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Qualitative Comparative Analysis case study: Evaluation of Jumpstart

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Helen Bowman
Dr Saad Mufti
Fiona Chapel
Dr Igor Tkalec
Jenni Whitfield

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Qualitative Comparative Analysis (QCA)

Impact Evaluation with Small Cohorts: Methodological Guidance (p. 54-59)

Case Study

This Qualitative Comparative Analysis (QCA) was conducted as part of a TASO programme to pilot the use of a series of small *n* methodologies within widening participation (WP).

QCA case study **A small-n study using Qualitative Comparative Analysis (QCA) to understand the combination of factors that contribute to a rise in self-reported confidence in participants on a non-accredited pre-entry programme.**
Programme overview
Programme context: The Lifelong Learning Centre (LLC) at the University of Leeds has a widening participation mission focusing on adult education and community outreach. The centre recruits mature, part-time and foundation-year students and supports them throughout the student life cycle. The Jumpstart programme is an outreach programme targeting adult learners who were studying at level 2 in Community Adult and Further Education and who were unaware of the possibilities of studying further at university or college. It aims to provide an inclusive and transformative learning experience for adults on a university campus or through a hybrid mode, allowing space for adult learners to progress between adult community education and higher education. It consists of 10 sessions run over eight weeks, with an additional week taken for a trip to the theatre. The course is non-accredited and uses a range of face to face and online delivery methods. The programme aims to increase participants' knowledge about their options in higher education and their confidence in applying to study in Higher Education (HE) through an approach rooted in the critical adult education tradition. The course content and methodology are

student-centred and emphasise the importance of students' experience as a starting point to draw learning from. This gives value to the students' experiences, promoting inclusivity and increasing learners' confidence.

Evaluation context:

The project team were interested in employing a supported, structured impact evaluation which was suited to the student cohort. Crucially, they did not want to subject participants to overly intrusive data collection which might negatively impact their desire to engage.

The team were particularly interested in understanding what combination of factors would contribute to increased student confidence. Qualitative Comparative Analysis (QCA) was particularly interesting to them as it offered the opportunity to understand the configuration of experiences and attributes that might contribute to an increase in confidence over the Jumpstart course. In particular, QCA was chosen because it seemed to provide a means for the team to:

- Better understand the contributing factors to students' changing perceptions of Higher Education as a realistic choice for them.
- Identify the (combinations of) conditions under which beneficial outcomes occur, as well as the conditions that appear to create barriers for students.

The key research questions were therefore:
What configuration of factors contribute to participants' rise in self-reported confidence?
What conditions appear to lead to beneficial outcomes, as well as the conditions that appear to create barriers for students?

Theory of Change development

The first stage in this evaluation process was to develop a Theory of Change mapping out what is known or assumed about how the programme delivers its outcomes. This would support the selection and calibration of QCA attributes and variables.

A high-level Theory of Change for Jumpstart already existed and was initially developed in 2021.Target groups intended impact and enabling factors for the program were well documented, and the initial phase involved drawing out more explicitly some of the underlying assumptions, the chain of impact (i.e. short, medium and long-term outcomes), and identifying monitoring targets.

The project team began by translating this work into a middle-level Theory of Change by theorising the change mechanisms that

connected individual sets of activities with intended outcomes.

This initial mid-level Theory of Change was developed through discussions with the practitioner delivering Jumpstart and other colleagues working in outreach and support activities across the Lifelong Learning Centre (LLC).

Step 1: Build a dichotomous data table

In QCA each case is transformed into a series of attribute variables and one outcome variable (i.e. intended programme outcome). These variables are translated into values (usually binary) and used to construct a table showing each case and the attribute values associated with them.

Selecting attributes (variables)

Based on the Theory of Change, practitioner reflections and a literature review, the project team identified a series of key factors that theoretically appear to have an effect on mature learners' readiness to apply to higher education and their confidence in making HE applications.

The team selected increased participant confidence as the QCA output measure (the outcome). This was derived by comparing self-reported measures of confidence pre- and post-intervention for each case (participant).

Calibrating attributes (variables)

Each of these factors was 'calibrated' (translated into a binary (presence/absence) variable) through close consultation between the programme practitioner and the evaluation team.

In this case, the programme team identified 5 key attributes (conditions in QCA terminology), which are theoretically relevant to participants showing an increase of confidence across the programme:

EDUCATION* - 'time out of education (in years)' and 'previous experiences with education' mapped as (positive/negative) variables.

