

Qualitative Work and the Testing and Development of Theory: Lessons from a Study Combining Cross-Case and Within-Case Analysis via Ragin's QCA

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Abstract: Charles RAGIN's work, especially his development of Qualitative Comparative Analysis (QCA), offers social scientists a way of bringing together the strengths of the qualitative and quantitative traditions. QCA takes a case-based rather than a variable-based analytic approach to cross-case analysis. One problem that arises in attempting to use QCA to explore causation in larger datasets, especially survey datasets, is that the detailed case knowledge available to those working in the qualitative tradition is usually unavailable. In the same way therefore that it can be difficult to establish causation from correlational analyses, the derivation of causal claims from QCA analyses can also be problematic. We discuss these problems in detail and then argue that they can be addressed by using QCA to identify particular types of cases for detailed within-case analysis focusing on causal processes. More specifically, we show how such in-depth, within-case analysis can identify factors that can be used to improve QCA models, including those used to select these cases for analysis. We illustrate this particular mode of combining methods by drawing on our work on educational transitions in Germany, drawing on both the German Socio-Economic Panel (SOEP) dataset and 43 individual interviews with German 17-year olds.

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1. Introduction

This article draws on a three-year project funded by the United Kingdom's Economic and Social Research Council (ESRC), focusing on the effects of family background and of the organisation of secondary schooling on educational achievement in Germany and England. This study employs RAGIN's configurational case-based *Qualitative Comparative Analysis* (QCA) (1987, 2000, 2008) as a means of combining the cross-case analysis of longitudinal survey data with the cross-case and within-case analysis of some 80 in-depth interviews with young people in Germany and England. It employs QCA in the context of a non-nested¹ mixed methods approach (SMALL, 2011), thereby aiming, by taking a case-based rather than a variable-based analytic approach, to avoid the quantitative/qualitative divide that bedevils much sociology (COOPER, GLAESSER, GOMM & HAMMERSLEY, 2012). Here, we draw on the German study. [1]

The primary focus of QCA, which applies Boolean logic in cross-case analysis, is on establishing the relations of sufficiency and/or necessity between configurations of putatively causal conditions and some chosen outcome. Its mathematical basis is the theory of crisp and fuzzy sets, though here we use only the former. While correlational approaches, including regression, based in linear algebra, typically aim to establish the relative importance of supposedly independent variables in accounting for some outcome, QCA typically explores which *combinations* of factors (or "causal recipes") are sufficient, or quasi-sufficient (to be explained below), for some outcome to occur. In this respect, it shares some goals that have characterised much work in qualitative sociology and case study research, especially in its early history, for example, that using analytic induction and some uses of grounded theorising (HAMMERSLEY & COOPER, 2012). RAGIN has sometimes presented QCA as a bridge across the qualitative-quantitative divide (2000, pp.28-30) though, more recently, he has argued that it can transcend the divide (2008, p.71). What perhaps distinguishes it most from some qualitative research, apart from its focus on causation, is that it does not set out from an assumption that all social science is necessarily hermeneutic in nature (COOPER et al., 2012). On the other hand, its use does not preclude an interpretive focus (see, e.g., RANTALA & HELLSTRÖM, 2001). [2]

QCA was developed in the context of small to medium n studies, largely in the field of political science (RAGIN, 1987). In that context, researchers usually have in-depth knowledge of their cases (e.g. of countries, elections, food riots). For this reason the causal interpretation of the regularities that QCA produces can be begun on the basis of this knowledge combined with reasoning drawing on established theory (RAGIN, 1987, pp.120-121), though other analytic problems can arise (COOPER & GLAESSER, 2011a). However, in studies that include the application of QCA to survey data, as ours does, such in-depth knowledge will usually be lacking (COOPER, 2005; COOPER & GLAESSER, 2008, 2010,

1 Nesting refers to the collecting of various types of data from the same actors, organisations, or entities (SMALL, 2011). There is, in fact, a small element of nesting in the work we carried out in England.

2011b; GLAESSER, 2008; GLAESSER & COOPER, 2011a, 2011b; RAGIN, 2006a). Here either *post hoc* interpretation based on existing theory will be needed to aid causal interpretation (in terms of plausible mechanisms) or a second stage of in-depth within-case data collection will be needed for the purposes of either seeking additional causal factors (RAGIN & SCHNEIDER, 2011) or process-tracing (GEORGE & BENNETT, 2005). Such additional in-depth work is our focus here. [3]

The article has the following structure:

1. Before describing some of the interpretive difficulties that characterise the causal analysis of the "truth tables" on which QCA depends, we first briefly introduce some key features of crisp set QCA.
2. Second, drawing on some arguments of PAWSON (2008), we note a problem which crisp set QCA shares with the correlational approach when used with large rather than small datasets.
3. We use an invented truth table to bring out, in more detail, some specific difficulties that arise for those wishing to make causal claims on the basis of applying QCA to survey data.
4. We apply the lessons of this section to real data from the German Socio-Economic Panel (SOEP) and illustrate how we have used Boolean analysis to select interviewees in order to develop theory / causal interpretations.
5. We use interview data to demonstrate how these can help us make explanatory sense of cases in QCA analyses of survey data.
6. In a brief conclusion we consider the implications of our interview analyses for our cross-case modelling. [4]

2. QCA: Key Features

Taking the case of crisp sets, where a case is simply either in or out of any set, then, for a condition, X, to be strictly sufficient for an outcome Y, we need the set of cases with the condition, X, to be a subset of the set of cases with the outcome². This situation is shown in the Venn diagram in Figure 1. Here, if X, then Y. More realistically, we will usually aim to test for quasi-sufficiency, as in Figure 2, where most, but not all, cases with the condition also have the outcome. Here, the proportion of the cases with X that also have Y can be used as a simple measure of the consistency of the subsethood relation with one of perfect sufficiency (RAGIN, 2006b).

2 We initially use X and Y to parallel the conventional usage in regression analysis, where Y is usually the dependent and X the independent variable.

