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CONVINCING EXPLANATIONS WITH QCA

The contribution of “essential” configurational models

Alessia Damonte

alessia.damonte@unimi.it

- *in progress, comments very welcome* -

Abstract. Since long, the scientific discourse maintains that sound models are a necessary requisite to convincing explanations. How to design them so that they suit configurational thinking is the question that Amenta and Poulsen first have explicitly put in the methodological agenda of Qualitative Comparative Analysis. The article contributes to the substantive and to the technical side of the answer. It reasons that the cogency of the starting hypothesis requires factors supporting the expectation that, were they jointly given, the outcome would certainly obtain; and considers Ostrom’s “action situation” as a fruitful framework for guidance in selection. It then addresses the related risk of overly rich models by adapting Baumgartner’s difference-making principle for specification tests to be run on candidate factors before minimizations. Exercises in replication will show the extent to which these criteria provide a useful diagnostics of existing models, and a blueprint for more convincing configurational explanations.

Keywords. Action situation, Configurational models, Explanations, Difference-makers, QCA, Validity.

Introduction

Convincing explanations are statements that, in answering to a why question, give the impression of being “final” and arouse “in our mind no additional questions” (Boudon 174). The impression improves when the argument is “compelling” and the claim “airtight” that the statement holds “true” (Cook & Campbell 1983; Yin 2000). In the scientific discourse, much of this impression has come to depend on the proof of evidence, and on the methods to build it. Methods clarify the special shape that evidence must display for the statement to hold, and develop protocols to secure that biases have been avoided or mitigated while running this test. Sound and suitable starting models constitute a necessary requisite of any empirical probation, as faults in their design can spoil the gains from a thorough case selection as much as from the proper treatment of evidence.

Unsurprisingly, model design is a demanding operation in any method with explanatory aims – even in the more consolidated. Experimental studies expect models to render the theoretical hypothesis without slippages, to include all and only those variables that are essential to the explanation, to impose the proper functional form to the explanatory variables, and to retain their value across settings (Campbell & Stanley 1966). Not all of these concerns apply to Qualitative Comparative Analysis – or, at least, apply in the same way. QCA accounts for diversity by pinning down minimal invariant combinations of conditions. Its solutions hold at the case level, yet have no currency outside the special space and time parameters used to select the population under analysis. Functional forms are findings rather than starting points. Yet, as Amenta and Poulsen (1994) have emphasized first, they can become unintelligible depending on the number and kind of conditions included in the truth table, and the algorithm alone can neither warrant that inessential elements will be proven irrelevant and dropped, nor that the factors together portray a meaningful explanatory hypothesis (De Meur *et al.* 2009, Marx 2010, Baumgartner and Thiem 2015).

The main question about good model design remains open in QCA. It asks how to build models such that the explanatory factors form a credible configurational “whole” and yield solutions that are essential to populations. This article contributes to the answer. It addresses the puzzle as two distinct yet related issues: first, how to theorize causation so that it supports configurational hypotheses; second, how to warrant that hypotheses include all and only the essential local specifications. Thus, section 1 drives Amenta and Poulsen’s suggestions for building configurational models to their consequence, and shows how a single unifying framework such as “action situation” (Ostrom 2005) can guide the researcher in selecting factors from different theories and in organizing them

into a single meaningful configurational model supporting deterministic expectations for QCA analysis. Section 2 addresses the technical question, and builds on the concept of “Boolean difference-makers” (Baumgartner 2012) to develop indexes assessing the import and essentiality of single conditions in securing sufficient solutions. Section 3 applies the criteria to known studies, while section 4 draws some provisional conclusions.

1. Theorizing convincing configurational models

“Where to begin” in QCA is the very pragmatic question that Amenta and Poulsen addressed as early as 1994. In their seminal contribution, they note how often starting models are directly built upon results from statistical studies, and how this dialogue with previous knowledge comes at a cost. Comprehensive truth tables, meant for portraying different theories in all their empirical richness, lead to escalating limited diversity and to results of unintelligible complexity. Selective truth tables – narrowing on special theories, or on statistical determinants – may seem nifty while entrenching unamendable biases. Even worse, neither comprehensive nor selective formal procedures can secure that truly explanatory configurations have been modeled. This doubt is corrosive, as it questions the very possibility of convincing configurational explanations. To overcome these faults, they shift the burden on theory, and suggest narrowing on those alone that are already “conjunctural or combinatorial in construction and that predict multiple causal combinations for one outcome” (Amenta and Poulsen 1994:29). The example they provide to illustrate their point is especially enlightening.