OUTREACH* - ‘participation in IAG in the past year’ (yes/no) and ‘participation in other outreach activity’ (yes/no; with extra weighting for recency) variables.

PERSONAL* - ‘have caring responsibility (yes/no)’ and ‘have support network (yes/no)’ variables.

TRAUMA - ‘is experiencing ongoing trauma (yes/no)’

JumpstartATTENDANCE – ‘% of attended Jumpstart classes’

*The first 3 conditions bring together two separate attributes. The programme team opted to bring these together through a logical union of two variables. A logical union is a set of all elements that belong to either set or are in both. The team collated these into a single calibrated data score based on the ‘max’ rule basis. For example, if a Jumpstart participant has a calibrated score of 0.8 in condition A and 0.4 in condition B, the ‘max’ rule states that the participant’s score in the logical union of A and B is 0.8 as this is the highest (maximum) value across all conditions that are part of the union. This value was then itself ‘calibrated’ – a threshold was set to determine whether the attribute was present or absent. The team took this approach because the sample of participants was relatively small and many cases were similar. The final two conditions were single attributes.

Crisp Set and Fuzzy Set Attributes

When incorporating participant attributes (as used here) into the data table, the variables can be either ‘crisp set’ (a binary value 0 for 1) or ‘fuzzy set’ (they can have a range of values, usually between 0 and 1).

EDUCATION, PERSONAL and TRAUMA were binary values (present or absent), while OUTREACH and JumpStartATTENDANCE were fuzzy because they were scaled to represent different levels of engagement.

What resulted was a table that showed the attribute outcomes for each participant case across the rows and the attribute outcomes as columns. The final variable here ‘CONFIDENCE_CHANGE’ is the outcome variable showing whether the programme’s objectives were met (the participant self-reported an increased in confidence).

"TRAUMA"	"JumpStartATTENDANCE"	"EDUCATION"	"OUTREACH"	"PERSONAL"	"CONFIDENCE_CHANGE"
1	0.9	1	1	1	1
1	0.4	1	1	1	0
1	0.6	1	0	1	0
1	0.9	1	0.25	1	1
1	1	1	1	1	1
0	0.4	1	0	1	1
1	0.7	1	0.625	1	1
1	0.9	1	0	1	0
0	0.9	1	0.25	0	1
1	1	0	1	1	1
1	0.6	1	0	1	0
1	0.6	1	0	1	1
1	0.7	1	1	0	1
1	0.9	0	0.875	1	1

Step 2: Construct a truth table

The next stage is to translate the table of outcomes into a 'Truth Table'. Software is usually used to assess the relationship between the attributes and the outcome variable (programme outcome). It shows the outcome associated with each different combination of attributes.

The programme team used R software to create a truth table. Rather than each row representing a particular case (participant), the rows in the truth table represent each different possible combination of attribute outcomes and show which of these combinations are correlated with a successful programme outcome. Where the OUT column shows '1' this is a successful outcome (increase in confidence) '0' is an unsuccessful outcome (no increase in confidence) and '?' where the answer is not clear.

This stage of analysis resulted in the following truth table, which shows the combinations of attributes ‘sufficient’ for an increase in confidence, or a lack of increase in confidence, to occur. In this case study, five combinations of attributes (or truth table rows) were sufficient for the outcome.

The combinations of conditions under which the outcome is observed are called sufficient paths, which together make a QCA solution formula. Combinations of conditions under which the outcome occurs are the essence of QCA analysis and are often interpreted as ‘recipes’ or ‘paths’ to the outcome. The combinations are explored through the so-called sufficiency analysis – this answers the question *which combination of conditions is sufficient for the occurrence of the outcome*?

	EDUCATION	OUTREACHFS	PERSONAL	TRAUMA	ATTENDANCEFUZZY	OUT	n	incl	PRI
16	0	1	1	1	1	1	2	1	1
18	1	0	0	0	1	1	1	1	1
21	1	0	1	0	0	1	1	1	1
28	1	1	0	1	1	1	1	1	1
32	1	1	1	1	1	1	3	0.874	0.874
31	1	1	1	1	0	0	1	0.455	0.455
24	1	0	1	1	1	0	5	0.451	0.451
1	0	0	0	0	0	?	0		
2	0	0	0	0	1	?	0		
3	0	0	0	1	0	?	0		
4	0	0	0	1	1	?	0		
5	0	0	1	0	0	?	0		
6	0	0	1	0	1	?	0		
7	0	0	1	1	0	?	0		
8	0	0	1	1	1	?	0		
9	0	1	0	0	0	?	0		
10	0	1	0	0	1	?	0		
11	0	1	0	1	0	?	0		
12	0	1	0	1	1	?	0		
13	0	1	1	0	0	?	0		
14	0	1	1	0	1	?	0		
15	0	1	1	1	0	?	0		
17	1	0	0	0	0	?	0		
19	1	0	0	1	0	?	0		
20	1	0	0	1	1	?	0		
22	1	0	1	0	1	?	0		
23	1	0	1	1	0	?	0		
25	1	1	0	0	0	?	0		
26	1	1	0	0	1	?	0		
27	1	1	0	1	0	?	0		
29	1	1	1	0	0	?	0		
30	1	1	1	0	1	?	0		

