

Set-Analytic Approaches, Especially Qualitative Comparative Analysis (QCA) Summary of the Final Report of QTD Working Group III.4

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1. Scope of Report

Our report focuses on set-analytic approaches that use algorithms and computer software for parts of their analysis, particularly Qualitative Comparative Analysis (QCA). We concentrate on transparency concerning the "analytic moment" that stretches from assigning membership scores of cases in the condition and outcome sets to the presentation and interpretation of the results obtained via the truth table's logical minimization.¹ We do not address transparency issues related to the research processes prior to and after this analytic moment as they are not specific to set-analytic approaches and are covered by other QTD working groups, such as those on research ethics, text-based sources, and non-automated content analysis.

2. Forms and Benefits of Research Transparency

Given our focus on set-analytic approaches as data analysis techniques, we discuss transparency measures regarding the *analytic process* and *data*. These measures have five main benefits that enhance the clarity of the analysis: enhancing the interpretability of the study's findings, allowing replication, improving the clarity of communication, improving understanding of QCA as a method in the discipline, and aiding teaching of and innovation in QCA. Most measures also enable replication. We emphasize six steps in the analysis about which QCA researchers should be transparent.

First, researchers should be transparent about how they transform their "raw" data into the membership scores of each case in the condition and outcome sets. Raw data can be any form of information about cases – from interviews to archival data or standardized indices; and sets can be crisp, fuzzy, or multi-value. *Set calibration* is typically an iterative process, and researchers need to explicate and justify what information they used, which qualitative anchors they have chosen, which form of calibration they employed, and on which software they relied. Both the raw and the calibrated data should be made available.

The next step is to conduct *tests of necessity*. Researchers need to discuss why a specific set is postulated as necessary for the outcome, instead of the other minimal supersets of that outcome that also pass the researchers' criteria for consistency and relevance. The latter choices, the thresholds for consistency and empirical relevance, also need to be explicated.

Step 3 involves representing the calibrated data in a *truth table*. For each truth table row, researchers should state what led to designate it as being sufficient for the outcome, not sufficient, or a logical remainder. This requires that researchers reveal the thresholds imposed regarding each row's consistency and case frequency. If further criteria have been used – such as the PRI-score (Proportional Reduction in Inconsistency) – researchers should explicate them too.

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¹ Note that we do not provide definitions of all QCA-concepts in this summary; in our report, we do.

Once the truth table is constructed, step 4 is that researchers summarize the information contained in the truth table via *logical minimization*. This requires that researchers reveal how they handled logical remainders, and if they allow only "easy" counterfactuals (intermediate solution), researchers should report their directional expectations. If model ambiguity arises – that is, if more than one solution formula can be obtained – it should be reported. Researchers should also state which software package they used for logical minimization.

Once all necessary and sufficient conditions have been identified, researchers need to *clearly present and interpret* their findings (step 5). This includes representation in the form of Boolean expressions, with all relevant parameters of fit. Labels should be displayed – best in a separate table - for cases that are typical for each sufficient term, that deviate from the broader picture, and that remain unexplained. Sometimes, the solution formula obtained not only reveals conjunctions of sufficient conditions, but also fulfills the empirical criteria for being interpreted as a disjunction that is necessary for the outcome; if so, this should be discussed as well. Relatedly, researchers should explicitly state whether their goal in using QCA is descriptive or causal inference.

Researchers should indicate in the text – and more extensively in an online appendix – which *robustness tests* have been performed (step 6) and what they reveal about the main findings and the analytic choices made during the analytic moment: calibration, thresholds for parameters of fit, and treatment of logical remainders. Additionally, robustness against equally plausible case- and condition-selection decisions should be performed.

3. Costs, Risks, and Limitations

The transparency measures discussed here are of relatively low costs and do not entail any real risks. The costs involve time and space needed for reporting all transparency measures. One risk consists of over-reporting, that is, inundating the reader with information such that clarity is hampered rather than fostered by transparency. Researchers therefore must guide the reader.

4. Recommendations

We recommend that QCA-researchers provide full information, as indicated above, about the (1) process of set-calibration, (2) tests of necessity, (3) construction of the truth table, (4) procedure of logical minimization, (5) details and interpretation of the findings, and (6) robustness tests performed. These are relatively low-cost measures that enhance the clarity of the analysis. In addition, in our report, we also recommend that QCA-researchers:

1. Provide the script of the analysis if using command-line software such as R, or screenshots if using graphical user interface software.
2. Report the software package used, including the version number.
3. Account for "going back and forth between theory and evidence" by discussing, for example, initial theoretical hunches, how the data altered these, whether and why selected cases were changed, and whether and why initial conditions were dropped or otherwise altered.

We advise cautious and selective use on the following practices:

4. When the data used are qualitative, we advise that researchers be aware of ethical, proprietary, and logistical concerns involved in sharing those data (see QTD working group reports on forms of evidence, sensitive contexts, and research ethics).

In our report, finally, we counsel against the following practices:

5. Lengthy appendices without a summary in the main text. Appendices should be curated appropriately.
6. Presenting research as hypothesis-testing when it followed the "dialogue between theory and evidence" approach.
7. Providing a substantive interpretation of *all* QCA solution formulas, unless the explicit goal is comparing them.