

Glossary

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This glossary provides definitions of key terms used throughout this book. The entries reflect conventional usage, as developed in book-length treatments of the method (Ragin 1987; 2000; 2008), prior lexicons in QCA textbooks (Kahwati and Kane 2020; Rihoux and Ragin 2009; Schneider and Wagemann 2012), and general glossaries on research methods (Gerring 2012; Seawright and Collier 2010). For contextual discussions, readers are referred to the respective pages highlighted in the index. Cross-references are given in italics.

Asymmetry. See causal complexity.

Attribute space. The multi-dimensional space, within which cases can be located. The attribute space has as many dimensions as the number of sets included in the truth table analysis. Also known as *property space*.

Boolean AND. Logical operator that refers to the *intersection* between two sets (also known as *conjunction* in the language of propositional logic). Case membership in the intersection between sets A and B equals the minimum membership score across the respective conditions.

Boolean minimization. Pairwise comparison of Boolean expressions to remove irrelevant elements and attain simpler expressions. Core of the *truth table algorithm*.

Boolean NOT. Logical operator that refers to the *negation* of a set (also known as *complement* in set-theoretic language). Case membership in the negation of set A equals $1 - A$.

Boolean operations. QCA draws on three operators from Boolean algebra: *Boolean AND*, *OR*, and *NOT*. See the respective definitions.

Boolean OR. Logical operator that refers to the *union* between two sets (also known as *disjunction* in the language of propositional logic). Case membership in the union between sets A and B equals the maximum membership score across the respective conditions.

Calibration. The transformation of qualitative and/or quantitative *raw data* (uncalibrated data) into membership scores in a target set. The *direct method* of calibration is a software-based transformation that requires the definition of three empirical anchors by the researcher. In the

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manual approach, the researcher directly assigns set-theoretic membership scores to cases. The less-often used *indirect method* of calibration requires the assignment of preliminary scores to individual cases before a statistical estimation technique is applied to calculate predicted fuzzy values based on the raw data and the initially assigned scores. Each approach requires the prior definition of consistent criteria and close correspondence with the underlying social science concept.

Case. Unit of analysis. In the truth table, cases are assigned to the *configuration* in which they hold the highest *set-membership score*.

Case selection. The identification of cases for *set-theoretic analysis*. Case selection for QCA can be based on *purposeful selection*, *given populations* or *scope conditions*, as the most common approaches, which also resonate with the qualitative research logic of QCA. Additionally, if certain requirements are met, it may be viable to use *sampling* techniques such as random sampling or stratified sampling to conduct the case selection. As a general principle, case selection should include only *relevant cases*.

Causal asymmetry. See *causal complexity*.

Causal complexity. An umbrella concept that entails three methodological assumptions that QCA rests on: (1) *conjunctural causation* describes a setting where single conditions do not individually suffice to generate the phenomenon of interest but where specific combinations of conditions are jointly sufficient for the outcome. (2) *Equifinality* relates to a setting where multiple paths comprised of individual conditions or combinations of conditions independently lead towards the same outcome. Finally, (3) *causal asymmetry* means that a recipe for the outcome can usually not be mirrored symmetrically to explain the non-outcome, but instead requires a separate analysis.

Causal mechanism. Generative process where several elements interact to bring about an outcome. Closely related to the within-case method of process tracing that aims at the identification of a causal link between a condition and an outcome. See also *multi-method research*.

Causation. The relation between a cause and its effect. The main theories of causation emphasize either regularity, probability, counterfactuals, or mechanisms (see Chapter 4).

Complement. See *negation*.

Complex solution. See *conservative solution*.

Complexity. See *causal complexity*.

Condition. An attribute, characteristic, or feature of a *case* that is used to describe and/or explain an *outcome*. In each condition, cases hold set-theoretic *membership scores* that result from calibration. The term corresponds to what are described as *variables* in statistical usage. A key

difference between variables and conditions is that the latter result from calibration, whereas the former can also be uncalibrated measures.

Configuration. A combination of conditions represented in a row of the *truth table*.

Conjunction. A combination of two or more conditions. See *Boolean AND*.

Conjunctural causation. See *causal complexity*.

Conservative solution (also: *complex solution*). One of three QCA solution types. The conservative solution results from the Boolean minimization of the truth table rows that are associated with the outcome and which meet the consistency and frequency thresholds specified by the researcher. This solution is termed conservative, because it works solely with empirical cases and does not incorporate logical remainders to achieve further simplification. See also *parsimonious solution* and *intermediate solution*.

