Qualitative Comparative Analysis (QCA) Case Study

Impact Evaluation with Small Cohorts: Methodological Guidance (57–63)

Methodological Steps
Rihoux, B. & Ragin, C. C. (2009) *Configurational comparative methods: Qualitative comparative analysis (QCA) and related techniques*. Sage Publications. Available at
https://methods.sagepub.com/book/configurational-comparative-methods
(No Open Access version is currently available.)

Case Study
Bingham, A. J., Dean, S. & Castillo, J. (2019) 'Qualitative comparative analysis in educational policy research: Procedures, processes, and possibilities', *Methodological Innovations*, 12(2). Available at
https://journals.sagepub.com/doi/pdf/10.1177/2059799119840982
(Open Access)

Fabricated WP Example
Barkat, S. (2019) 'Evaluating the impact of the Academic Enrichment Programme on widening access to selective universities: Application of the Theory of Change framework', *British Educational Research Journal* Vol. 45(6) 1160–1185.
Available at: https://doi.org/10.1002/berj.3556
(No Open Access version is currently available.)

The fabricated example draws on a Theory of Change developed by Barkat (2019) to document an academic enrichment programme for Y12 students. All the details below, however, are fabricated and do not refer either to the intervention or its evaluation as described in the paper.

In the table below, the 'Case Study' column breaks the case study evaluation down into a series of methodological steps as described by the Methodological Guidance. In the 'Fabricated WP Example' column, we apply the logic of these steps to a hypothetical evaluation of a fabricated widening participation intervention, to suggest how a QCA approach to evaluation might unfold when applied to an intervention of this type. The nature of this 'Small *n*' approach means that there may be no single 'correct' way of applying this methodology. The example given should be considered illustrative rather than a definitive model.

Case Study	**Fabricated WP Example**
Bingham et al. (2019) Outline of paper: In this paper, which provides a methodological overview of QCA in educational research, Bingham et al. describe the application of QCA to an early alert intervention in a US university. The intervention is designed to identify those students at risk of failing in maths and encourage them to take mitigating action. Key evaluation question: How did the various pre-existing contexts and intervention factors contribute to the two intended outcomes?	There are few published examples of the application of QCA to the evaluation of WP-focused interventions. The example below is a hypothetical model to suggest how this approach could be used in the evaluation of a WP intervention. The starting point for this discussion draws on a Theory of Change documented in Barkat 2019, but the discussion below is based on an entirely fabricated example case study. Outline of paper: The article outlines the development of a Theory of Change approach to evaluating the impact of an academic enrichment programme for disadvantaged young people in Y12.
Step 1 - Build a dichotomous data table	
The evaluators used QCA to explore the relationship between several (dichotomous – Y/N) input variables, indicating whether the student in each case was: i) first time in Year 1 (i.e. not repeating the first year) ii) full-time iii) confirmed as having accessed the maths support centre iv) confirmed as having met with an advisor following the early alert v) enrolled in an advanced-level maths course Bingham et al. noted that they anticipated adding to this list of conditions as the evaluation progressed and more information was uncovered. These input variables were mapped against two main outcome variables indicating whether the student: Y) passed the maths course Z) continued into next term	The various causal conditions in the evaluation were derived from a Theory of Change. The ToC was based on: i) a relevant literature review ii) interviews with intervention participants iii) interviews with delivery staff iv) discussion with researchers in Level 3 pedagogy The TOC identifies four potential causal factors associated with achieving sufficient grades to meet the academic entry requirements of highly selective institutions. Participants were: A. above an initial Level 2 attainment threshold at the start of the course B. receiving optional additional coaching on how to succeed in common forms of assessment C. self-reporting a baseline level of confidence in their own academic abilities