In explaining the United States’ welfare programs in the first decades of the last century, they indicate institutional politics theory as the prototype of configurational thinking, because of its combination of “structural situations and political actors in the advancement of public spending policies” (*ibid.*:32). They select four factors consistent with it – the spending ideology of the ruling party; an agency with power on social programs; voting rights; and patronage parties – that they hybridize with an element from the power resource theory – namely, strong labor movements. The enlightening part emerges when the authors justify their model design. To them, voting rights have to be included as they channel the demands for spending programs into the policymaking system that would otherwise be directed outside, toward charities and other societal organizations. The labor movement is added as its presence bolsters the demand. The spending ideology of the ruling party matters as much as their members make the budget. The consensus strategy of the parties decides whether spending is delivered as a

favor instead of an entitlement. A powerful agency matters because of the interest it has in furthering social spending programs.

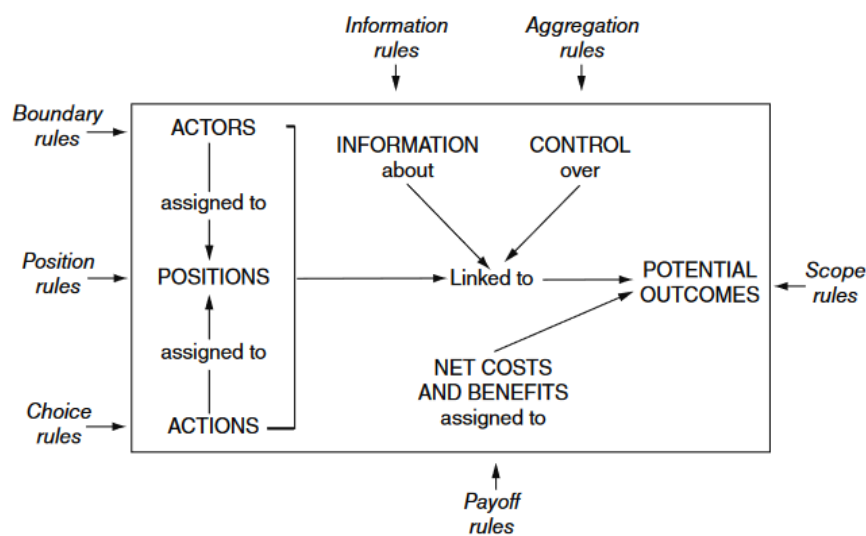
These reasons expose a single rationale underlying the selection – the aim to provide a consistent causal story to the occurrence of the outcome, where consistency is secured by the reference to theoretical assumptions about some underlying generative process. Indeed, their model entails that social spending programs are the output of a policymaking process, which obtains under condition that those in power back the content and those who oppose the content cannot obstruct the process. These implicit assumptions allow for special expectations about the contribution of each condition to the outcome – and possibly for claims of necessity. In the example, the claim is made for voting rights, as the element without which the causal story of public welfare programs cannot initiate.

Amenta and Poulsen’s benchmark then entails that configurational models require a framework providing a common ground to different theories of the generation of a same outcome. The framework makes a single sense of both the *processes* leading to the outcome and the *structures* shaping their direction, although only one side of the story is modeled. In their example, events remain unobserved. Their analysis neither shows that welfare demands gained salience following trade unions’ pressures; nor that societal priorities actually imparted a twist to the government agenda; nor that political patrons tended to veto redistributive spending and were sidelined, while agencies and pro-spending deputies allied to foster welfare programs in the budgeting process. Instead, their model assumes all these events as implied by the very same occurrence of the outcome, and pinpoints instead the conditions under which the right chain of events has to materialize. In their rendering, the conditions are key actors’ properties, such as power and preferences, all pointing in a same direction. This suggestion chimes with the stance that QCA is better geared to account for complex units’ performance by a set of their properties arranged in “explanatory typologies” that support special expectations about their behavior, rather than by the behavior itself (Berg-Schlosser and Cromqvist 2005, Elman 2005).

