007, 77-78).

This thinking is aligned with QCA's assumptions about causality with the move away from the 'net effects' thinking that dominates conventional quantitative analysis, which is linear and additive to thinking about how different combinations of conditions may generate the same outcome. Gatrell (2005, 2665), for example, argues that 'complexity is about relationships that cannot simply be reduced to simple linear models or their variants (such as logistic regression)'. New methodologies are required to undertake complexity research and, in this paper, we argue that QCA is one such method because it is able to overcome the limitations of traditional quantitative methods by taking a non-linear, pathway approach that also involves qualitative interpretation.

Health resilience

There is a well-established geographical literature that demonstrates the area-level relationship between socio-economic deprivation and poorer population health (e.g. Shaw et al., 1999; Mitchell et al., 2009). Within this field of research, particular attention has been paid to outlying cases, most notably those areas that have worse health than similarly deprived areas. The excess mortality in Glasgow (the so-called Glasgow effect) is an example (Walsh et al., 2010; Popham and Boyle, 2011). More recently though, there has been an interest in those areas that exhibit better health outcomes than would be expected given their level of deprivation (Doran et al., 2006; Tunstall et al., 2007; Cairns et al., 2012). For example, Doran and colleagues (2006) found that life expectancy was negatively associated with deprivation across English local authorities, but they also identified some local authorities that had higher life expectancy than would be expected given their levels of deprivation. Similarly, Tunstall and colleagues (2007) examined mortality rates between 1981 and 2001 in the 54 most deprived parliamentary constituencies in the UK. They found that eighteen areas had lower mortality than would be expected given their levels of deprivation. This 'defying the odds' has been conceptualised in the literature as 'health resilience': the capability of communities *"to cope successfully (in terms of health) in the face of significant adversity or risk"* (Tunstall et al, 2007, p.337). This paper uses 'health resilience' as a case study drawing on data from previous qualitative and quantitative studies (Cairns and Bambra, 2013). Health resilience is operationalised as 'areas that exhibit better health outcomes than would be expected given their level of deprivation' (Cairns and Bambra, 2013: 231).

Methodology

Qualitative Comparative Analysis

Qualitative Comparative Analysis (QCA) is a configurational analysis method: a configuration is the set of characteristics of the cases. This method analyses cases by revealing sub-groups across them and allows researchers to develop set-theoretic knowledge about causality. It provides a resource for systematic comparative analysis while retaining the case as the unit of analysis. We argue that this method can be used to bridge the quantitative-qualitative divide as both types of data can be included in a QCA and can be in the form of either binary data (crisp set) or ordinal (fuzzy set). The method therefore overcomes some of the limitations of traditional qualitative and quantitative research.

QCA is a case-oriented rather than variable-focused approach; it therefore requires familiarity with cases which demands in-depth knowledge of a place. The method does not involve specifying a single model that best fits the data, but instead involves determining the number and character of different models leading to an outcome of interest that exist among the cases (Berg-Schlosser et al 2009), so recognising various pathways toward the same outcome. As such QCA is multi-directional (non-linear) and in so doing manages to delineate the diversity of cases with regards to their different conditions and contexts and this is achieved by comparing cases as configurations. The configurational approach of QCA assists with the development of set-theoretic knowledge around types of cases and how these associate with outcomes. The notion of cases as configurations of conditions has a close connection to complexity theory and emphasises the significance of interactions and dynamics between conditions and how these configure in non-linear ways. This method can be used for a range of purposes including typology building, testing existing theories and developing new theories or assumptions. QCA works with small *N*s typically between 5-50 cases. Two of the main advantages of QCA are replicability and transparency (Rihoux 2006), which is a limitation of traditional qualitative research. Indeed, as Blackman et al (2011) argue, QCA enables causal arguments to be made by creating a very close correspondence between theory and data analysis.