Step 3: Resolve contradictory configurations

QCA analysis outcomes are not always neat and clear and often contradictory configurations are produced. These are outcomes where the same combination of attributes is associated with different outcomes.

Where contradictory outcomes emerge, evaluators need to engage in an iterative process of rethinking and retesting their attribute data. The TASO *Methodological Guidance* suggests several ways of resolving these contradictions; by adding additional conditions or attributes to the data, recalibrating the data (e.g. altering the threshold at which a binary value is switched from 0 to 1) or changing how the underlying variable is operationalised.

In this case, the programme team found no contradictory configurations in the analysis. This meant that none of the possible logical combinations of conditions is simultaneously sufficient both for the presence and the absence of the outcome. This strengthens the assumptions the team made about the attributes (conditions).

Step 4: Boolean minimalisation

The next stage is to logically reduce or refine the truth table to produce a simpler and clearer set of rules (attribute combinations) leading to a successful outcome. This is normally performed in software.

The team used R software to compute a Boolean minimisation of the conditions required for a successful outcome. The logical reminders are marked with a '?' in the outcomes column of the truth table produced in step 2. This stage in analysis employed 15 out of the 25 logical remainder rows in the truth table [1,2,5,6,9,10,12,13,14,17,22,25,26,29,30] as simplifying assumptions to produce the most parsimonious solution.

The project team conformed to QCA standards of good practice and reported conservative and intermediate solution formulas with their corresponding parameters in the table below.

Conservative solution formula:

```
## M1: EDUCATION*OUTREACH*TRAUMA*JumpStartATTENDANCE +
##     OUTREACH*PERSONAL*TRAUMA*JumpStartATTENDANCE +
##     EDUCATION*~OUTREACH*~PERSONAL*~TRAUMA*JumpStartATTENDANCE +
##     EDUCATION*~OUTREACH*PERSONAL*~TRAUMA*~JumpStartATTENDANCE
##     -> CONFIDENCE_CHANGE
##
##                                                                  inclS   PRI   covS   covU
## ------------------------------------------------------------------------------------------
## 1              EDUCATION*OUTREACH*TRAUMA*JumpStartATTENDANCE  0.897  0.897  0.347  0.070 (4 cases)
## 2               OUTREACH*PERSONAL*TRAUMA*JumpStartATTENDANCE  0.921  0.921  0.465  0.188 (5 cases)
## 3  EDUCATION*~OUTREACH*~PERSONAL*~TRAUMA*JumpStartATTENDANCE  1.000  1.000  0.075  0.075 (1 case)
## 4  EDUCATION*~OUTREACH*PERSONAL*~TRAUMA*~JumpStartATTENDANCE  1.000  1.000  0.060  0.060 (1 case)
## ------------------------------------------------------------------------------------------
##                                                           M1  0.944  0.944  0.670
```

Intermediate solution formula (directional expectations: all conditions in presence contribute to the occurrence of the outcome):

```
## M1:    EDUCATION*OUTREACH*JumpStartATTENDANCE +
##        EDUCATION*PERSONAL*~TRAUMA +
##        EDUCATION*~TRAUMA*JumpStartATTENDANCE +
##        OUTREACH*PERSONAL*TRAUMA*JumpStartATTENDANCE
##        -> CONFIDENCE_CHANGE
```

```
##
##                                                 inclS   PRI   covS   covU
## ------------------------------------------------------------------------
## 1        EDUCATION*OUTREACH*JumpStartATTENDANCE  0.903  0.903  0.372  0.070 (4 cases)
## 2                    EDUCATION*PERSONAL*~TRAUMA  1.000  1.000  0.100  0.060 (1 case)
## 3         EDUCATION*~TRAUMA*JumpStartATTENDANCE  1.000  1.000  0.130  0.065 (1 case)
## 4  OUTREACH*PERSONAL*TRAUMA*JumpStartATTENDANCE  0.921  0.921  0.465  0.188 (5 cases)
## ------------------------------------------------------------------------

##                                           M1  0.948  0.948  0.725
```

Step 5: bring in logical remainders cases

The final analysis stage brings in 'logical remainders', a pool of potential cases that can reduce or minimize the solution still further.