Underlying frameworks do not have to remain unspoken, however. When looking for an explicit schema that can give consistency to configurational models in the social sciences across a variety of field theories, the concept of “action situation” (Ostrom 2005) provides a fruitful example. As Figure 1 summarizes, the core of the framework assumes that outcomes follow from the interplay of the actions that participants choose. Participants opt for a special course of action on the basis of the position they hold in the situation, the costs and rewards associated to alternatives, as well as of the degree of control and information that they have on it. The whole situation, in turn, is shaped by rules –

establishing for each position how they can be held and lost, which capacities are warranted and which obligations are associated, which alternative courses of action can be undertaken, at which special cost and return for both the collective and the position holder. As the framework treats shaping rules as external constraints, each action situation can be treated as a closed analytic “holon” in which causation clearly flows from rules and actors to outcomes, through strategies and actions. As such, it can support and organize a variety of substantive hypotheses about the generation of special effects.

Fig.1. Action situation: elements and constraints



Source: adapted from Ostrom (2005).

From a configurational viewpoint, the framework indicates that, to unfold as expected, the “right” actors have to be in the “right” positions and equipped with the “right” endowments – as well as put under “right” rules. Configurational hypotheses that portray such a “right” situation can therefore maintain that the complete model, if observed, would limit the degrees of freedom of the participants to the point of locking in their strategy on the outcome. So understood, configurational models can justify a stance on the determinism of *complete and rightly set conjunctural hypotheses* – that is, the claim of their sufficiency.

The unity of an action situation however also suggests that strategy-based, resource-based, and rule-based substantive theories are not truly alternative explanations. Rather, they are alternative analytical entry points on the same generative process – which makes them interdependent at best, and clearly dependent according to the ontological

assumptions of the framework. This consideration is quite consequential, as it entails that a truly complete configurational explanation would surely include all the factors required to account for the outcome, but redundantly so. Indeed, being C_R the complete “right” conjunction of rules, C_{AP} the complete “right” conjunction of the properties that special actors get or maintain when in special positions, C_B the complete “right” conjunction of actors’ strategic behavior, S_E the complete and “right” sequence of events, Y as the expected outcome, and right-headed arrows as relationships of sufficiency, the causal assumptions engrained in an action situation can be summarized as in model \mathcal{M} below:

$$\mathcal{M} \quad C_R \rightarrow C_{AP} \rightarrow C_B \rightarrow S_E \rightarrow Y$$

Be the model empirically true, any explanation of Y based on more than one complete antecedent would prove redundant to the population at hand, while any complete antecedent alone should provide a “locking in” model and sufficient to any consequent down to Y . Yet, the relationship between conjunctions is defined by the relationship between their elements, as analytically each event required to bring the outcome about follows from the right behavior c_B stemming from a subset of actors with the right properties c_{AP} as shaped by the right and related rules c_R . Hence, a minimally sufficient causal story of Y can be also modeled with elements from different antecedents – provided that they do not operationalize the same chain of sufficiency, i.e., that they indicate *essential* elements alone.

How to test that a single antecedent or a hybrid model only includes essential elements is the question that motivates the next section.

2. Correcting the model for the population

The current methodological discourse already recognizes that configurational findings can misrepresent causation if factors are included in a solution that are inessential to account for the outcome. The point has been especially emphasized by Baumgartner (2009, 2012, Baumgartner and Thiem 2015), who has developed a fully alternative protocol to QCA for retrieving causal structures with Boolean analysis.

Coincidence analysis (CNA) assumes determinism as a property not of correct and complete hypotheses, but of observed configurations directly. The conjunctions that observations associate to an outcome are therefore naturally sufficient to it, and their disjunction is necessary. Yet, observed causation may include sub-products or by-

products of causation, whereas proper ascription can only be to those minimal models that preserve necessity and sufficiency as observed. The protocol hence assesses the existence of logical dependencies among all the explanatory elements by treating any factor as an outcome, then checking for redundancies in the remaining conjunct; and identifies redundancies by first dropping a condition from this conjunct, then checking that the remaining part is not shared by any configurations with opposite outcome.