For the purposes of this case study, we will focus on outcome Y.	D. self-reporting an elaborated personal career pathway that provided context – and therefore motivation – for succeeding in Level 3 qualifications. A successful outcome of the programme is that the student achieves the Level 3 grades required to meet the entry requirements for selective universities.
Step 2 – Construct a truth table	
The evaluators collected data about the distribution of condition outcomes for each case student. This truth table is included below.	A hypothetical (and randomised) outcomes table was constructed showing each of the student cases, whether they met each of the conditions discussed above and whether they achieved the intended programme outcome. This was processed using the freeware software Tosmana to group the different outcome combinations for each condition and indicate whether this led to a successful programme outcome. The truth table is included below.
Step 3 – Resolve contradictory configurations	
This stage was not included in the case study.	The visualisation diagram shows two sets of inconclusive combined outcomes in the conditions (marked as C in the diagram/truth table). This is because different student cases had the same pattern of conditional outcomes but different intervention outcomes. This creates an ambiguity in the data; further work is needed to resolve it. Possible solutions that the evaluators could have implemented were i) to change the threshold for success in one or more of the conditions (i.e. levels of pre-existing academic confidence seen as sufficient to meet Condition C) or ii) to add additional conditions to help further distinguish between these contradictory cases.

Step 4 – Boolean Minimalisation	
In the article, the evaluators process the truth table and establish Boolean logic for the two different outcomes of interest, comprising combinations of passed and failed conditions. Y = AbCDe + aBcDE + aBCD + BCdE Z = Abcd + aB + aE + Ce + BD + BE For Outcome Y, the evaluators concluded that students who received an alert about their maths progress passed the course when the following conditions were met: ● The student met for an early alert meeting with their tutor (D) AND ○ were first time in Year 1 (A) ○ were not full time (b) ○ used the maths advice centre (C) ○ were not in a higher-level maths course (e) OR ○ were not first time in Year 1 (repeat students) (a) ○ were full time (B) ○ did not use the maths advice centre (c) and ○ were involved in a higher-level maths course (E) OR ○ were not first time in Year 1 (repeat students) (a) ○ were full time (B) ○ did use the maths advice centre (C) OR ● Students who did not meet for an early alert meeting (d) and ○ were full time (B) ○ used the maths advice centre (C) and ○ were taking an advanced maths course (E).	The Boolean conditions are shown in the results table below. These condense the patterns of condition outcomes into summary rules. The rules indicate whether a condition pass is required (upper case) or a condition fail is required (lower case). The rules also indicate whether rules are required in combination (AND) or whether there are alternative conditions (OR). For this fabricated case study, condition patterns were allocated on a randomised basis and therefore the outcomes discussed below are likely to be more counter-intuitive than might be found using real data. Successful programme outcome = a * B * D + a * b * c For a positive outcome, students must be below the Level 2 attainment threshold at the start of the programmes (fail condition a). They must also have either passed B (have additional coaching) AND D (have a pre-decided career pathway) or NOT have additional coaching (b) AND a level of pre-existing academic confidence that is below the threshold (c). This suggests that condition A relates negatively to the programme outcome and that a low level of Level 2 attainment was necessary to achieve the programme outcomes (but not sufficient; it requires other conditions to be met). Hypothetically, this could suggest that students who meet and exceed the Level 2 attainment threshold do not appropriately engage with the programme, but those who fall below are encouraged to focus on the programme content. Similarly, the interaction between meeting conditions B and D suggests that the additional assessment