There are six stages involved in QCA analysis (Rihoux and Ragin 2009): building the 'data table'; constructing the 'truth table'; resolving contradictory configurations; Boolean minimisation based on the idea of maximum parsimony (the minimal formulas resulting from the analysis); consideration of 'logical remainders'; and, lastly, interpretation. These stages relate to a process that Rihoux and Lobe (2009) describe as the 'funnel of complexity', wherein the researcher/s reduce the inherent complexity of cases to some level of parsimony, so as to be able to draw meaningful comparisons between cases and then conduct further 'downstream: interpretation' by developing set-theoretic knowledge about different types of cases. ***Data***

This paper utilises quantitative and qualitative data collected from a mixed-methods study that considered area level health resilience -the ability of some areas (wards) to 'defy the odds' by achieving better than expected population health outcomes given their level of socio-economic deprivation (Cairns and Bambra, 2013). Quantitative research methods (secondary data analysis) identified areas in England that 'over-performed' in health terms (morbidity or mortality) relative to their level of deprivation. These were classified as exhibiting 'health resilience'. An in depth qualitative case study of one of these resilient areas was then conducted using focus groups and semi-structured interviews (Cairns and Bambra, 2013). ***Analysis***

The methodology that is applied in this paper is crisp set QCA. This was originally developed by Charles Ragin (1987). This approach involves the selection of a range of conditions considered to be relevant to the outcome under investigation. In this QCA analysis, the outcome of interest is area level health resilience (coded as either 1=resilient; 0=not resilient). There are four conditions of interest that were identified from the qualitative case study as potentially contributing to area level health resilience: greenspace; gardens; social capital; and crime. For the crisp set QCA analysis these conditions were odichotomised as follows: greenspace ('green'; 1= high presence; 0=low or no presence), gardens (1= high presence; 0= low or no presence), social capital ('socCap'; 1=high; 0=low) and crime (1=low; 0=high). The conditions therefore represent differences in *kind* rather than *degree* and rely on judgement and justification for setting the thresholds. We set the following thresholds to determine whether there was a 'high' amount of each outcome - if areas had scores in the highest quartile, then these were coded as '1' with the other three quartiles coded as '0' (Table 1). The conditions were chosen based on qualitative interpretation from the case study findings whilst the thresholds were based on the statistical mean - thus combining both qualitative and quantitative data in analysis.

csQCA analysis was conducted using the fsQCA software. This can be downloaded freely from http://www.compasss.org/.

Findings

Table 2 shows the data table, in which each row represents an individual case (an area). Table 3 - the key output known in QCA as the 'truth table' - shows that there are six configurations (denoted by the black boxes) leading to health resilience. A coding of '1' is positively associated with health resilience. Each of these configurations can therefore be viewed as a separate *pathway* to health resilience. For example, the configuration consisting of the presence of greenspace, presence of gardens, high social capital and low crime covers three cases that are all health resilient (5th row, Table 3). This is the configuration which is most consistent with the health geography literature on salutogenic links between health and place (Bambra, 2016). This configuration has a consistency score of 1, because there are no contradictory cases within this configuration. Contradictory cases are those that have similar inputs but a different outcome i.e. where there is green space, gardens, high social capital and low crime but no health resilience. The first row in table 3 is a configuration consisting of four cases with a consistency score of 0.75 (i.e. 3 out of the four cases with this configuration exhibit health resilience). This configuration has high social capital, low crime, but an absence of greenspace, and an absence of gardens. Consequently, the social environment appears to have more importance than the natural environment in terms of pathways to health resilience in these cases. The contradictory case here provides an interesting example of causal complexity and non-linearity - as the same outcome results from a different configuration of inputs. The truth table output is effective at identifying these contradictory cases and targeting further qualitative interpretation around these. For example, it would be possible to consider in more detail the nature of place in these four cases and question what is different about the contradictory case compared to the others.

The red box highlights a 'contradictory configuration' (i.e., different outcomes are achieved for cases with the same profile of conditions). One of the two cases exhibits health resilience - resulting from a combination of high social capital and the presence of gardens. The other case has the same configuration of conditions but it is not resilient. This makes this a 'contradictory configuration' for which it is not possible to build set-theoretic knowledge. Again, a result like this requires further qualitative investigation.