The protocol unfolds from the idea that non-redundant factors are “Boolean difference-makers”. Strictly connected to counterfactual and contrastive assessments of causation (Menzies 2004), difference-making is the property of those factors without which some event cannot occur – unless the event is overdetermined. The property is usually proven when evidence shows that variations in the factor affects the occurrence of the event. The proof is however far from final if the units of analysis are not comparable as twin worlds, and unless opportune designs and controls are deployed so as to warrant that the detected change in the event can be clearly ascribed to the sole variation in the factor (Cook and Campbell *). These requisites are seldom met in the usual Boolean analysis, and it seems still debatable whether CNA’s assumptions about the necessity and sufficiency of observed configurations can compensate for less demanding designs. Moreover, so far the protocol retrieves more alternative “causal structures” than are theoretically meaningful – which may undermine the cogency of explanatory arguments rather than tightening them.

The idea of difference-makers can nevertheless prove fruitful within the framework of QCA, too, when developed into a test for the essentiality of a theoretical causal factor to the population under analysis. As such, it qualifies as a complement to Quine-McCluskey minimizations, rather than an alternative – although a needed one. Indeed, Quine-McCluskey minimizations suit causal assessments of observational data because they build on the easier assumption of dissimilarity of the units of analysis. As a consequence, in a reversal of standard contrast and counterfactual strategies, they ascribe causation to invariance. They consider variation to signal irrelevance, and pinpoint minimal explanations by dropping the only different component in otherwise twin configurations with same outcome until the least complex set of conjuncts is found that still covers all the primitive configurations. However, as CNA scholars point out, in so doing the Quine-McCluskey only establishes that some factors are *relevant* to the occurrence of the outcome in some subpopulations, not that they are all *essential* to account for the cases at hand. As minimizations treat any conditions as a direct cause to the outcome, essentiality is an assumption instead; when untested, it can lay solutions open to the suspect of confirmation bias. In the current practice, however, such a test is lacking. The only prescribed assessment consists in the so-called “analysis of necessity”, in which the

consistency and coverage of necessity is calculated of individual conditions to the outcome. Given the symmetric meaning of the parameters, the analysis also displays the coverage and consistency of sufficiency, respectively; thus, it yields all the information about the kind of set relationship that links each condition to the outcome. Although originally envisaged to find and drop those “trivial” necessary conditions which would have inflated the results without adding to its explanatory power (Goertz 2006), the analysis is now usually meant for acknowledging necessary conditions. The idea of difference-makers can fill this gap, and equip QCA with a test for the inessentiality of single conditions to explain a population that can guide model building. To serve this purpose, however, the difference-making principle has to be adapted to the rationale of QCA, i.e., chasing sufficiency.

In QCA, sufficiency is satisfied when a solution W distributes evidence such that, being y the absence of the outcome, intersection Wy is empty (Ragin 2008). Yet, solutions mirror the distribution in the truth table – so that the fit is actually decided by models. Sufficiency is warranted when models render the starting hypothesis so that no primitive configuration in the truth table is “contradictory” – i.e., is observed in instances with opposite outcome. Contradictions undermine the claim that solutions are causal, as they blur the difference between intentionally explanatory models and intentionally random models (Marx 2010). Moreover, they signal a variety of possible design problems – ill-calibration of the raw variables, choice of ambiguous indicators for theoretical constructs, or underspecification of the model itself. The good practice has long suggested that minimizations should be run only after contradictions are unraveled, and the usual solution to underspecification has always been to add the further factor that is substantively consistent with the theory of reference and that tells the positive instances out of the negative in the contradictory primitive (Rihoux and De Meur 2009, Schneider and Wagemann 2010).

The good practice hence entails the more general principle that the capacity of unraveling contradictions proves that a condition is a difference-maker to the population, therefore essential to explain its special diversity; and that ascertained difference-making power provides a reason for keeping a condition in the model. The principle can be operationalized so as to test those factors that complete configurational hypotheses suggest for inclusion, so as to ascertain their essentiality independent of the test of relevance by minimizations. As this sorting power may be both absolute, of the single condition, and relative to the starting model, the test can require two separate indexes. In the following, *import* refers to the individual capacity of a single condition to tell either positive or negative instances out of a non-specified population; *essentiality* instead to whether each condition is required for preserving the non-contradictoriness

of a complete starting model. Both are gauged through the cardinality of single property sets and intersection.