The evaluators concluded that there were two important conditions for successfully completing the maths course (Y): having an early alert meeting (D) and being enrolled in a higher-level maths course (E), although these were neither sufficient in themselves nor necessary.	coaching could reinforce, or be reinforced by, a pre-existing career plan. The interaction between b and c could suggest that a lack of additional coaching combined with low academic confidence increases student motivation to engage in additional academic work outside the programme. Moreover, the outcome a*b*C, leading to a negative programme outcome, strengthens the case that condition C (a pre-existing level of academic confidence) is important to outcomes and that too much confidence can work against the desired outcomes, perhaps by reducing participant motivation. These hypotheses could suggest areas for further research or additional conditions for a future iteration of this evaluation process.
Step 5 – Bring in logical remainders cases	
This stage was not included in the case study.	A consideration of the logical remainders (cases with no conditions met – CM and CN in the table below) had no impact on the minimalisation process for the positive outcome. However, including logical remainders in the analysis of the negative outcomes table served to create a more parsimonious Boolean logic – a more condensed formula explaining the relationship between cases. The resulting table and results are included below. A discussion of this outcome lies beyond the scope of this case study, but comparing the Boolean logic for the outcomes with and without logical remainders confirms the consistency of the two processing outcomes.
Conclusion	
The authors of the article conclude that QCA is useful for approximating and exploring causal conditions and for investigating the relationship between these different causal conditions. They also note that QCA can produce a level of generalisability because it includes multiple cases. At the same time, however, limited cases result in a potential lack of diversity in the cases included and this should be noted when presenting the findings.	This hypothetical case study suggests that the use of dichotomous variables can be useful when exploring how different sets of potentially causal conditions (drawn from a literature review) can be tested for relevance and impact. Even a small number of conditions can lead to complex interactions and influences, and this approach can therefore be usefully combined with other case-based approaches (for example GEM) to unpick how the different causal factors interrelate and increase or negate other causes.

Truth table from Bingham et al. (2019)

Conditions					Outcome	Cases
A: first time in Year 1	B: full time	C: used maths advice centre	D: met for early alert meeting	E: enrolled in advanced maths course	Y – Outcome: Passed math course with a C – or better.	Number of cases (frequency)
0	1	0	1	1	1	3
0	1	1	0	1	1	14
0	1	1	1	0	1	2
0	1	1	1	1	1	11
1	0	1	1	0	1	1
1	1	1	0	1	1	1

Hypothetical WP Case Study

Cases = individual intervention participants
Conditions = meeting or not meeting the required condition

Outcome Table
This shows whether each student met (1) or did not meet (0) the stated condition and whether they successfully achieved (1) or failed to meet (0) the intended programme outcome.

Cases	Conditions				Result
Students	A: meets Level 2 attainment threshold prior to course	B: participates in additional assessment coaching	C: has pre-existing academic confidence	D: has decided career path prior to course	Outcome: meets academic level required for progression to selective institution
CA	1	0	1	1	1
CB	1	0	1	1	0
CC	1	0	1	1	1
CD	1	0	1	0	1

CE	1	0	1	0	0
CF	0	0	1	0	0
CG	0	1	1	1	1
CH	0	1	1	1	1
CI	0	1	0	0	0
CJ	1	1	0	0	0
CK	1	0	0	1	0
CL	0	0	0	1	1
CM	0	0	0	0	1
CN	0	0	0	0	1
CO	1	1	0	0	0
CP	1	1	0	1	0
CQ	1	1	1	1	0
CR	0	0	1	1	0
CS	1	0	1	1	1
CT	0	1	0	1	1

To produce the outputs shown below, this outcome table was processed using the freeware software Tosmana, a tool created by Lasse Cronqvist at the University of Trier, Germany. It is provided as freeware and available at Tosmana - Tool for Small-N Analysis (QCA)
A manual is available at https://www.tosmana.net/downloads/tosmana_manual1_52.pdf
Tosmana is available for Windows only. A list of QCA analysis software for other platforms is available at Software | COMPASSS

Truth Table
Processing the Outcome Table produces a further table which groups the patterns of outcomes into configurations that lead to a successful outcome (1), lead to an unsuccessful outcome (0) or are inconclusive (C). This is run twice, once for a positive programme outcome (1) and once for a negative programme outcome (0).

