

Qualitative Comparative Analysis

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Presentation by

Carroll T. Patterson, PhD

QCA Background

QCA:

- Began in the social sciences in the US, spread to Europe
- Rapidly spreading use in evaluation – DFID is in the lead
- Growing application in public health, governance, agriculture, ed.
- Open source software (fsQCA), Stata and R modules

QCA has a number of properties that made it attractive for evaluation:

- Turn from Simplicity to **Managing Complexity**
- Forces us to think about meaningful **changes in condition**
- Small to **Medium Sample Sizes** – 10 to 300
- Blends well with other **methods**
- **Formal** and Participatory (stakeholders build a model)

QCA answers these type of “How” Questions

- How our activities work in some contexts but not in others
- How our activities sometimes require other factors outside the control of the program to be successful
- How outcomes are the result of combinations of factors instead of single causes
- How different combinations of activities can lead to the same outcome
- How key factors can prevent the outcome from occurring

Boolean Algebra and M&E

For QCA, meaningful change is divided into sets of membership/nonmembership and analyzed with Boolean algebra.

We apply this to M&E data by changing **Indicators** into **Sets**.

Indicators:

- aggregate; count the quantity of things, especially outputs directly controlled by the project
- define results in terms of “more is better”....more implementation means more outputs, and *assumes* these outputs lead to outcomes, etc.

$$1+1=2$$

Sets:

- categorical and based upon membership inside or outside of a category of outcomes, 1 = membership; 0=non membership.
- Sets also define results in terms of qualitative definitions of the success (=1) or unsuccess (=0)

$$1+1=1$$

Boolean Algebra is a FORMAL logic and thus reduces individual biases

QCA Thresholds and Variables

- QCA can incorporate a wide **multiple variable** and **variable types**, e.g. Categorical, Qualitative, Continuous at once.
- All variables types can be turned into membership variables (sets) through **threshold setting**
- We can model various **degrees of membership** (continuous variables)
- Membership must be defined for both independent variables (factors) and the dependent variable (outcome)

Concepts of QCA: Boolean Minimization

- Build a **Truth Table** – complete representation of patterns in the data, i.e. a “model” of the intervention and all relevant factors

Case	Meds	Staff	Equip	Train	Village teams	Motorcycles	Ambulances	↓ Death
A	1	1	1	1	0	0	1	1
B	1	0	0	1	1	1	0	1
C	1	1	0	0	0	1	1	0

- Requires **variation** to minimize complex functions using Boolean Algebra:

$$A+B+C = 1$$

$$A+b+C = 1$$

$$\text{Result: } A+C = 1$$

- Results are **asymmetrical**, e.g. cannot infer: $a + b \not\Rightarrow 0$
- Generates “**causal suggestions**” → intensive search for explanation begins and the results must be **interpreted**

Necessary and Sufficient Conditions

Boolean Algebra can use combinations of sets to identify the **Necessary** and/or **Sufficient** conditions/outputs for successful outcomes, e.g. early learning

E.g. teacher training is necessary but not sufficient to improve early learning outcomes

It also identifies how there are multiple paths to achieving the same outcome.

E.g. teacher training, done in combination with deworming OR government education support, can improve early learning outcomes

In other words, we can add complexity and still generalize.

When conducted in cooperation with rigorous RCT/quasi experimental research designs, we gain a more complete picture of **how** and **why** positive social change occurs, i.e. it does not replace statistical analysis, but complements it.

SOCHA

QCA Treatment/Control Analysis of how Program, District Education Funding and Deworming Presence relates to Early Learning

<i>HH Identifier</i>	<i>Program Implemented?</i>	<i>District Education Funding?</i>	<i>WHO Deworming ?</i>	<i>Outcome</i>	<i>Result</i>
Schools in the Treatment Group (i.e. the program) s=150					
A (62)	1	1	1	Success	All factors present are sufficient, but not necessary
B (32)	1	1	0	Success	Combining the program with DG funding is sufficient
C (24)	1	0	1	Success	Combining the program with deworming is sufficient
D (34)	1	0	0	Unsuccess	The program alone is insufficient
Schools in the Control Group (i.e. not in the program) s=150					
E (49)	0	1	1	Unsuccess	Combining Public Health with Deworming is insufficient
F (59)	0	1	0	Unsuccess	DG funding is insufficient
G (27)	0	0	1	Unsuccess	Deworming is insufficient
H (16)	0	0	0	Unsuccess	Doing nothing is insufficient