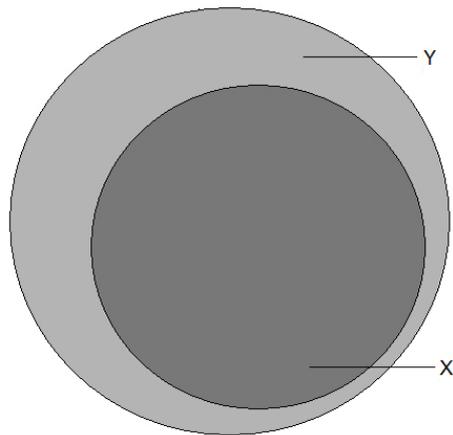


Figure 1: X strictly sufficient for Y

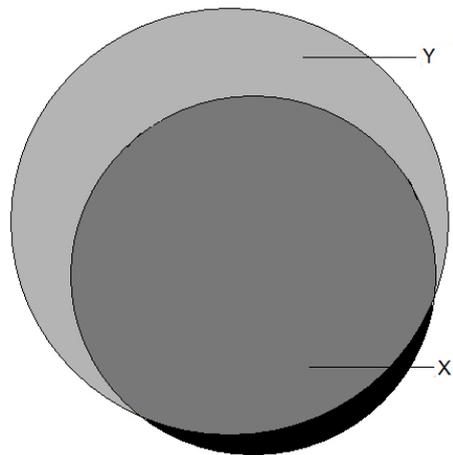


Figure 2: X quasi-sufficient for Y [5]

It can also be seen in these figures that not all cases of Y are "explained", or covered, by X. To capture this RAGIN employs a measure termed "coverage" which reports the proportion of the outcome set Y covered, or overlapped by, X. In these simple cases, this measure is equivalent to a measure of consistency with the necessity of X for Y. For X to be strictly necessary for Y, Y must be a subset of X. [6]

We will explain later how this set theoretic approach can be applied when X stands for a range of "causal" conditions rather than a single X. All that needs to be noted for now is that given a range of conditions, A, B, C, D, E, F and an outcome O, QCA might allow us to produce a set theoretic expression for the combinations of conditions that are quasi-sufficient for the outcome of the following form, where the left-hand side is a subset (or near subset) of the right-hand side, and where upper case letters indicate the presence of a condition, lower case letters its absence, the * indicates logical AND (set intersection), the + indicates logical OR (set union) and the => indicates "is quasi-sufficient for":

$$A*B*C + D*E*f +B*D*F => O [7]$$

This can be contrasted with a standard linear additive regression equation of the form:

$$O = \text{intercept} + 2.4A + 0.5B + 0.01C + 3D + 1.8E + 0.7F + \text{error term} [8]$$

Both expressions are algebraic representations of "regularities", typically "probabilistic" in nature (GOLDTHORPE, 2007, Chapter 6). One major difference between them is that the first has three types of cases (each characterised by a different conjunction of conditions) explicitly written into it, while the second does not. Another is that the apparent effect of F varies by type of case in the first expression, but not in the second³. These features of the set theoretic expression allow us, to quote RAGIN (2008, p.182), "to bring some of the spirit and logic of case-oriented investigation to large-N research". We turn now to the relation between regularities and "explanation". [9]

3. Regularities and Mechanisms

The issue of what it is to explain some outcome has exercised philosophers, scientists and social scientists for centuries. Notwithstanding the ease with which it can be shown that simple persisting regularities are not generally sufficient to ground a causal claim (PSILLOS, 2002), HUME's "regularity view of causation" has seemed to underlie much quantitative social science⁴ (PAWSON, 1989, 2008). Previous generations of sociologists who have taken courses in the philosophy of science / social science have often encountered this regularity, or constant conjunction, view in the form of HEMPEL's covering law account of explanation:

"The basic idea of the covering-law account is very simple: An explanation is a deductive (or statistical) argument that has a description of the *explanandum* phenomenon as a conclusion and one or more empirically validated general law statements and a set of statements describing particular facts (the initial conditions) as its premise. The core underlying idea is that explanations make the *explanandum* expected [given the explanans, etc.]. This means that explanation and prediction are more or less the same thing; the only difference is that in the case of explanation we already know the outcome" (HEDSTRÖM & YLIKOSKI, 2010, pp.54-55). [10]

The "regularities" / laws view of explanation has received criticism over a long period, and from many directions. BHASKAR's development (1975, 1979) of a realist account of the sciences, including social science, has influenced many scholars, including PAWSON (1989, 2008), whose work we discuss later. Here, structures and entities with causal powers, sometimes hidden behind immediately

3 Regression models can be made to simulate these features by using dummy variables, interaction terms, etc. but these must be introduced as modifications to the basic form of regression. QCA automatically produces skeletal "cases" and contextualises the effects of conditions.

4 Also much qualitative work (see grounded theory, analytic induction, etc.).

apparent empirical regularities, become the focus of attention. BOUDON's (1976) arguments for generative models, in his debate with HAUSER (1976), also have been influential, as can be seen in GOLDTHORPE's (2007, Chapter 6) particular arguments for the need to account for regularities via generative mechanisms involving rational choice. In this tradition, HEDSTRÖM and YLIKOSKI (2010) in describing some of the standard problems with HEMPEL's account of explanation, also note that, for advocates of mechanism-based approaches, the regularities on which HEMPEL depends are actually the things that need to be explained (see also LIEBERSON, 1985). GEORGE and BENNETT (2005) argue for within-case process-tracing as one route to this knowledge. Others, including GOLDTHORPE (2007, Chapter 9), in the tradition of POPPER, are less concerned about the source of any models of generative mechanisms, focusing more on their predictive power and/or falsifiability. Some philosophers, of course, worry less than realists about the development of models seen to represent the actually existing mechanisms and processes that generate outcomes. For instrumentalists and pragmatists of various kinds, if prediction is adequate, for practical purposes, this may be enough (ALMEDER, 2008). The ultimate "truth" of the causal claim can be put to one side. [11]

PAWSON (2008) has discussed these issues, relating them to QCA. He terms those following HEMPEL/HUME, "successionists", and those following MILL⁵/RAGIN, "configurationists". He argues that, from a realist perspective, neither the former, with their typical tools (regression, etc.) nor the latter, with theirs (QCA, etc.) adequately address causation:

"Although they provide vital data on the way society is patterned our first two strategies never manage to get beyond description. The models, estimates, effect sizes and so on that are provided are always makeshift. They lack staying power and have no status as enduring causal laws because they are always modified by further investigations of the same ilk, which may be fed by previously 'unconsidered' variables or attributes. Our supply of such items is limitless, with the consequence that these models and their findings have no capacity for cumulation. Variables are ten-for-a-penny and have no explanatory memory. To be sure the pathways and associations described are always revealing of some interesting dynamic at play in the make up of society. However, the reason why they are compelling ... is that they depend on tacit use of generative thinking. We are able to make sense of the correlations and configurations uncovered because we already have awareness, as social scientists and citizens, of the kinds of choices and constraints that are unobserved in such causal models but which condition their outward shape. In short, the successionist and configurational strategies are partial and defective forms of generative inquiry" (PAWSON, 2008, p.2). [12]