Table 4 shows a Boolean minimisation using the fsQCA software for the areas with resilient outcomes. This procedure reduces the resilient configurations (the six black boxes of Table 3) into the more minimal formula outlined in Table 4. This is the reduction of complex configurations into more parsimonious configurations (Rihoux and De Meur 2009). Ragin (1987, 93) summarises it as 'if two Boolean [dichotomous] expressions differ in only one causal condition yet produce the same outcome, the causal condition that distinguishes the two expressions can be considered irrelevant and can be removed.' The 'descriptive formula' provided here covers all of the configurations associated with resilient areas as there is a solution coverage of 1.0. The solution consistency is 0.866667 and this indicates that the combined consistency of these minimised configurations is strong. The 'raw coverage' of each configuration is the extent to which each explains the outcome and the 'unique coverage' explains the proportion of cases exclusively covered by that configuration. The results of table 4 can be read as follows. The '1' outcome (resilience) is observed:

- In areas that combine presence of gardens [garden] *AND* high levels of social capital [socCap]

OR

- In areas that combine high levels of social capital [socCap] *AND* low levels of crime [crime]

OR

- In areas that combine presence of green space [green] *AND* presence of gardens [garden] *AND* low levels of crime [crime]

The Boolean minimisation therefore identifies three different pathways to health resilience - thereby enabling the development of theoretical knowledge.

Discussion

Each of the configurations in table 4 identifies Boolean minimised 'pathways' to health resilience that can be regarded as 'types' of cases for further qualitative interpretation. One example reveals that the social context (high social capital and low crime) can be sufficient for health resilience. Each of these pathways is in keeping with the wider health geography literature that links access to green space, high social capital and low crime to better health outcomes (Bambra, 2016). Further the configurations highlight the significance of different combinations of the social context and the natural environment. For example, there is a combination of the natural environment (high presence of green space and gardens) and social context (low crime) in one minimised configuration. In this example social capital is not significant as the combination of the remaining three conditions is sufficient for health resilience. This advances the evidence about pathways to health resilience covered in the previous quantitative and qualitative research (Cairns and Bambra, 2013).

An advantage of QCA is that the truth table enables researchers to explore contradictory cases qualitatively (Blackman et al., 2013). The contradictory configuration identified in this study consists of high levels of social capital, presence of gardens, low levels of crime, and absence of green spaces. Through Boolean minimisation it appears that the gardens in themselves are not creating health resilience via the experience of being exposed to nature but through the social elements of gardening, such as communal gardening or allotments. The QCA therefore begins to paint a more nuanced picture of how particular features of place (in this case gardens) might be conducive to good health outcomes.

It is outside the scope of this paper but there are also other techniques in addition to crisp set QCA, such as fuzzy set analysis. Whilst one of the benefits of crisp set analysis is that it manages to take something complex and simplify it into the presence or absence of a particular outcome of interest (dichotomous), it is also considered by some to be a limitation since dichotomisation might not be able to disentangle important differences (e.g. in terms of quality of gardens of social relationships) between cases. Wistow et al (2015) however argue that it has the advantage of identifying transitions between types of complex systems, rather than focusing on incremental change that may relate to a state of dynamic equilibrium. Fuzzy set analysis though is able to deal with this limitation by enabling the researcher to explore different degrees of membership. For example, in a fuzzy set QCA conditions are given membership scores between 1.00 (full membership) and 0.00 (fully out). Consequently, this kind of analysis would enable the exploration of the relationship between the extent of social capital and resilience – a more graded approach. However, fuzzy sets are not well suited to truth table analyses because there is no simple way to sort cases according to combinations of conditions, given that they each may display different membership scores (Ragin 2009). Future geographical research could use fuzzy set analysis now that this paper has demonstrated the general applicability of QCA methods.

Indeed, QCA should be considered alongside other methodologies within geographical research and enable researchers to get beyond the quantitative and qualitative divide. Just as multilevel modelling has enabled health geographers to overcome the false dualism of compositional and contextual effects on area level health (Cummins et al, 2007), QCA has the potential to further disentangle the complex pathways between health and place. Indeed, QCA provides a systematic framing to assist in the unpacking of complex causal pathways to area-level health outcomes by considering different configurations of contextual, compositional and collective factors. QCA enables researchers to break complexity down into a simplified and minimalistic output, which can be easily interpreted by different audiences. While at first glance there may appear to be a paradox in what we are saying here given that we are essentially reducing complexity in order to understand it. However, the ability to identify pathways to health outcomes will help us to make sense of the processes and interactions involved in a specific pathway. Indeed, King et al (1994, 42) argue that all research in the social sciences necessarily implies simplification in relation to the infinite complexity of the world. De Meur et al (2009, 149) add that, 'simplification is what allows us to make progress in our understanding of complexity'. The main advantage of the methodology to geographers demonstrated throughout this paper is that the QCA outputs are not the final stage of analysis but provide tools to develop further qualitative insight *across and within* the cases identified through the configurations. QCA also manages to look at the interactions *between* factors - an important part of capturing complexity.