As for import, if we let

- \mathcal{M} be a model explaining Y with k specifying conditions, tested on a population \mathcal{P} of \mathcal{N} instances,
- X be the k -th explanatory condition in \mathcal{M} ;
- m be a submodel of \mathcal{M} such that $m = \{X\}$;
- p be the subpopulation of instances observed in non-contradictory primitives generated by m ;
- n the cardinality of p ,

the import of a condition X in \mathcal{P} is then given by the following ratio:

$$import = n / \mathcal{N}$$

The index can take values between 0 and 1. The highest score proves a condition to be necessary and sufficient to the outcome, as it orders the population in two non-contradictory clusters. Just the opposite, its lowest score proves that the condition has no sorting power in \mathcal{P} .

Conditions with no detectable import may nevertheless prove essential to the explanatory capacity of the overall model because of their contribution to non-contradictory truth tables. Essentiality thus complements import with a more conclusive information about the capacity of a condition to prevent contradictions in the truth table. It can be gauged as the difference in the number of instances in contradictory configurations in the full model, and in the same model without that condition. More in detail, if again we let

- \mathcal{M} be the model explaining Y_i with k specifying conditions, tested on population \mathcal{P} of \mathcal{N} instances,
- X_i be the k -th explanatory condition in \mathcal{M} ;
- m' be a submodel of \mathcal{M} such that $\mathcal{M} \setminus m' = \{X_i\}$;
- Q be the subpopulation of contradictory instances from \mathcal{M} ;
- q' be the subpopulation of contradictory instances from m' ;
- q'' be the difference $q' \setminus Q$;
- n'' the numerosity of q'' ,

we have that, when \mathcal{M} is overspecified, $\mathcal{Q} = \{\emptyset\}$; and if \mathbf{X} is inessential, then $\mathbf{q}' = \mathcal{Q}$ and $\mathbf{q}'' = \{\emptyset\}$, while if \mathbf{X} is essential, then $\mathbf{q}' > \mathcal{Q}$ and $\mathbf{q}'' \neq \{\emptyset\}$. Thus, the essentiality of \mathbf{X} can be synthesized as:

$$\text{essentiality} = \mathbf{n}'' / \mathcal{N}$$

Again, the index spans from 1 to 0. As dropping an inessential condition generates no new contradictions, when a condition is inessential, \mathbf{n}'' takes the 0-value and the ratio is null. As dropping the only necessary and sufficient condition in a model instead turns the whole population into a single contradiction, the most essential condition would make $\mathbf{n}'' = \mathcal{N}$ and give the index the full value of 1.

The meaning of the two indexes becomes clearer when applied to a fictional dataset with known solutions $A+B \rightarrow Y, ab \rightarrow y$ to which a trivial condition is added to blur results – as in Table 1 below.

Table 1. Fictional Dataset (a); and the related truth table(b).

(a)					(b)							
instances	A	B	C	Y	A	B	C	instances	Y	S-cons	y	S-cons
i1	0.2	0.8	1.0	0.9	0	1	1	i1, i2	1	1.00	0	0.40
i2	0.1	0.7	1.0	0.8	1	0	1	i3, i4	1	1.00	0	0.40
i3	0.7	0.1	1.0	0.8	1	1	1	i5, i6	1	1.00	0	0.41
i4	0.8	0.2	1.0	0.9	0	0	1	i7, i8	0	0.53	1	0.81
i5	0.7	0.8	1.0	0.8	0	1	0					
i6	0.8	0.7	1.0	0.9	1	0	0					
i7	0.1	0.1	1.0	0.1	1	1	0					
i8	0.1	0.1	1.0	0.2	0	0	0					

The Standard Analysis of sufficiency with fsQCA retrieves $AC + BC$ as both complex and intermediate solutions to Y with a consistency of sufficiency (S-cons for short) equals to 1.00, and $A + B$ as the parsimonious solution, again with S-cons of 1.000; while it explains y with abc as complex solution, and with ab as both the parsimonious and the intermediate solution, always with S-cons of 0.81. Import and essentiality should ascertain that the trivial condition does not have explanatory power and hence can be dropped from the analysis of sufficiency.