PAWSON wants a turn to "generative mechanisms", sharing with BOUDON, GOLDTHORPE and others, a concern with agents and choice (though note the reference to constraints alongside choice in the quote above):

5 RAGIN's (1987) development of QCA builds on ideas in MILL's (2006 [1843]) "A System of Logic".

"Generativists, too, begin with measurable patterns and uniformities. It is assumed that these are brought about by the action of some underlying 'mechanism'. Mechanisms are not variables or attributes and thus not always directly measurable. They are processes describing the human actions that have led to the uniformity. Because they depend on this choice making capacity of individuals and groups, the emergence of social uniformities is always highly conditional. Causal explanation is thus a matter of producing theories of the mechanisms that explain both the presence and absence of the 'uniformity' " (PAWSON, 2008, p.1). [13]

We accept the main lines of his argument (see also CARTWRIGHT's, 2007, comments on QCA). Indeed, below, we will spell out in more detail than he has some of the problems involved in interpreting regularities in the QCA context. We have, however, argued elsewhere that, in terms of establishing the complex regularities that characterise social life, configurational tools such as QCA might be expected to be more useful than "successionist" tools such as regression (COOPER & GLAESSER, 2010; and see RAGIN, 2006a). This is particularly so where causal heterogeneity exists, arising from the existence of several types of distinct case. This view underlies our decision to employ QCA in the current study. We will now discuss these problems in more detail, in the context of applying QCA to an invented dataset. [14]

4. Invented Data

Table 1 shows invented data for 2170 cases. These are set out in a "truth table", the key device used in QCA (RAGIN, 2008). In the crisp set context, a truth table simply shows, for each row—or each combinations of conditions—the proportions of the cases in the configuration that achieve the outcome (and here also its negation). There are three conditions A, B and C, all thought to be causally relevant, and an outcome O. Later in this section, we will assume that the outcome, O, is "being literate", that A stands for belonging to a family amongst the social elite in early nineteenth century England, that B stands for having parents who value literacy, and that C stands for being male. The presence of a factor is indicated by a one, its absence by a zero (so that C = 0 indicates being female). The consistencies with sufficiency, i.e. the proportions of cases achieving the outcome, are shown for each configuration, for both the outcome and its negation, o. These consistencies are ordered, high to low, for the outcome. We will use these cases to make a number of points. The basic facts about the truth table are these (please note that we will replace A*B*C by ABC, and so on, when our meaning is clear):

1. There are three configurations (111, 110, and 101 or ABC, ABc and AbC) with high consistencies in respect of the outcome, O. At least 89% of the cases in these rows achieve the outcome, being literate, enough to ground a claim of quasi-sufficiency.
2. There are three configurations (010, 001 and 000 or aBc, abC and abc) with high consistencies in respect of the negated outcome, o, not being literate (at least 0.94).

3. There are two configurations (100 and 011 or Abc and aBC) which are "contradictory rows", i.e. they do not have high consistencies with respect to O or o. [15]

The next step is to solve the truth table, in the sense of simplifying the group of configurations that share the same relation to the outcome or its negation. If we take the first of the three groups above, those with high consistencies in respect of the outcome, and ask the fsQCA software⁶ (RAGIN, DRASS & DAVEY, 2006) to solve the truth table for these three rows, effectively setting a threshold for quasi-sufficiency of 0.89, we can obtain a minimised solution for obtaining O, i.e. for being literate. The minimisation procedure is simple to understand, though hard to implement manually when there are more than a few conditions. Here, 111 and 110 can be reduced to 11- where the dash indicates that the third condition (C) makes no relevant difference to quasi-sufficiency, given our chosen threshold. This gives us the term AB. Then, taking 111 and 101, we can obtain 1-1, or AC, since B makes no relevant difference here. These two are alternative paths to the outcome, and hence we obtain AB + AC, i.e. AB *or* AC. The full details of this solution are shown in Table 2.

A	B	C	Number	Consistency for O	Consistency for o	n with O	n with o
1	1	1	120	0.925	0.075	111	9
1	1	0	110	0.900	0.100	99	11
1	0	1	100	0.890	0.110	89	11
1	0	0	120	0.500	0.500	60	60
0	1	1	100	0.350	0.650	35	65
0	1	0	100	0.060	0.940	6	94
0	0	1	800	0.020	0.980	16	784
0	0	0	720	0.008	0.992	6	714

Table 1: Invented data for O = Function (A,B,C) [16]

We should briefly explain the terms raw and unique coverage that appear in Table 2. Since conditions (here A, B, C) are usually correlated, terms in QCA solutions will usually overlap one another. Here, the sets AB and AC overlap, since ABC, containing 120 cases, is a subset of both of them. This means that the coverage for each term in the solution can be partitioned into two parts. The raw coverage of AB, for example, refers to all of AB, while its unique coverage refers only to that part of AB which does not overlap with any other sets in the solution (here AC), i.e. here to the coverage of AB—ABC. The coverage due to ABC can be found by subtracting, for either AB or AC, the unique coverage from

6 This software, freely available, allows researchers to carry out Boolean analyses of datasets. It implements both crisp and fuzzy set QCA; see <http://www.u.arizona.edu/~cragin/fsQCA/> [Accessed: February 15, 2012].

the raw coverage (giving 0.263). It can be seen that the unique coverage of AB (0.235) plus the unique coverage of AC (0.211) plus the coverage of ABC (0.263) sum to the coverage of the overall solution (0.709). When, then, a term in the solution has a large raw coverage but a small unique coverage, this implies that there is a substantial overlap between it and at least one other term in the solution.