The TASO *Methodological Guidance* suggests that 'by including hypothetical cases, the software can develop broader categories of membership and make simplifying assumptions' (p.57). This simplest possible description is often referred to as the most parsimonious solution.

```
## M1: ~TRAUMA + OUTREACH*JumpStartATTENDANCE -> CONFIDENCE_CHANGE
##
##                                 inclS   PRI   covS   covU
## ----------------------------------------------------------
```

```
## 1                       ~TRAUMA  1.000  1.000  0.200  0.175 (2 cases)
## 2  OUTREACH*JumpStartATTENDANCE  0.933  0.933  0.560  0.535 (6 cases)
## ------------------------------------------------------------
##                              M1  0.948  0.948  0.735
```

The outcome is shown as a combination / relationship of attributes that lead to a successful outcome. Attributes can combine either through an AND (shown as *) relationship (both are necessary) or an OR (shown as +) relationship (either is necessary).

In this case, the first set of conditions shows that participants who do NOT (~) have experience of 'TRAUMA' ***OR*** have a necessary level of participation in OUTREACH ***AND*** JUMPSTART is sufficient for an increase in confidence (outcome).

Software can also produce a Venn diagram to visualise this parsimonious solution:

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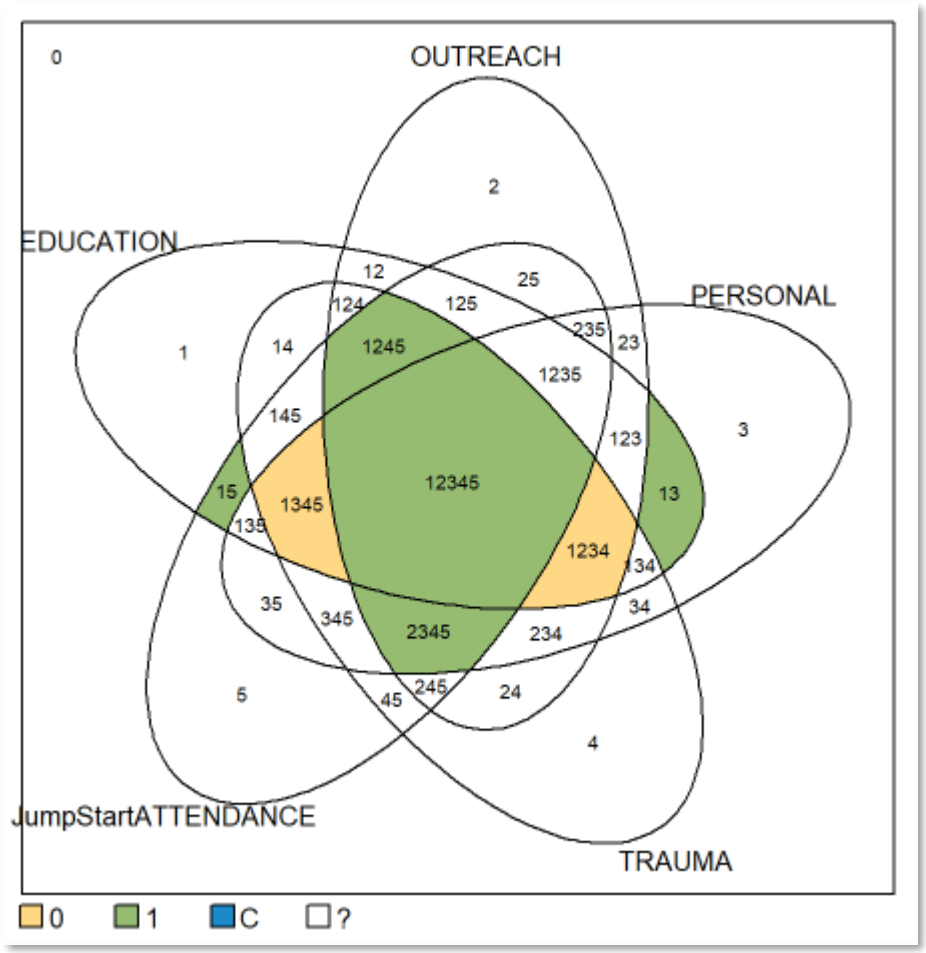

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Evaluation outcomes

The QCA analysis shows that:

Participants who are *NOT* experiencing ongoing trauma/traumatic event in their life [~TRAUMA]

OR

who a) have participated in/attended up to 3 outreach activities OR have participated in IAG in the current year [OUTREACH]

AND

b) have attended more than 50% of JumpStart sessions/classes [JumpStartATTENDANCE] will report increased confidence.