Consistency. Metric that helps to assess the fit of the empirical evidence with a set-theoretic relationship of necessity or sufficiency. Consistency is calculated separately for necessary and sufficient conditions.

Contradiction. Truth table row that entails cases with qualitatively different outcome values (crisp set membership scores of 1 and 0, or fuzzy-set membership scores above and below 0.5). Also referred to as *contradictory configuration*.

Contradictory assumptions. Logical remainders that are assumed to be sufficient for both the outcome and the non-outcome, which occurs when the same logical remainders are used for both analyses. Also referred to as *contradictory simplifying assumptions* and *incoherent counterfactuals*.

Contradictory configuration. See *contradiction*.

Counterfactual. Reasoning about a case that did not occur. *Logical remainders* are potential counterfactual cases. That is, they are combinations of conditions without empirical instances for whom the plausibility of the outcome can be evaluated by the researcher.

Counterfactual theories of causation. Perspectives on causation where a potential cause is a difference maker without which the outcome would not have occurred.

Coverage. Metric that helps to assess the empirical relevance of necessary and/or sufficient conditions. For set relations of sufficiency, this shows how much of the empirical evidence is accounted for by a condition or conjunction. For set relations of necessity, this helps to distinguish relevant from trivial necessary conditions. See also *relevance of necessity*.

Crisp-set QCA. Analysis solely conducted with *crisp sets*, where set-membership scores in all conditions and the outcome take on binary values.

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Cross-over. Empirical anchor for the set-theoretic *calibration*, which specifies the qualitative point between membership and non-membership in a set. Also known as *point of maximum ambiguity*.

csQCA. See crisp-set QCA.

Dependent variable. See *outcome*.

Deviant case. Case that holds membership in the *solution* but not in the *outcome*. For fuzzy sets, this means that membership scores in the solution exceed 0.5 and membership scores in the outcome are below 0.5.

Difficult counterfactuals. Logical remainders that are simplifying (and which thus contribute to a less complex solution), but for which theoretical and substantive knowledge do not suggest the presence of the outcome. Difficult counterfactuals should be excluded from the *intermediate solution*.

Direct method of calibration. See *calibration*.

Directional expectation. Expectation derived from theoretical or substantive knowledge whether the presence or absence of a condition should be associated with the outcome of the analysis. The *intermediate solution* allows for the specification of directional expectations for any number of conditions.

Disjunction. See *Boolean OR*.

Easy counterfactuals. Logical remainders that are simplifying (and which thus contribute to a less complex solution) and for which theoretical and substantive knowledge suggests the presence of the outcome.

Empirical anchors. Also known as *qualitative anchors*. See *calibration*.

Enhanced Standard Analysis (ESA). Analytical refinement of the *standard analysis* (Ragin 2008), which excludes logical remainders that rest on *untenable assumptions* (Schneider and Wagemann 2013).

Epistemology. Perspective on the constitution and origins of knowledge (“what can be known”).

Equifinality. See *causal complexity*.

Euler diagram. Visual representation of existing intersections between crisp sets (binary values), whereas a *Venn diagram* shows all logically possible intersections.

Explanatory condition. See *condition*.

External standards. Criteria used for set-theoretic *calibration*, with particular importance for the definition of the empirical anchors for the direct method of calibration.

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fsQCA. See fuzzy-set QCA.

Fuzzy sets. Sets that allow for graded membership with scores ranging from 0 to 1. Fuzzy sets express qualitative and quantitative differences, distinguishing between being rather inside a set (scores above 0.5) and being rather outside a set (scores below 0.5), as well as gradations of imperfect set membership.

Fuzzy-set ideal type analysis. QCA variant that employs fuzzy sets for systematic empirical comparison and typological theorizing, but which does not aim to explain or account for an outcome (Kvist 2007). The *attribute space* that is circumscribed by the truth table represents the number of ideal types in a given analysis.

Fuzzy-set QCA. Analysis conducted with *fuzzy sets*, where set-membership scores in the conditions and/or the outcome take on values from 0 to 1.

General causation. Perspective on causation where individual observations are seen as representations of classes of phenomena. See also *singular causation*.

Given population. A predefined population of cases circumscribed by social facts (e.g., member states in an international organization, voters in an electoral district, or companies in a stock index).

Good counterfactuals. Counterfactuals that do not rest on *untenable assumptions* and which may or may not contribute to parsimony (Schneider and Wagemann 2012). See also *plausible counterfactuals*.