	Raw coverage	Unique coverage	Consistency
A*B	0.498	0.235	0.913
A*C	0.474	0.211	0.909
Solution coverage: 0.709			
Solution consistency: 0.906			

Table 2: Minimised (sufficiency) solution for the outcome O [17]

If we were merely concerned to derive a summary description of the relations in the truth table, or if we believed that we could generalise from this description to make predictions about similar cases outside the dataset, we might be happy to stop here. AB + AC would tell us a great deal. Given a new case falling into the set AB+AC, we could, on a probabilistic⁷ view of regularities, and if we believed there were good grounds for being able to generalise our findings, claim, using the consistency with sufficiency of the overall solution (Table 2), that there is a 0.906 chance of this case having the outcome. If, on the other hand, we take a realist view, wanting to be able to understand the generative processes by which these configurational regularities are produced, things are considerably more complicated. [18]

Consider that fsQCA has collapsed the two configurations ABC and ABc to AB because the absence or presence of C makes no relevant difference to quasi-sufficiency. For a researcher interested in fairly accurate prediction of the outcome from a configuration, or the simplest possible description of the top three rows of the truth table, this makes sense. However, for a researcher wanting to focus on generative causation, it may not. Consider an illustration. Our outcome, O, is "being literate". A stands, as we noted, for belonging to a family amongst the social elite in early nineteenth century England. B stands for having parents who value literacy. C stands for being male, with c then indicating being female. "AB => literacy" suggests that gender makes no difference and, indeed, this is true in the sense that, irrespective of gender, the conjunction of A and B is quasi-sufficient for the outcome. The causal routes to the outcome may, nevertheless, of course, differ. Boys may receive their education in schools, girls in the home. If we were to add the condition D, "attended school", to the truth table (thereby doubling its number of rows, since D or d are added to each existing row), and to assume that all elite boys attended school, and that all elite girls were educated

⁷ As usually understood, i.e. with probability being estimated from relative frequencies. Also, strictly speaking, assuming that we picked the case at random.

at home, we would have, with cases⁸, the rows ABCD for boys and ABcd for girls. Clearly, what matters here is that, for boys, ABD predicts the outcome and, for girls, ABd. We can fill out plausible full causal paths. A provides resources, B the desire for, and D or d the causally effective path to literacy. It might seem that, dropping D, and introducing a new condition E, standing for some effective means of teaching literacy (instruction in a school or in the home), would resolve this. We would then have ABCE and ABcE leading to literacy, which could be collapsed to ABE. Against this, we can note that the E is not a homogeneous category and that the sorts of literacy acquired might well be expected to vary as a consequence of D or d. It may only be if we collapse an outcome, "literacy", whose nature actually varies according to how and where it was acquired, that the various minimisations discussed here would make sense. [19]

Let's assume we have settled for ABD and ABd as possibly capturing two causally different paths to literacy⁹, one via school, one not. Now consider A, i.e. elite family origins. In order to understand exactly how membership of such families operates as part of the first causal conjunction ABD we might need to collect in-depth data from a sample of the 120 families with these conjoined conditions. Here we have two subtypes to sample, ABDO and ABDo, cases that respectively are *typical* for this configuration with respect to quasi-sufficiency and those that are *deviant* (GLAESSER & COOPER, 2011b). We might have theoretical expectations suggesting that elite status might feature in two differing ways as a part of filled-out narratives, N1 and N2, of how boys become literate via school. In-depth study of typical cases might provide supporting evidence for N1 but none for N2, but it might also provide evidence for another, unanticipated N3. Such discoveries frequently occur in qualitative research and, indeed, are a key reason for employing these methods. Study of the deviant cases might inform us about a condition F (perhaps something picking up cognitive ability) that we have missed and that, when we split the row, ABD into ABDF and ABDF, might move the consistency of ABDF further towards one and that of ABDF towards zero¹⁰. [20]

Another focus might be on necessity. AB+AC suggests that A is a necessary condition. In fact, it is not possible to read off necessity so simply from a solution (GLAESSER & COOPER, 2010). In this case, however, a separate test does find

8 We add "with cases" here because some of our new rows might not have cases or, at best, just a few. For example, we can expect, given our assumptions, that there no or few cases of elite girls being educated in school. This "limited diversity" (RAGIN, 2008, p.141) is a common feature of social datasets and, hence, truth tables.

9 We have dropped C/c partly in order to keep this paragraph simpler. Note, in passing, that had we settled for ABCD and ABcd, then these terms could not be collapsed to AB, since we have, by assumption, no cases for ABCd and ABcD, but these configurations are also subsets of AB. This point has other general implications which we do not have space to discuss here.

10 It might be worth trying to differentiate two types of missed conditions that might be found, those that are very rare (e.g. a rare childhood disease) and those that are less so (e.g. a less than adequate educational experience). Here, in addition, the rare disease might be seen as falling outside the causal system being theorised in a way that the quality of the educational experience might not. On the other hand, there will be diseases that are related to elite and non-elite status and, for this reason, it is hard to draw any firm lines here. A rare disease might also be considered more like a contingent or chance event than one correlated with elite/non-elite status.

A to be quasi-necessary (with a consistency of 0.851). Nevertheless there are many cases without A, i.e. cases from non-elite families, who achieve the outcome (63 of the 422 who have the outcome). These are deviant with respect to necessity (GLAESSER & COOPER, 2011b). 35 of them are in aBC. Sampling some of these cases for in-depth study would seem a good strategy for discovering what factor, not yet in the model, can substitute for A, at least for males from families desiring literacy. [21]

Two further considerations are redundancy and spuriousness. Forget the specific truth table above for a moment. Imagine some other dataset, from another society, but with the same factors, had produced the solution, with very high consistency values, $ACD \Rightarrow O$. Being a schooled male from the elite is quasi-sufficient for literacy. Let's also assume that C (being male) and D (attending school) are very highly correlated, at least given elite membership, i.e. at least when A is present. A case with one of C or D almost always has the other. Furthermore, dropping them in turn from the model leads to the solutions $AD \Rightarrow O$ and $AC \Rightarrow O$, with very similar overall consistency and coverage figures. Now, at the level of generative processes, we cannot determine from these results whether both of C and D are actually causally effective, as opposed to being merely predictive, of the outcome. Considering the solution $AC \Rightarrow O$, there is no sign of D in AC but, since we have assumed that C and D are highly correlated, then whenever C is present, D usually is, and it is therefore possible that the unobserved D is, in some way, doing the causal work. Again, we need causal interpretation, via in-depth study (and/or very well-established existing theory) to determine whether C or D or both are really implicated causally in the pathway ACD. However, as we noted earlier, there is also the possibility that neither C nor D is causally effective, but that some other missed condition, E, correlated with both C and D, is the real causal ingredient in the recipe, i.e. ACD should then, from a realist perspective, be rejected in favour of AE. Again in-depth study of a sample of cases should be able to provide relevant evidence. [22]

Returning to our first society, i.e. to Table 1 for A, B, C and O, the contradictory rows themselves (100, 011) are particularly interesting from the point of view of theory development (RAGIN & SCHNEIDER, 2011). In-depth study of cases with and without the outcome can be expected, unless pure chance (such as random sampling error) lies behind the 0.5 and 0.35 consistencies for O, to point to further explanatory factors. These factors, when incorporated into the truth table, might move consistencies for these cases, now further differentiated, closer to one or zero. [23]