If we calculate the import of each condition as in Table 2.a and Table 2.b, indeed we see that both condition **A** and condition **B** generate a non-contradictory cluster of 4 instances

out of 8, as $\mathcal{P}_A = \{i3, i4, i5, i6\}$ while $\mathcal{P}_B = \{i1, i2, i5, i6\}$. So, $\text{import}_A = \text{import}_B = 4/8 = 0.5$. Table 2.c makes out clear that condition **C** has no sorting power instead, as it clusters all the instances in a contradictory configuration. Thus, $\text{import}_C = 0/8 = 0$.

Table 2. Import of (a) condition **A**, (b) condition **B**, and (c) condition **C** on the model as in Table 1.

(a)				(b)				(c)			
A	instances	nr	Y	B	instances	nr	Y	C	instances	nr	Y
1	i3, i4, i5, i6	4	1	1	i1, i2, i5, i6		1	1	i1, i2, i3, i4, i5, i6, i7, i8	8	Cd
0	i1, i2, i7, i8	4	Cd	0	i3, i4, i7, i8		Cd	0	-		1

Keys: “nr” = number of instances in the configuration, “Cd” = contradictory outcome

Essentiality further confirms that **C** does not really contribute to the model, as its dropping does not generate contradictions. We know that $\mathcal{N}=8$ by design. From Table 1.b, we learn that $\mathcal{Q} = \{\emptyset\}$ and, from Table 3.c, that $\mathcal{Q}'_C = \{\emptyset\}$. Hence, $\mathbf{n}''_C=0$, and $\text{essentiality}_C = 0/8=0$. When instead we consider the model without **A**, Table 3.a tells us that $\mathcal{Q}'_A = \mathcal{Q}''_A = \{i3, i4, i7, i8\}$, so that $\mathbf{n}''_A=4$ and $\text{essentiality}_A = 4/8 = 0.5$. From Table 3.b we learn that **B** gets the same essentiality score, although based on partially different elements as $\mathcal{Q}'_B = \{i1, i2, i7, i8\}$.

Table 3. Truth tables obtained by dropping (a) **A**, (b) **B**, (c) **C** from the model in Table 1.

(a)					(b)					(c)				
B	C	Inst.	nr	Y	A	C	Inst.	nr	Y	A	B	Inst.	nr	Y
1	1	i1, i2, i5, i6	4	1	1	1	i3, i4, i5, i6	4	1	1	1	i5, i6	2	1
0	1	i3, i4, i7, i8	4	Cd	0	1	i1, i2, i7, i8	4	Cd	1	0	i3, i4	2	1
1	0				1	0			1	0	1	i1, i2	2	1
0	0				0	0			0	0	0	i7, i8	2	0

Keys: “nr” = number of instances in the configuration, “Cd” = contradictory outcome

Import and essentiality here agree on suggesting that the correct model explaining **Y** only requires conditions **A** and **B**. Streamlining the model has two main consequences on the results: first, given that the truth table is fully specified, the complex, the parsimonious, and the intermediate solutions overlap; second, the new solutions maintain the same S-cons values as those from the overspecified model.

Provisional conclusions

Sound models are necessary to convincing explanations. Yet, the requisites of sound models change with the special ontological and epistemological assumptions engrained in the method chosen for probation.

QCA assesses the sufficiency of configurational hypotheses. Suitably sound models are those which justify such a determinism in observation. Convincing models portray a complete ideal conjunction of conditions that leaves no room for any outcome different from the expected one. To overcome the difficulties in configurational model building, the point is made that a single encompassing framework can prove useful where macro and micro components are kept together and causation is given a direction – as is in Ostrom’s action situation. A similar framework also provides a yardstick for improving existing models, as it suggests which additional elements could make the hypothesis truly compelling.

Yet, configurational thinking may easily yield overly rich hypotheses with respect to the population at hand, raising the question of formal criteria for establishing that a condition is required for a sound the explanation. This empirical matter is usually understood as the difference-making capacity of a factor to the outcome, and connected to variation. This work adapts the concept to the explanatory aim of QCA – that of making non-contradictory sense of the diversity in a population for ascribing sufficiency to invariant implicants – and operationalizes it as import and essentiality. The two indexes provide a further guidance in building complete and essential explanatory models while casting new light on the correctness of existing studies. Replications will tell whether import and essentiality can yield results as neat as the fictional ones.

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