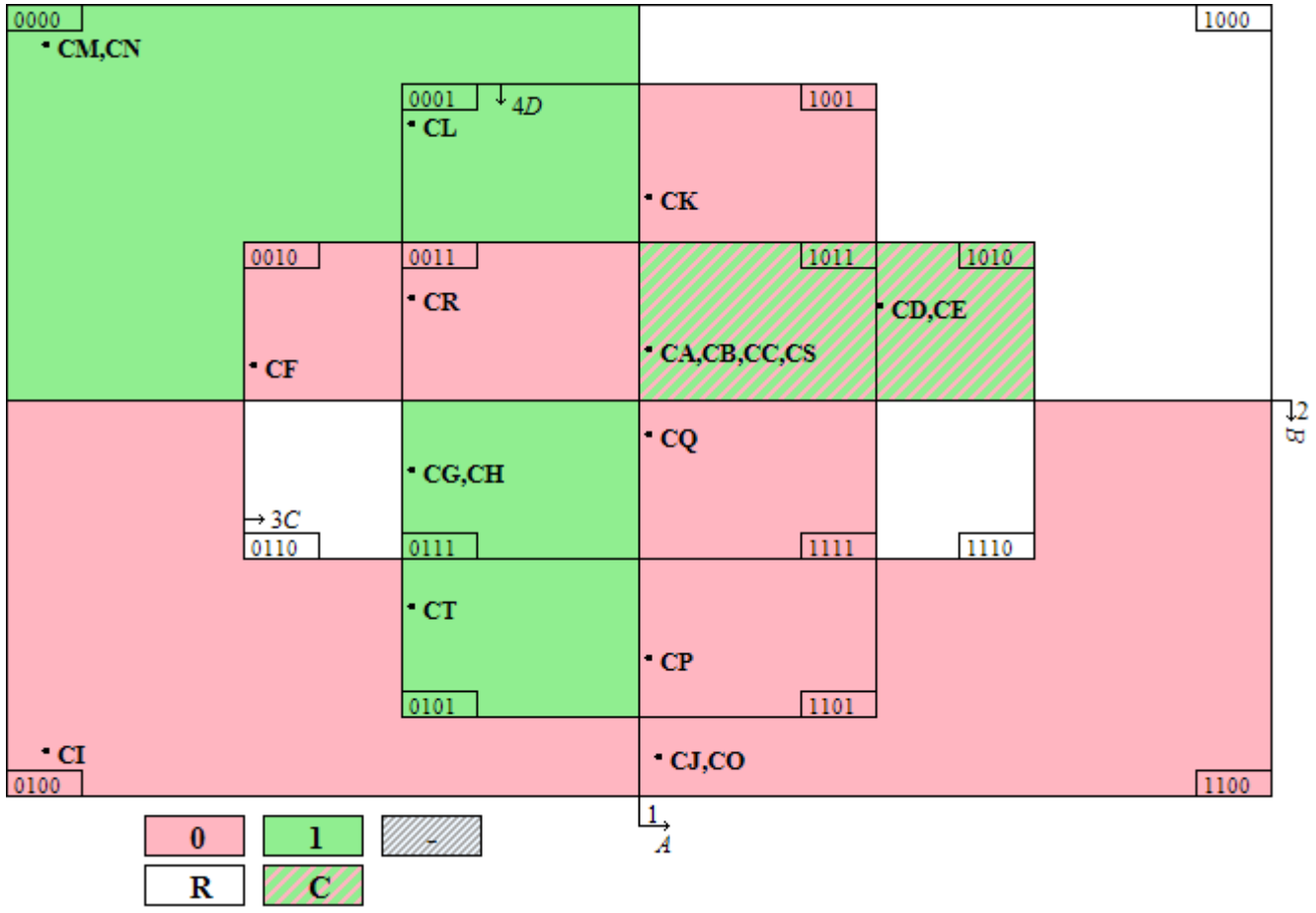
Truth Table for Positive Programme Outcome

O: Outcome Case ID

v1	v2	v3	v4	O	id
0	0	0	0	1	CM, CN
0	0	0	1	1	CL
0	0	1	0	0	CF
0	0	1	1	0	CR
0	1	0	0	0	CI
0	1	0	1	1	CT
0	1	1	1	1	CG, CH
1	0	0	1	0	CK
1	0	1	0	C	CD(1), CE(0)
1	0	1	1	C	CA(1), CB(0), CC(1), CS(1)
1	1	0	0	0	CJ, CO
1	1	0	1	0	CP
1	1	1	1	0	CQ

In the table above, Students CD and CE have the same conditional outcomes (1010), but one fails and one passes the programme outcome.
Similarly, students CA, CC and CS have the same pattern of conditional outcomes (1011), but three pass and one fails the outcome.
These two sets of conditional configurations are, therefore, inconclusive.