Further, QCA has been shown to be appropriate for policy research as it is able to simplify complex causation (Blackman et al 2011) and it therefore represents an opportunity for geographical research to engage more with policy through mixed-methods research. Qualitative investigation has often been seen as the 'handmaiden' to quantitative research when it is actually a crucial component to understanding complex causation as identified in this paper. Consequently, a potential limitation of QCA, identified by Goldthorpe (1997) is that QCA does not describe the process or the 'how' of causal combinations that explain the outcome. De Meur et al (2009) call this 'the black box problem' and argue that this is common to all quantitative methods. They also argue (2009, 160) that this is not the aim of QCA, 'it describes the conditions that are present or absent when an outcome of interest is observed or not observed. The more in-depth analysis of underlying processes…must be carried out by the researcher.' The configurations developed through a QCA provide a tool for systematic cross-case comparisons and for the development of set-theoretic knowledge, which has been likened by Blackman et al (2013) to a 'tin-opener' for developing accounts of causality in more detail. In this respect QCA includes many of the benefits associated with quantitative studies, while retaining a clear focus on the case(s) and the potential for detailed qualitative interpretation of the results incorporating dialogues from local policy makers, practitioners and community groups, for example.

Conclusion

This has explored the potential utility of QCA methodology for geographical research using the case study of health resilience. It has demonstrated the potential benefits of the methodology in helping geographers make sense of complex processes and outcomes, by identifying pathways linking health and place. It is therefore a technique which should be added to the current tool box of methods used by geographers when examining complexity, QCA is therefore an insightful methodology that could be applied widely by geographers to help make sense of complex spatial phenomena.

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Table 1: Descriptive statistics

		Crime score[a]	Social Fragmentation score[b]	Domestic Gardens (in thousands m^2)	Greenspace (in thousands m^2)
Mean		.4658	-.0003	709.82	14570.26
Minimum		-19.10	-7.19	4	9
Maximum		40.33	23.20	5731	446522
Quartiles	25%	-.5333	-2.1190	418.34	751.59
	50%	-.1200	-.7782	615.48	2812.67
	75%	.4242	1.0658	878.53	17860.23

a IMD crime sub-domain score

b Composite measure consisting of four Census variables (in %'s) standardised to create this score

Table 2: Data table

Green	Garden	SocCap	Crime	Outcome
1	1	1	1	1
1	1	1	1	1
1	1	1	1	1
0	0	1	1	1
0	1	1	1	1
1	0	1	1	1
1	1	0	1	1
1	1	0	1	1
1	1	1	0	1
1	1	1	0	1
0	1	1	0	1
0	0	1	1	1
0	0	1	1	1
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	1	0
0	0	0	1	0
1	1	0	0	0
0	1	1	0	0
0	0	1	1	0
0	0	0	1	0
0	0	1	0	0
1	0	0	1	0
1	0	0	1	0
1	0	1	0	0
0	1	0	0	0
0	1	0	0	0
0	1	0	1	0
1	0	1	0	0
0	1	0	0	0
1	1	0	0	0

Table 3: Truth table

Green	Garden	SocCap	Crime	Number	Outcome	Raw consist.	PRI consist.	Product
0	0	1	1	4		0.75	0.75	0.5625
0	0	0	0	3		0	0	0
0	0	0	1	3		0	0	0
0	1	0	0	3		0	0	0
1	1	1	1	3		1	1	1
0	1	1	0	2		0.5	0.5	0.25
1	0	0	1	2		0	0	0
1	0	1	0	2		0	0	0
1	1	0	0	2		0	0	0
1	1	0	1	2		1	1	1
1	1	1	0	2		1	1	1
0	0	1	0	1		0	0	0
0	1	0	1	1		0	0	0
0	1	1	1	1		1	1	1
1	0	1	1	1		1	1	1
1	0	0	0	0				

Table 4: Boolean minimisation

Minimised configuration	Raw Coverage	Unique Coverage	Consistency
garden*soccap	0.538462	0.230769	0.875000
soccap*crime	0.615385	0.307692	0.888889
green*garden*crime	0.384615	0.153846	1.000000