Ideal type. See fuzzy-set ideal type analysis.

Implausible counterfactuals. Logical remainders that are not plausible as counterfactuals because they meet at least one of the following criteria: (1) theoretical and substantive knowledge does not suggest the presence of the outcome, (2) the respective configuration is contradictory, (3) empirically impossible, or (4) conflicts with a statement of necessity. Antonym: *plausible counterfactuals*.

Impossible cases. Cases where the outcome or the non-outcome is deemed impossible by what is known about the world. As a general principle, only *relevant cases* should be included where the outcome could possibly happen, and which are substantively important. See also *irrelevant cases*.

Impossible counterfactuals. Logical remainders that entail a conjunction of conditions that is not possible in logical terms or by what is known about the world.

Incoherent counterfactuals. Logical remainders that conflict with a previously identified necessary condition.

Indirect method of calibration. See *calibration*.

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Intermediate solution. One of three solution types. The intermediate solution results from the *Boolean minimization* of the truth table rows that are associated with the outcome and which meet the consistency and frequency thresholds specified by the researcher. To derive a less complex solution, the procedure for the intermediate solution is further allowed to consider certain logical remainders in the pairwise Boolean minimization. This can be done via specifying *directional expectations* for each condition or by excluding *implausible counterfactuals*. As such, the intermediate solution is positioned between the *conservative solution* and the *parsimonious solution*.

Intersection. A combination of two or more *conditions*. See *Boolean AND*.

INUS condition. Insufficient but necessary part of a condition that is itself unnecessary but sufficient for the result (Mackie 1965).

Irrelevant cases. Cases where either (1) the outcome or the non-outcome is deemed impossible by what is known about the world, or which are (2) substantively unimportant in light of a study's research aims. As a general principle, only *relevant cases* should be included for case selection. Antonym *relevant cases*. See also *impossible cases*.

Limited diversity. Phenomenon that occurs when the number of logically possible configurations exceeds the number of empirical cases. Hence, the extent to which there is limited diversity in a given analysis can be seen from the number of *logical remainder* rows in the *truth table*.

Logical remainder. Truth table row that is not associated with any empirical case.

MDSO-MSDO. Technique for pairwise Boolean comparison of cases and conditions. MDSO stands for *most different cases, similar outcome*, whereas MSDO refers to *most similar cases, different outcome* (De Meur and Gottcheiner 2009).

Measurement. See *calibration*.

Measures of fit. Metrics to assess set-theoretic relationships in empirical data. The primary measures of fit for QCA are *consistency* and *coverage*, which are calculated independently for set-theoretic relations of necessity and sufficiency.

Mechanistic theories of causation. Perspectives on causation that identify the *causal mechanism* that links a causal condition to an outcome.

Membership score (Synonym: *membership value*). Numerical representation of case membership in a given set. Crisp-set membership can assume scores of 1 and 0, while fuzzy-set membership can also take on decimal scores in between these values.

Mill's methods. Methods of scientific inquiry developed by John Stuart Mill in *A System of Logic* (1843). Mill's methods include the method of agreement and method of difference, as well as the lesser-known method of residues and method of concomitant variations, and the joint

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method of agreement and difference. QCA builds on a systematic application of the joint method. However, it is important to note that QCA goes well beyond Mill's methods. This includes the consideration of *causal complexity*, *limited diversity*, *measures of fit*, and *Boolean minimization* for a systematic comparative procedure and inferential analysis.

Minimization. See Boolean minimization.

Model. Term used for the entirety of conditions used in a truth table analysis.

Model ambiguity. The phenomenon that, depending on the structure of the truth table and the assumptions made, several logically equivalent solution terms may be derived from the same empirical data (Baumgartner and Thiem 2017).

Multi-method research. The combination of two or more research methods to gain inferential leverage. In the set-theoretic context, multi-method research designs typically entail the combination of QCA, as a method for cross-case analysis, with process tracing to conduct within-case analysis, and specifically, for the identification of causal mechanisms. This does not preclude the combination of QCA with other qualitative and/or quantitative methods.

Multi-value QCA. Variant of QCA that incorporates multi-value conditions (Cronqvist and Berg-Schlosser 2009).

mvQCA. See multi-value QCA.

Necessary Condition Analysis (NCA). A distinct methodology for the identification of necessary conditions in data sets. Rather than working with the metric of consistency, as QCA does, NCA employs different levels of conditions, as in "level X is necessary for level Y" (Dul 2016; Vis and Dul 2018).