Lastly, consider the bottom three rows, where most cases are without the outcome. Much of the above discussion, suitably inverted, applies to these, though in many empirical contexts the negated outcome, o, may be much more heterogeneous in nature than O. In particular, studying the few cases here who achieve the outcome might be informative, though we might perhaps expect to find some coding or data entry errors among them. [24]

Before turning to the analysis of some real SOEP data, we might briefly summarise our main argument to this point. QCA describes complex cross-case relationships in datasets and can clearly be used to make predictions of various kinds. Using it, however, as a tool for causal analysis is less straightforward. To achieve this, we argue, it needs to be combined with additional within-case analyses. Studying, e.g. via interviews, the processes by which outcomes are achieved or not, and for cases that are typical or deviant with respect to their configurational type, allows us to both fill out causal narratives and to identify factors that seem to have been important but which we have not included in our initial truth table, i.e. in our model. [25]

5. Real (SOEP) Data

The SOEP is a representative household panel study, conducted annually since 1984 in West Germany, with East German households added in 1990. The outcome we will employ here is the type of school young people attended at the age of 17. Of the three hierarchically ordered types of secondary school in Germany, the *Gymnasium* is the highest in academic status, offering the *Abitur* which is the qualification allowing university entry, the *Realschule* is the intermediate type, and the *Hauptschule* is the lowest. In some places, comprehensive schools also exist. At the end of primary school, children receive a "recommendation" for the type of secondary school they are best suited for, according to their marks and their teacher's assessment. The recommendation is binding to various degrees in most parts of Germany and it takes some effort to enter a higher school type than that recommended by the primary school. For the purposes of this article, we use all those cases from the SOEP with no missing values who were born between 1986 and 1990 on any of the type of school attended at age 17, parental education, parental social class and recommendation of the primary school¹¹ (n = 790). The four conditions we use in the following example are: having at least one parent with the highest school qualification, the *Abitur* ("ABI_1P"), having at least one parent in the service class ("SC_1P"), whether the case is male or female (MALE/male), and having had a recommendation for the *Gymnasium* (GY_REC). The outcome is whether the case was in the *Gymnasium* at the age of 17 (GY_17).

Table 3: Truth table with four conditions: [click here to download](#) [26]

Our resulting truth table (Table 3), ordered by consistency, can be solved for either the outcome or its negation. We will focus here on solving it for the outcome, being in the *Gymnasium* at age 17. It is possible, of course, to explore models that include all or only some of the conditions. Since the recommendation, on an examination of the truth table, is found to be a crucial component of paths to the outcome, we will restrict ourselves to models including this condition. A range of solutions, employing different models, and all using a

¹¹ The resulting dataset has a slightly higher proportion of cases with the recommendation for the *Gymnasium* than there were in the whole cohort: 54.8% of valid cases versus 48.5%. For GY_17 the corresponding figures are 48.4% and 38.7%.

threshold for consistency of 0.75, are shown in Table 4. The underlying truth tables have just two rows in the case of solution 1, increasing to 16 for solution 8.

	Model	Solution (for quasi-sufficiency)	Overall consistency	Overall coverage
1	gy17 = f(GY_REC)	GY_REC	0.785	0.890
2	gy17 = f(MALE, GY_REC)	GY_REC	0.785	0.890
3	gy17 = f(SC_1P, GY_REC)	SC_1P*GY_REC	0.837	0.631
4	gy17 = f(MALE, SC_1P, GY_REC)	SC_1P*GY_REC	0.837	0.631
5	gy17 = f(ABI_1P, GY_REC)	ABI_1P*GY_REC	0.865	0.552
6	gy17 = f(MALE, ABI_1P, GY_REC)	ABI_1P*GY_REC	0.865	0.552
7	gy17 = f(ABI_1P, SC_1P, GY_REC)	ABI_1P*GY_REC	0.865	0.552
8	gy17 = f(MALE, ABI_1P, SC_1P, GY_REC)	ABI_1P*GY_REC + MALE*SC_1P*GY_REC	0.855	0.634

Table 4: Various solutions for GY_17 [27]

Now, if we were merely interested in description and/or prediction, we might argue for solution (1), which indicates that the recommendation for the *Gymnasium* (GY_REC) is, on its own, quasi-sufficient for the outcome, on grounds of adequate consistency, parsimony and very good coverage. On the other hand, we might argue for solution (6) or (7), each of which shows the combination of the recommendation with at least one parent having the *Abitur* (ABI_1P) as quasi-sufficient, on the grounds of their having the highest consistency, or perhaps solution (8), which includes the additional combination of being male and having the recommendation, and having at least one parent in the service class (SC_1P), because of its similar consistency but higher coverage. Sociologically, however, the differences in consistency between the rows (configurations) of the truth table underlying any minimised solution are often of great interest. Also, as we have argued, the minimisation process can deflect our attention from causal complexity and generative mechanisms that differ between configurations. Therefore, given our concern here to explore causal processes via interviews, we will concentrate our attention on the model employing all of our conditions (8) and the five rows of the truth table that underlie the resulting solution. Before focusing on it, however, we should just note, briefly, an important feature of these solutions. A comparison of models (3), (5) and (7), combining the recommendation with, respectively, SC_1P and ABI_1P and then both, provides an empirical illustration of the problem concerning redundancy and/or spuriousness discussed earlier with reference to all three of the

configurations ACD, AC and AD being quasi-sufficient for an outcome (with A becoming GY_REC, C becoming SC_1P, and D becoming ABI_1P). The solutions (3), (5) and (7) are broadly similar in terms of the indices of consistency and coverage. To make an informed choice between them requires us to bring something additional to the decision, over and above these indices. This might be theoretical reasoning. For example, we might argue that, in the German context, without an important fee-paying school sector, higher parental education (and, specifically, educated parents' knowledge of the *Gymnasium*) might be expected to be more important than the resources, whether financial or of social connections, that are associated with higher parental class. Or, and this is the position we have taken in our current work, we might want to collect within-case qualitative data to inform choices like that between (3), (5) and (7). What, given our conjunctural working assumptions, we would not want to do is to use something like logistic regression to determine which of ABI_1P and SC_1P should be dropped. Given what Table 4 shows [re (3) versus (5)], combined with the high correlation between ABI_1P and SC_1P apparent from Table 3¹², this would be useful only if our purpose was merely descriptive and/or predictive¹³.