Visualisation Table for Positive Programme Outcome



Pink squares indicate a negative programme outcome; green squares indicate a positive programme outcome. The combination of conditions is shown in the corner of each box (e.g. the box on the bottom left = 0100 (fail condition A, pass condition B, fail condition C, fail condition D)).

The hatched green and pink boxes in the top right indicate contradictory programme outcomes for participants with the same pattern of condition outcomes.

Results For Positive Programme Outcome

a * B * D + (CG,CH+CT)	a * b * c (CL+CM,CN)

There were no simplifying assumptions.

This indicates that for a positive outcome the following conditions were required:

Fail Condition **a** (Level 2 attainment is lower than threshold prior to course) **AND pass** Condition **B** (participate in additional assessment coaching) **AND pass** Condition **D** (have a decided career path prior to course).

OR

Fail Condition **a** (Level 2 attainment is lower than threshold prior to course) **AND fail** Condition **b** (do not participate in additional assessment coaching) **AND fail** Condition **c** (level of pre-existing academic confidence is lower than threshold).

Truth Table for Negative Programme Outcomes

O:				Outcome	Case ID
v1	v2	v3	v4	O	id
0	0	0	0	1	CM, CN
0	0	0	1	1	CL
0	0	1	0	0	CF
0	0	1	1	0	CR
0	1	0	0	0	CI
0	1	0	1	1	CT
0	1	1	1	1	CG, CH
1	0	0	1	0	CK
1	0	1	0	C	CD(1), CE(0)
1	0	1	1	C	CA(1), CB(0), CC(1), CS(1)

1	1	0	0	0	CJ, CO
1	1	0	1	0	CP
1	1	1	1	0	CQ

Results for Negative Programme Outcome

a * b * C + (CF+CR)	B * c * d + (CI+CJ,CO)	A * c * D + (CK+CP)	A * B * D (CP+CQ)

There were no simplifying assumptions/no logical remainders were included.

This indicates that the following conditions were required for a negative programme outcome:

Fail Condition **a** (Level 2 attainment is lower than threshold prior to course) **AND fail** Condition **b** (do not participate in additional assessment coaching) **AND pass** Condition **C** (level of pre-existing academic confidence is above threshold)

OR

PASS Condition **B** (participate in additional assessment coaching) **AND fail** Condition **c** (level of pre-existing academic confidence is lower than threshold) **AND fail** Condition **d** (do not have a decided career path prior to course)

OR

PASS Condition **A** (Level 2 attainment is above threshold prior to course) **AND fail** Condition **c** (level of pre-existing academic confidence is lower than threshold) **AND pass** Condition **D** (have a decided career path prior to course)

OR

PASS Condition **A** (Level 2 attainment is above threshold prior to course) **AND pass** Condition **B** (participate in additional assessment coaching) **AND pass** Condition **D** (have a decided career path prior to course).

Truth Table for Negative Programme Outcomes (Including Logical Remainders)

O: Outcome id: Case ID

v1	v2	v3	v4	O	id
0	0	0	0	1	CM, CN
0	0	0	1	1	CL
0	0	1	0	0	CF
0	0	1	1	0	CR
0	1	0	0	0	CI
0	1	0	1	1	CT
0	1	1	1	1	CG, CH
1	0	0	1	0	CK
1	0	1	0	C	CD(1), CE(0)
1	0	1	1	C	CA(1), CB(0), CC(1), CS(1)
1	1	0	0	0	CJ, CO
1	1	0	1	0	CP
1	1	1	1	0	CQ

Results for Negative Programme Outcome (Including Logical Remainders)

A * B + A * c + B * d + a * b * C
(CJ,CO+CP+CQ) (CJ,CO+CK+CP) (CI+CJ,CO) (CF+CR)

There were three simplifying assumptions:

A{0}B{1}C{1}D{0} +
A{1}B{0}C{0}D{0} +
A{1}B{1}C{1}D{0}