Necessary condition. A necessary condition means that a factor is always present when the outcome of interest occurs. Put differently, the outcome does occur without the presence of the necessary condition. From a theory perspective, we can say that necessary conditions explain failure because they are a prerequisite for a phenomenon to occur.

Negation. See *Boolean NOT*.

Negative case. Case that does not hold membership in the *outcome*.

Neopositivism. Social scientific perspective that regards social phenomena as governed by observable regularities that can be objectively assessed by researchers.

Notation. QCA draws on different notational systems. Depending on a subfield's custom, it may be preferred to use symbols and terms from Boolean algebra, propositional logic, and/or set theory.

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Ontology. Perspective on social and physical reality (“what the world is made of”). Ontological assumptions have epistemological and methodological implications, but by definition they cannot be proven.

Outcome. The phenomenon to be accounted for in the set-theoretic analysis. Similar (but not identical) to *dependent variable* in statistical approaches.

Parsimonious solution. One of three solution types. The parsimonious solution results from the *Boolean minimization* of the truth table rows that are associated with the outcome and which meet the consistency and frequency thresholds specified by the researcher. To derive a less complex solution, the procedure for the parsimonious solution is further allowed to consider all logical remainders in the pairwise minimization. Those logical remainders that are used are referred to as *simplifying assumptions*, because they simplify the resultant solution and rest on assumptions about counterfactual cases. Notably, the parsimonious solution may rest on *untenable assumptions*. See also *conservative solution* and *intermediate solution*.

Path. One configuration in a solution (which typically includes several paths).

Pathway case. Case that is uniquely covered by one solution path. See also *typical case*.

Plausible counterfactuals. Logical remainders that meet all of the following criteria: (1) theoretical and substantive knowledge suggests the presence of the outcome, (2) the respective configuration is not contradictory, (3) empirically possible, and (4) does not conflict with a statement of necessity. Antonym: *implausible counterfactuals*.

Point of maximum ambiguity. See *cross-over*.

Population. See *case selection*.

Positive case. Case that holds membership in the *outcome*.

Positivism. See *Neopositivism*.

Proportional Reduction in Inconsistency (PRI). PRI is a measure to identify *simultaneous subset relations* in the analysis of sufficient conditions.

Prime implicants. Boolean expressions that result from the minimization of truth table rows that are associated with the outcome (*primitive expressions*). Prime implicants are supersets of the primitive expressions they are derived from. The prime implicant chart helps to determine whether any prime implicants are redundant because the entailed information is already covered by other prime implicants. In such a situation, a simpler solution term can be derived by eliminating the redundant prime implicants.

Primitive expression. Expression that represents a truth table row associated with the outcome. See also *prime implicants*.

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Probability theories of causation. Perspectives on causation where a potential cause is seen as a probability raiser for the occurrence of its effect.

Property space. See *attribute space*.

Purposeful selection. See *case selection*.

Qualitative anchors. Also known as *empirical anchors*. See *calibration*.

Quine-McCluskey algorithm. See *truth table algorithm*.

Random selection. See *case selection*.

Raw coverage. Metric to assess how much of the empirical evidence is accounted for by a given solution path. See also *solution coverage* and *unique coverage*.

Raw data. See *calibration*.

Recipe. A *configuration* that is sufficient for the outcome. In that sense, the term is used interchangeably with *path* and *pathway*. But recipe is also used to denote entire *solutions*.

Regularity theories of causation. Perspectives on causation where a potential cause appears repeatedly and in a regular fashion.

Relevance of Necessity (RoN). Metric to assess whether a condition that fulfills the formal criteria for necessity may be a trivial necessary condition (Schneider and Wagemann 2012).

Relevant cases. Cases where (1) the outcome and the non-outcome are deemed possible by what is known about the world, (2) and which are substantively important in light of a study's research aims. As a general principle, only relevant cases should be included for case selection. Antonym: *irrelevant cases*. See also *impossible cases*.

Remainders. See logical remainders.

Research cycle. Ideal-typical conception of the social scientific research process, which starts with the definition of the research problem and research question and moves on to include the formulation of theoretical expectations, selection of cases and conditions, data gathering, calibration, and set-theoretic analysis, before closing with substantive interpretation, which in turn may give rise to revisiting the initial stages of the research cycle.