	Raw coverage	Unique coverage	Consistency
ABI_1P*GY_REC+	0.552	0.306	0.865
MALE*SC_1P*GY_REC	0.327	0.081	0.833
Solution coverage: 0.634			
Solution consistency: 0.855			

Table 5: Solution for the analysis with four conditions [28]

The full details of solution (8) are shown in Table 5. A separate test for the quasi-necessity of GY_REC shows this passing with a consistency of 0.890. On the basis of solution (8), we drew up (in GLAESSER & COOPER, 2011b) a table showing typical and deviant cases for the quasi-sufficient configurations and deviant cases for the necessary condition, GY_REC¹⁴. We reproduce it as Table 6 here, but with the addition of the names of available interviewees from the German sample¹⁵. These interviewees, it should be noted, appear here in the rows to which they were allocated, on the basis of the conditions and the outcome that appear in the truth table, *before* we began detailed analysis of the interviews.

12 A simple indicator of the degree of correlation is that the numbers of cases are unevenly distributed over the rows. As a specific example, cases with a parent with the *Abitur* tend to have a parent in the service class, and vice versa.

13 If we do use binary logistic regression to predict the outcome, the various models favour ABI_1P very slightly over SC_1P: [click here to download](#).

14 We omitted a specific row for typicality re the quasi-necessary condition, GY_REC, and do so here. Of course, cases falling in rows 1 and 2 of Table 6 are typical with respect to necessity in that they have the outcome and the necessary condition.

15 The interviewees were chosen based on information given on a short form that pupils in nine schools (three *Hauptschulen* and two each of *Realschulen*, *Gymnasium* and *Gesamtschulen*) had completed, giving details of parents' education and occupation and of the recommendation received at the end of primary school.

Some numbers here are small. Of course, with four conditions, we have a truth table with 16 rows. Clearly, even with 43 interviews, especially given the practical problems of trying to select by type prior to interview, we can expect some rows to be represented by only one or two cases. This problem, often ignored by some who claim to be able to explore the effects of many factors with few cases, becomes more obvious when types of cases are set out in a truth table representing the relevant four-dimensional property space (BECKER, 1998, Chapter 5). [29]

It will be seen that Ludwig appears twice, since he is included in the intersection of ABI_1P*GY_REC and MALE*SC_1P*GY_REC, i.e. he is a case from the second row of the truth table (i.e. he is MALE*ABI_1P*SC_1P*GY_REC). [30]

Given the space available to us here, we will focus on deviant cases, with respect to both necessity and sufficiency, i.e. rows 3 and 5. Such deviant cases are especially interesting from the perspective of theory development. We will look at the one male from row 3 and a male and a female from row 5, to see what we can learn that might take us beyond our initial solution 8.

	Configuration	Outcome	Types of cases	Apparently available interviewees (pseudonyms)
1	ABI_1P*GY_REC	present	typical	Alina, Anna, Lena, Ludwig, Roman, Daniela, Nicole
2	MALE*SC_1P*GY_REC	present	typical	Jonas, Ludwig
3	ABI_1P*GY_REC	absent	deviant with regard to sufficiency	Samuel
4	MALE*SC_1P*GY_REC	absent	deviant with regard to sufficiency	None.
5	gy_rec	present	deviant with regard to necessity	Sibel, Andreas Julia, Christian, Aynur, Tessa ¹⁶

Table 6: Types of configurations [31]

16 Julia, Christian, Aynur and Tessa are on the *Gymnasium* route within *Gesamtschulen*.

6. Cases Deviant with Respect to the Necessity of GY_REC

Our analysis of the SOEP data has shown that having the recommendation for the *Gymnasium* is a quasi-necessary condition for being in the *Gymnasium* at age 17. Given that such a quasi-necessary condition exists, we would expect cases with the outcome to be characterised by it. Deviant cases, however, will have the outcome without having this condition. RAGIN and SCHNEIDER (2011, pp.160-162), in a recent discussion of case-oriented theory building and testing, have addressed, in the abstract, how we might aim to make sense of such deviant cases. Formally, given the outcome O and the quasi-necessary condition X1, the strategy involves finding an X2 that might substitute for X1, leading to the claim that "X1 or X2" is an improved expression of the necessary condition (i.e. one with higher consistency measures with a relation of necessity). We will bear this formal advice in mind in discussing our deviant cases. However, X2 may not, in practice, be reducible to a single factor, but may be some conjunction of factors. [32]

We look in detail at two cases, Andreas and Sibel, who clearly, at around age 17, are *Abitur* bound in spite of not having had the recommendation. [33]

6.1 Andreas

Andreas is a case in the configuration, MALE*ABI_1P*SC_1P*gy_rec. At age ten he received the recommendation for *Realschule*. His marks were, however, borderline for the *Gymnasium* recommendation and he could have taken the optional examination that, had he passed it, would have enabled him to get his recommendation upgraded. He did not, however, and said that he instead decided to follow his friends to the *Realschule*, knowing that he would still be able to aim for the *Abitur*. He did make it quite clear that while the *Realschule* was then acceptable, the *Hauptschule* would not have been. For him the *Realschule* represented the lower bound of acceptable secondary schooling. He has a clear view that there are distinctive types of pupil, in line with his favourable views of the German selective system, but he clearly did not believe himself to be one of the type suited to the *Hauptschule*. He says his parents were happy with his decision to go to the *Realschule*. At the time of interview he has the marks to go on to a Technical *Gymnasium* and clearly intends to, hence our decision to allocate him the outcome. He also has clear ideas about his career, aiming to be a pilot with Lufthansa if possible (he already flies gliders) or, if not, to have some sort of related technical career. [34]

When we come to consider how it is that, without the *Gymnasium* recommendation, he has come to this point, it seems that the educational careers of his siblings are key factors. His elder brother had also gone to the *Realschule* and then on to a Technical *Gymnasium*. Both a younger brother and sister are attending *Gymnasium* and earning good marks (better than his). He is already unhappy to be the only one of the four now not attending a *Gymnasium*, and will be pleased when he is at the Technical *Gymnasium*. Both his parents have the *Abitur*. It seems that his later educational career merely reflects what is normal—

habitual—in his family. The lack of the recommendation, in the context of this family, is a setback that can be calmly overcome, given knowledge of the system, i.e. that it is possible to gain access to a *Gymnasium* track from the *Realschule*. (We should add that he also will have needed a certain level of cognitive ability, alongside his desire to progress. We do not have data on ability, either in SOEP or for our interviewees.) [35]