Consistency (0.948) of the most parsimonious solution is high at 95%, meaning that there is a close to perfect subset relation between the conditions and the outcome. Coverage (0.735) - proportion of cases that have outcome=1 covered by the sufficient path is also relatively high and acceptable at 73%. Note that the maximum value for both consistency and coverage is 1 (or 100%).

The project team suggest that the model is 'somewhat robust'. They subjected it to a series of tests to assess how secure the outcomes were. The team explored five robustness criteria including:

- increasing the minimum number of cases covered by a sufficient truth table from 1 to 2
- increasing the consistency threshold from 0.8 to 1
- test solution (assessing the overlap between original parsimonious solution and the parsimonious solution produced with consistency threshold 1 [the test solution]. More overlap indicates higher robustness)
- exploring true logical contradictions in the sufficiency plot, and
- assessing potentially omitted conditions.

Although sensitive to changes in consistency threshold and in minimum number of cases covered by a single truth table row, the solution is arguably somewhat robust as there is an evident overlap between the original and the test solution, there are no true logical contradictions, and consistency scores for truth table rows are predominantly high.

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Evaluation Conclusions

QCA analysis suggests that there are multiple paths through which Jumpstart participants can developed increased confidence about engaging in higher education.

Importantly, attendance at Jumpstart sessions was observed to be relevant for the positive change in confidence. Arguably, the main limitation of the analysis is the sample size as it introduces issues of limited diversity within the sample. The project team intend to re-run the QCA analysis with an additional cohort of Jumpstart participants in the future.

The parsimonious solution suggests that a sensitive but thorough approach to interviewing participants, sustained engagement with outreach activities and the provision of impartial advice and guidance are important to help participants make informed decisions about their engagement with the Jumpstart course and formal education opportunities. It also suggests that the participation in Jumpstart in combination with other outreach activities is important in building self-reported confidence.

Following reflection on the outcomes of this QCA evaluation, the project team intend to further refine the underlying assumptions detailed in the programme Theory of Change. The practitioner team will also review how self-reported confidence data is captured and invite a broader array of stakeholders for inputs (including former participants and guest lecturers) to extend their understanding of the potential mechanisms and attributes leading to a successful programme outcome.

Adaptions to the methodology

No adaptations were made to the core methodology and good standards of practice throughout the evaluation process.

R packages used:

- Dusa, A. (2019) *QCA with R. A Comprehensive Resource*. Springer International Publishing.
- Dusa, A. (2022) *_venn: Draw Venn Diagrams. R package version 1.11. https://CRAN.R-project.org/package=venn* Hlavac, M. (2022)*. stargazer: Well-Formatted Regression and Summary Statistics Tables. R package version 5.2.3.* https://CRAN.R-project.org/package=stargazer
- Oana, I & Schneider,C. (2018). SetMethods: An Add-on R Package for Advanced QCA. *The R Journal* 10(1): 507-33.

https://journal.r-project.org/archive/2018/RJ-2018-031/index.html

Reflections from using the QCA methodology

In their report, the project team reflected that, as an approach suited to analysing social science phenomena and as a methodological technique, QCA is a 'back-and-forth' iterative process. In this, it supports and allows for modifications in the modelling process, which would normally be driven by conceptual/theoretical or primary data insight.

The main challenge the project team encountered was missing data for a handful of Jumpstart participants, which QCA cannot handle (as statistical models can). Consequently, they had to shrink the sample and keep only those participants for whom data was available. However, the team managed to retrieve additional data for some participants at a later stage. This had a positive effect on the modelling process. Once the portion of missing data was patched, the tested models started to make both intuitive and empirical sense.

In terms of advice for peers attempting to employ QCA evaluation in an HE context, the team suggest that the calibration process, through which raw data is transformed into calibrated QCA crisp or fuzzy scores is crucial. To this end, it would be vital for a project team to construct an initial calibration framework (including theoretically relevant factors for the outcomes, as well as their measures; and the scales or thresholds used to calibrate attributes into QCA scores) before the evaluation begins. This would make the modelling process much easier and more effective as QCA allows adaptations of the calibration framework as needed in later stages of the evaluation.