Research design. Strategy of scientific inquiry that aims to identify appropriate solutions to scientific problems.

Robustness tests. Procedures to establish the extent to which the results of the set-theoretic analysis are conditional upon specific analytical choices, such as case selection criteria, calibration thresholds, or decisions made throughout the analysis, including consistency and frequency levels, and the treatment of logical remainders.

Sampling. See *case selection*.

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Scope condition. Criterion that confines the selection of cases on the basis of theoretical or substantive considerations.

Set operations. See *Boolean operations*.

Set relations. QCA evolves around set relations of necessity and sufficiency. See *necessary condition* and *sufficient condition*.

Set-theoretic analysis. Analysis of set-theoretic relationships of necessity and/or sufficiency. See also *truth table analysis*.

Set theory. Unifying theory of mathematics. QCA draws on set theory to analyze social phenomena and the set relations between them.

Set. A group of elements that share certain characteristics.

Simplifying assumptions. *Logical remainders* that are treated as if they were sufficient for the outcome when deriving the parsimonious and/or intermediate solution.

Simultaneous subset relations. Phenomenon that may occur with fuzzy-set data when a configuration is both a subset of the outcome and a subset of the non-outcome. This would be a logical contradiction. However, based solely on the measures of *consistency* and *coverage* it would be difficult to determine whether a configuration should be treated as sufficient for the outcome or the non-outcome. To identify such situations, the PRI metric was introduced. See *proportional reduction in inconsistency*.

Singular causation. Perspective where causal claims are derived from singular cases, without assuming a larger, more general pattern. See also *general causation*.

Solutions. QCA entails three different solution types. These result from the *Boolean minimization* procedure and the treatment of *logical remainders*. See *complex solution*, *parsimonious solution*, and *intermediate solution*.

Solution coverage. Metric that helps to assess how much of the empirical evidence is accounted for by all paths in a given solution. See also *raw coverage* and *unique coverage*.

Standard analysis. Term used to describe the analytical procedure of deriving a complex solution, parsimonious solution, and intermediate solution (Ragin 2008). See also *enhanced standard analysis*.

Sufficient condition. A sufficient condition means that whenever a factor is present, the outcome is also present. Hence, we can say that sufficient conditions serve to explain success, as they always lead towards the outcome.

SUIN Condition. A sufficient but unnecessary part of a factor that is insufficient but necessary for an outcome (Mahoney et al. 2009).

Token-level explanation. See *singular causation*.

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Tosmana. Software initially developed for crisp-set and multi-value QCA, but its functionality has been expanded to also cover fuzzy-set QCA (Cronqvist 2019).

Trivialness. A condition or configuration that fulfills the criteria for set relations of necessity and/or sufficiency, but which constitutes a trivial finding. See also *relevance of necessity*.

Truth table. The truth table shows the number of possible combinations of conditions and the empirical distribution of cases across those configurations. The number of possible rows equals 2^k , where k is the number of conditions included in a given study. The truth table further indicates how consistent the set-theoretic relationship of sufficiency is for each row.

Truth table algorithm. The algorithm used for the Boolean minimization and the construction of QCA solution terms. The standard remains the Quine-McCluskey (QMC) algorithm, but this has been complemented by an enhanced version (eQMC) and the Consistency Cubes algorithm (Duşa 2018).

Truth table analysis. Analytical procedure that involves the *Boolean minimization* of configurations that are sufficient for the outcome, based on consistency and frequency thresholds specified by the researcher. The truth table analysis yields different *solution terms*, depending on the treatment of logical remainders.

Two-step approach. QCA variant that splits up the analysis into separate truth table procedures based on the distinction between remote and proximate conditions (Schneider and Wagemann 2006)

Type-level causation. See *general causation*.

Typical case. Case that holds membership in the solution and the outcome and where set-membership scores in the latter exceed those in the former. See also *pathway case*.

Typological reasoning. See *fuzzy set ideal type analysis*.

Union. See *Boolean OR*.

Unique coverage. Metric that helps to assess how much of the empirical evidence is accounted for by a given solution path. See also *solution coverage* and *raw coverage*.

Untenable assumptions. Umbrella category that contains *incoherent counterfactuals* and *impossible counterfactuals* (Schneider and Wagemann 2012).

Venn diagram. Visual representation of all logically possible intersections between crisp sets (binary values), whereas a *Euler diagram* only shows existing intersections.

XY Plot. Visual representation of set relations between fuzzy sets (degrees of membership).

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