A candidate X2 here seems to comprise, then, a family where gaining the *Abitur* is a normal element for both parents and their children conjoined with the organisational possibility of moving from the *Realschule* to some type of *Gymnasium*. We can run a quick check on the importance of having an *Abitur* in the family background by assessing the quasi-necessity of GY_REC + ABI_1P for all our SOEP cases. This has a consistency of 0.96, higher than the 0.89 we found for GY_REC itself¹⁷. [36]

6.2 Sibel

Sibel is in the configuration male*ABI_1P*sc_1p*gy_rec, with her mother supplying the ABI_1P and, with it, personal parental knowledge of the *Gymnasium*. She is now in a *Gymnasium*. Sibel's recommendation was for the *Realschule*. She had borderline marks, high enough in fact that, had her parents challenged the recommendation, they might have overturned it. It seems they were anxious about whether she would cope with the demands of the *Gymnasium* and also knew that the possibility of changing track later did exist. Sibel, whose father is a skilled manual worker of Turkish origin with no school qualifications, but whose mother is a *Gymnasium*-educated native German, also had nothing against going to the *Realschule*, the one where her brother already was (in a large city). She says she felt protected by his being there. In her tenth school year she joined a special booster class in the *Realschule* which would allow eventual access to a *Gymnasium*. Here she made friends with others aiming for the *Gymnasium*. In her current *Gymnasium*, which she chose by word of mouth, she is coping with the work. She says she did not contemplate leaving school after the tenth year, since she has wanted for years to get to a *Gymnasium* in order to become qualified to get a good job (one that is enjoyable and does not pay badly). She reads a lot, like her mother. Her mother has been supportive but not pressuring. She is intending to go on to study something like event management. (Her brother has returned to school in order to be able to study "renewable energies" at university later). [37]

Have we here any obvious candidate for an X2? Like Andreas, Sibel has a parent with the *Abitur* and also has had access to a *Realschule* in a large city that made mobility to the *Gymnasium* possible for some pupils. She does also have some relatives who have studied beyond school, including an aunt. Perhaps again, though with less conviction, we can say that a candidate X2 combines some organisational features of secondary schooling (flexibility) with a family

¹⁷ On its own ABI_1P has a consistency with necessity of only 0.62.

environment where some knowledge of the *Abitur* and its value exists? Again, plus some necessary level of ability? [38]

These two cases suggest, given the apparent importance for them of being in a *Realschule*, that we might rerun the QCA, testing for the necessity of at least a *Realschule* recommendation. If we do this, we find that having at least a *Realschule* recommendation is quasi-necessary at a consistency level of 0.992, i.e. it is almost strictly necessary. There are just 3 amongst the 790 cases in our SOEP dataset who achieve GY_17 having received a recommendation for the *Hauptschule*. In all three cases at least one parent has the *Abitur* (and, in one case, both)¹⁸. In all three cases, one parent is in the service class. Two are male¹⁹. [39]

Before moving on, we should stress that, in finding a potential X2, we have identified some factors that seem able to substitute, as *necessary* conditions, for GY_REC. Given the asymmetry of necessary and sufficient conditions, it does not follow automatically that all, or even many, of those with this X2 will have the outcome GY_17. Having noted this, we can, in this case, explore it a little with the SOEP data. If we look at ABI_2P (both parents having *Abitur*) as a proxy for the normality of the *Abitur* within a family, then we find that, with a consistency of 0.800, ABI_2P is quasi-sufficient for GY_17²⁰. [40]

7. Cases Deviant with Respect to the Sufficiency of ABI_1P*GY_REC

In the context of sufficiency, as RAGIN and SCHNEIDER (2011) note, theory development requires us to try to raise consistency measures by adding factors to the configurations that form the rows of our truth tables. The basic idea is to move from X1 to "X1 combined with X2". If we add a single factor X2 then each row of the truth table will be split into two, doubling the size of the table, and any

18 A test for the quasi-necessity of ABI_1P + REC_for_at_least_REALSCHULE has a consistency of 1.0.

19 If we run a model, GY_17=F(SC_1P, ABI_1P, MALE), we do actually find that SC_1P*ABI_1P is just about quasi-sufficient, with a consistency of 0.758 (compared to the 0.855 we found for our solution 8).

20 It certainly is not necessary; consistency here is only 0.325, but this is not surprising, given educational expansion.

causal arguments will tend to be more detailed, i.e. less inclusive (p.159)²¹. Of course, X2 may turn out to be the absence of some factor. [41]

7.1 Samuel

Samuel is MALE* ABI_1P*sc_1P*GY_REC. His parents both, in fact, have the *Abitur*, but neither is in the service class. His father is a plumber; his mother a seamstress. When he received the recommendation for the *Gymnasium* he seems to have decided that, given that he does not tend to like putting lots of effort into his schoolwork, he would be a candidate for dropping out of the *Gymnasium* later (as others, he says, with better marks than he had, had done). It would be safer to go to the *Realschule*. This, he says, was the right decision to have made. He knew, at primary school, that the *Abitur* opened up more possibilities, but he also knew that a good *Realschule* qualification can suffice. He had discussed this decision with his parents. They made it clear it was his choice. They would support him, whichever choice he made, but they did note that he must not regret it later. He was, by the way, aware that his mother had gained the *Abitur* after having initially had a recommendation for and having attended the *Hauptschule*. He knew such educational mobility was possible for him too. [42]

He has three siblings. His older sister is doing an apprenticeship as a confectioner (having originally had a *Realschule* recommendation, but having gone to the *Hauptschule* because of her problems with German, but then having gained the *Realschulabschluss*²² via the 9+1 route²³). His younger brother is at *Gymnasium*; his younger sister at primary school. [43]

He makes it clear that he has reflected a lot on his educational and future occupational choices. He argues that a poor *Gymnasium* qualification is worth no more than a good one from a *Realschule*. Crucially though, he works with his self-employed father—a plumber—during school holidays, enjoys this, finding the work has variety, and wants to follow in his father's footsteps. He notes he will be

21 The trade-off here, between inclusiveness and detail reminds us of Lewis CARROLL's (1893) discussion of the scale of maps (in his *Sylvie and Bruno Concluded*, p.169):

"Mein Herr looked so thoroughly bewildered that I thought it best to change the subject. 'What a useful thing a pocket-map is!' I remarked.

'That's another thing we've learned from your Nation,' said Mein Herr, 'map-making. But we've carried it much further than you. What do you consider the largest map that would be really useful?'

'About six inches to the mile.'

'Only six inches!' exclaimed Mein Herr. 'We very soon got to six yards to the mile.'

Then we tried a hundred yards to the mile. And then came the grandest idea of all! We actually made a map of the country, on the scale of a mile to the mile!