Conclusion 1: The program is necessary, but not sufficient, for success

Conclusion 2: Neither DE funding nor Deworming are necessary for success

Conclusion 3: The program **MUST** be implemented in combination with either District Government **OR** External Donor Programs to be successful

Examples of QCA

An Example of using QCA in Complex Programming

QCA was used to ask *why some farmers influenced by an agricultural assistance project failed while others succeeded in times of economic crisis.*

QCA analyzed the outcomes associated with three activities designed to help farmers – diversify income, adopt new technologies, and access micro credit. They found that:

- Farmers who tried none of the three activities FAILED
- Farmers who tried all three options FAILED
- Farmers who only adopted one project activity also FAILED

But farmers who diversified incomes IN COMBINATION with EITHER adopting new technologies OR accessing more micro credit...SUCCEEDED

Lesson Learned: In the context of economic crisis, too much risk taking or too much risk avoidance leads to failure. Instead, only *selective combinations* of the program will lead to success

QCA in Pre Primary Education: Impact Evaluation Insurance

Medium Sized Pre Primary Education Program in Tanzania: 120 Schools with an RCT, multi component program

ToC held that improving **classroom quality will improve test scores.**

RCT assumed this, but was not designed to detect this

RCT was threatened by **contamination** from other programs (WASH, School Feeding)

Expanding the Analysis Required “Outside the Frame” M&E

Traditional M&E looks at factors within a program’s control, i.e. outputs. Guided by the “logframe”, IPs were not incentivized to *systematically* capture external factors

In applying QCA, we went outside the “frame” to gather sets on:

- Implementation Variation
- Implementation Quality
- Teacher/Student Interactions (process variables)
- Local Government, Donor and Assistance Provider Presence
- Control Schools

Expanding the Analysis: Tanzania Case Study

School ID	Program Components					Exogenous School Factors			Remote Factors		Classroom Quality?
	Teacher Training	Mentoring	Parent Partnerships	Learning Kits	HT Training	Mother Tongue	Capitation Grant	PTA	WASH	School Feeding	
1	1	1	1	1	1	0	1	1	0	0	0
2	1	0	0	0	0	1	1	0	0	1	1
3	1	1	1	0	0	0	1	1	0	0	0
4	1	0	0	1	1	1	0	0	1	0	1
5	1	0	1	1	1	1	0	0	0	0	1
6	1	1	0	0	0	1	1	0	1	0	1
7	1	0	1	0	0	0	0	0	0	1	1
8	1	0	0	1	1	1	0	0	0	1	1
9	1	1	1	1	0	0	0	1	0	0	0
10	1	0	0	1	0	1	0	0	1	1	1
11	0	0	0	1	1	0	1	1	1	0	0
12	0	0	0	0	0	0	1	0	1	0	1
13	0	0	0	0	1	1	1	1	1	0	0
14	0	0	0	0	1	1	0	0	0	1	1
15	0	0	0	0	0	1	1	1	0	0	0
16	0	0	0	1	0	0	1	0	1	1	1
17	0	0	0	1	1	0	1	1	0	1	0
18	0	1	0	1	0	0	1	1	1	1	0

Pilot Results on Improving Classroom Quality

Exogenous Factors:

- PPE Advocacy and District Awareness are neither necessary nor sufficient
- Capitation Grants, where there is a lack of mother tongue, form part of a set of sufficient conditions, but only in combination with each other
- The LACK of PTAs is part of a combination of factors associated with success

Component Factors:

- School feeding was not relevant to changes in classroom quality
- Mentoring is necessary condition for improvement
- Teacher training is sufficient but not necessary, and only with deworming
- Learning kits plus mentoring is another combination, esp. when capitation grants are lacking and SMCs stand alone

E.g.: QCA for Cost Effectiveness Analyses

- Maternal Health Program with a 1 year pilot and 26 activities. Very successful (MMR reduced by 30%); Very Expensive (\$)
- Question: Can we achieve the same results for less? What activities should define the essential package(s) and is it cost effective?
- Covered 99 Facilities – not sufficiently powered and not set up for impact evaluation
- Not Interested in alternative programs

Maternal Health Program Cost Effectiveness Analysis

Out of the 26 activities, We identified **five** pathways the program travelled to achieve the reported 30% reduction:

Most common Paths

- Health Teams + Transport Vouchers + Medicines + Staffing (Level III Pathway)
- Transport Vouchers + Medicines + Mentoring + Equipment (Level III Pathway)
- Ambulances + Medicines + Equipment (Level IV Pathway)