'Have you used it much?' I enquired.

'It has never been spread out, yet,' said Mein Herr: 'the farmers objected: they said it would cover the whole country, and shut out the sunlight! So we now use the country itself, as its own map, and I assure you it does nearly as well.' "

22 The *Realschulabschluss* is the qualification awarded at the end of the *Realschule*.

23 This route gives able *Hauptschule* pupils, who have taken some extra lessons, the opportunity to gain the *Realschulabschluss*.

doing what his father did, since it seems that he found his own training and initial jobs through an uncle who was a plumber. He does not need to study in higher education after school for his chosen career. His mother is also self-employed. She, he says, had had enough of school by the time she'd finished the *Gymnasium* and wanted to earn some money. He seems to have the same view for himself. [44]

There are, however, elements of a connection with higher education in his family. He says an uncle has a doctorate and works as a university researcher. He also suggests his father might have gone to higher education had money not been a problem. He also has acquaintances who are studying, but this is not for him. [45]

He also makes it clear that his preference is for outdoor activities rather than things like reading. He likes fresh air, not sitting still! In this regard, it is perhaps important that his mother made special efforts to ensure he read well. [46]

An X2? It seems that Samuel has, from an early age, been reflecting on his path through schooling and into work. While his having had the recommendation for *Gymnasium* clearly provided him with the possibility of attending *Gymnasium*, he seems to have decided, quite reflectively, early on, that this academic route, and what it led to, was not for him. He had available a model of a self-employed skilled manual working life that appealed to him and he seems to have used this in making cost-benefit (not just financial) comparisons with the alternative academic pathway he could have followed. Perhaps, then, the X2 here is the combination of a considered preference for practical activities coupled with the availability (and holiday experience) of a future job that pays enough, does not require higher education study and is enjoyable and varied. However, it may be that this could be understood, in a less specific sense, as having to do with an *absence*, i.e. having no immediate family experience of service class work and the opportunities it might offer for a varied working life, etc.²⁴. [47]

8. Conclusion

We have taken the position here that regularities alone cannot establish causation. Given a regularity established by some means of cross-case analysis of survey data, a further step is needed. This might be theoretical interpretation, where strong enough theory, derived from earlier research, exists. Alternatively, and this is the position we have explored here, we can use within-case data collection and analysis in an attempt to gain access to the processes that generate quasi-regularities and the exceptions to them. In our case this second step has involved reliance on individual interviews. [48]

Given our use of QCA to analyse survey data in a configurational manner, it is a natural move for us to use the results of our set theoretic analyses to choose

²⁴ We could ask whether, *given* $ABI_1P^*GY_REC$, it is then quasi-necessary to be SC_0P in order to be deviant in the way Samuel is. If we do, we find SC_0P having a consistency with necessity of 0.242 for $\sim GY_17$ (where the \sim indicates *not* GY_17). This (within-configuration) necessity hypothesis needs to be discarded. On the other hand, a parallel test for the necessity of neither parent having a degree does approach the 0.75 threshold (reaching 0.727).

typical or deviant cases, in respect of either quasi-sufficiency or quasi-necessity, for such in-depth attention. Here, in relation to the outcome of being in the *Gymnasium* at age 17, we have chosen to discuss deviant rather than typical cases, with the goal of understanding why it is, re sufficiency, that some cases with a normally sufficient combination of conditions to gain this outcome did not and why, re necessity, some cases lacking a normal necessary condition nevertheless managed to achieve it. We related the analysis of these chosen cases to RAGIN and SCHNEIDER's (2011) account of what theory building might comprise within a set theoretic approach. [49]

With respect to necessity, we were able, for both cases we looked at, to uncover a possible substitute for the previously established necessary condition of a recommendation for the *Gymnasium* though, clearly, further work would be needed to establish whether this substitute characterises other deviant cases. Similarly, re sufficiency, in the case of Samuel, we were able to uncover factors, including possibly the *absence* of certain experiences that might account for his deviance. [50]

An important common factor for all three cases was the immediate and extended familial context in terms of what it was "natural" or habitual to do, both educationally and occupationally. This was especially clear for Andreas and Samuel. Sibel's case is more complex, given the discrepancy between the social and educational status of her parents. Indeed, we can speculate that, had she been in a family context more like that of Andreas, she might have gone straight into the *Gymnasium*. However, taking these three deviant cases together, our analyses suggest that QCA models of the pattern of educational outcomes in Germany might be improved by extending the indicators of class and educational background beyond parents to include, where possible, siblings and other close relatives. [51]

We have focused in this article on discussing "deviant" cases, i.e. those who did not conform to expectations. We have shown how the detailed study of such cases can contribute to theory development, by suggesting additional factors we might include in cross-case analyses. We do not have space here to discuss any of our typical cases in the same amount of depth, but we should just like to note briefly some of our findings with regard to such typical cases and the manner in which they can serve to confirm theory. A key theory in the field is BOURDIEU's concerning the role of habitus (1977). According to habitus theory, we should expect to find that young people act in line with a set of behaviours and dispositions which is common in their family of origin. We have already seen evidence of such processes in our discussion of Andreas and Samuel. One of the types of typical cases with regard to sufficiency we described (see Table 6) comprises young people who have at least one parent with *Abitur*, who themselves received the recommendation for the *Gymnasium* and who indeed are in a *Gymnasium* at the age of 17. We are finding evidence, in our interview data, of such people talking about how their educational careers to date represent what is normal and expected in their families. Such expectations do seem to have contributed to a large extent to their pursuing this particular pathway. Their

"decision-making" seems to take place within such frameworks. We will report on this ongoing work in future papers²⁵. [52]

At the beginning of the article, we noted that QCA has been presented by RAGIN variously as a bridge between quantitative and qualitative approaches or as transcending the divide between them. Our own view is that QCA, used as we have used it here, to test and further develop theoretical explanations of observed regularities, provides a particularly fruitful way of combining approaches that are often seen as falling into two competing camps. There has been much discussion of mixed methods in recent years. QCA, with its focus on holistic cases rather than supposedly "independent" variables, provides a case-based means of combining methods for those wishing to explain rather than just describe the social world, i.e. for those seeking knowledge of generative processes. Its particular strength is its focus on holistic cases rather than supposedly independent variables. TURNER (1948), long ago, argued against the assumption of causal homogeneity that characterised conventional statistical approaches. QCA offers social scientists who wish to avoid this working assumption a tool that can describe complex regularities arising from casual heterogeneity. We have illustrated here how it can also be used as part of an approach that moves beyond recording such regularities to explaining them. [53]

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