Less Common Paths

- Infrastructure + Medicines + Mentoring (Level IV Pathway)
- Private Vouchers + Transport Vouchers + Medicines (Private HF Pathway, less successful)

Activities, such as **Training**, were **Irrelevant** under any scenario we modelled

Activity Break Down of Added Costs Per Birth

Activity	Year 1 Cost (w/set up)	Year 2 Cost (operational)
SMGL management	\$ 18.14	\$ 17.98
Awareness Campaigns	\$ 4.46	\$ 4.17
Village Health Teams	\$ 6.45	\$ 2.80
Transport Vouchers	\$ 3.15	\$ 2.67
Ambulances	\$ 12.96	\$ 1.02
Training	\$ 4.63	\$ 4.40
Mentoring	\$ 2.53	\$ 2.40
Hiring additional personnel	\$ 9.09	\$ 9.07
Private Facilities' Vouchers	\$ 78.57	\$ 78.42
Medicines purchased	\$ 16.13	\$ 17.26
Equipment purchased	\$ 15.86	\$ 2.46
Upgrades, Renovations and Builds	\$ 30.23	\$ 8.58
System Strengthening	\$ 2.35	\$ 2.20

*Expressed in Cost/Birth, added to Gov Base. Amounts in USD

Which Pathways are Most Cost Effective?

Cost Effective Pathways to Reduced MMR Expressed in \$/Improved Birth for Year 1

*Note: Amounts do not include \$18.14/improved birth for Program Management Costs

	More Expensive	Less Expensive
More Effective	(CC) Ambulances + Medicines + Equipment: \$47.48 (CC) Transport Vouchers + Medicines + Mentor + Equipment: \$44.13	(Lv III) VHTs + Transport Vouchers + Medicines + Staffing: \$34.83
Less Effective	<u>Uncommon Pathways</u> (Lv IV) Infrastructure + Mentor + Medicine: \$48.89 (Private) Private Vouchers + Transport Vouchers + Medicines: \$104.30, not very effective	<u>Not relevant or effective</u> Training: \$4.63 (not relevant) Level Vs (not effective)

Conclusions and Implications

QCA is a legitimate, mathematically based approach to formally answering “how” questions around complex program effectiveness.

Moves the M&E paradigm:

- Away from Results as increasing outputs
- Toward Results as a meaningful change from one condition to another

Changes our thinking about how we produce social change:

- Gives us an analytical strategy for disentangling complexity while retaining the ability to generalize
- Allows us to explore variation in outcomes and avoid eliminating context
- Facilitates “Configurational thinking”

Insurance Policy for RCTs:

- Builds upon the counterfactual and sampling design to tell the story in a more complete way
- Explains anomalies and cases where the data doesn’t make sense
- Disentangles the successful elements of an intervention from unsuccessful ones.

Parameters of Fit and Internal Tests

- Consistency: degree to which a relation of necessity or sufficiency bzw. causal condition(s) and outcome is met (akin to significance values)
- Various Coverage Scores: Overall goodness of fit of the model (akin to R-squareds) as well as individual solutions (akin to partial correlation coeff)
- Logical Tests for Necessity: What factors must always be there (or not there) for the outcome to be achieved.
- Threshold Testing: Identify which variables are sensitive to threshold setting and the effect on results

Some Current Challenges Facing M&E

- The Log Frame and Implementation Blinders
- Silo effect of M&E and Program Management
- Unidirectional output indicators lead to questions regarding “*What do the numbers mean?*” but oftentimes provide no answers
- Targets are arbitrary and not rooted in desired change
- Most projects lack **rigorous** analytical tools that can tell them what numbers mean and how we do this.

Result: Performance Management is prioritized over hypothesis testing

The Rigorous Impact Evaluation Problem

RCTs, the “Gold Standard,” passes the verdict on “what works and what doesn’t.”
BUT, although RCTs are incredibly expensive, they **do not answer how questions**

There are two reasons for this:

- Answering “How” questions requires more gold
- Collecting the information needed to answer “How” questions sits outside the traditional M&E framework

RCT’s are not designed to empower program learning, and in fact disempower Implementers who have little say

The Result: Conceptual Gap b/w. Evidence and Implementation

Today we find a large conceptual gap between the rigorous analytical concerns of an impact evaluation who generate “evidence” and the day to day implementation concerns of programming.

