ROTTERDAM SCHOOL OF MANAGEMENT
ERASMUS UNIVERSITY

TECHNOLOGY & OPERATIONS MANAGEMENT

WHY DOES NCA IDENTIFY MORE NECESSARY CONDITIONS THAN fsQCA?

JAN DUL

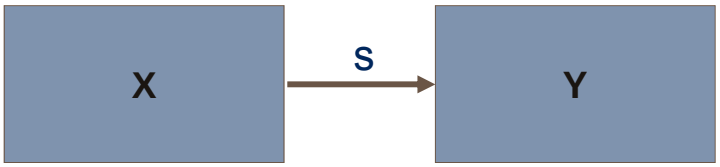
www.erim.nl/nca

Dul, J. (2016). Necessary Condition Analysis (NCA) Logic and Methodology of "Necessary but Not Sufficient" Causality. *Organizational Research Methods*, *19*(1), 10-52.

CAUSAL MODEL IN APPLIED SCIENCES

S → = Sufficient causal relationshop: X produces Y

- Causal complexity



Cause

Effect

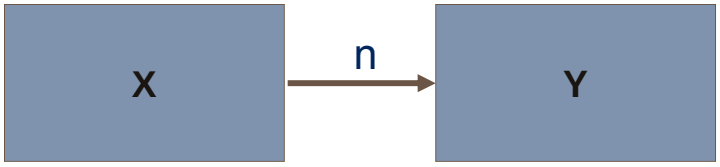
To be influenced (designed, controlled, managed)

To be desired or prevented

CAUSAL MODEL IN APPLIED SCIENCES

n → = Necessary causal relationshop: X allows Y

- Causal simplicity



Cause

Effect

"Why things don't happen"

To be influenced (designed, controlled, managed)

To be desired or prevented

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SINGLE NECESSARY CONDITION (CAUSE)

- Traveling to Zurich is **necessary but not sufficient** for presenting at this workshop
- A high GMAT test score is **necessary but not sufficient** for admission to a PhD program
- HIV is **necessary but not sufficient** for AIDS

Goertz's First Law: "For any research area one can find important necessary hypotheses" (2003: 66)

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NECESSITY IN QCA'S CAUSAL MODEL

Example of QCA logical statements:
Y = X1*X2*X3 + X4*X5 (1)

X1, X2, X3, X4, X5: **each INUS condition**
Mackie,1965: "Insufficient but Non-redundant (i.e., Necessary) part of an Unnecessary but Sufficient condition.

Y = X1*X2*X3 + X3*X4 (2)

X1, X2, X3, X4: **each INUS condition**
X3: **necessary condition** ←
Mackie (1965, p/253): "some causal statements pick out something that is not only an INUS condition but also a necessary condition".

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THE SINGLE NECESSARY CONDITION SHOULD BE PART OF ANY SUFFICIENT CONFIGURATION

Ragin 2000, (p.254):

"If a causal condition passes the researcher's test of necessity, then this condition should be made a component of every causal expression that the researcher examines subsequently in the analysis of sufficiency. "

Ragin, C. C. (2000). *Fuzzy-set social science*. University of Chicago Press.

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IDENTIFYING SINGLE NECESSARY CONDITIONS

1. QCA – Post Truth Table Analysis
2. QCA – Pre Truth Table Analysis
3. NCA

Dul, J. (2016). Identifying single necessary conditions with NCA and fsQCA. *Journal of Business Research*, *69*(4), 1516-1523.

fsQCA – POST TRUTH TABLE ANALYSIS

- Common condition in each identified sufficient configurations
- Example:

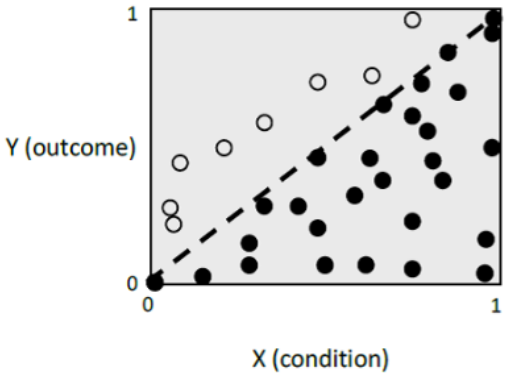
The solutions for RP4 highlight brand quality as a necessary condition for high scores in brand trust. The results also indicate the

Chatzipanagiotou, K., Veloutsou, C., & Christodoulides, G. (2016). Decoding the complexity of the consumer-based brand equity process. *Journal of Business Research*.

	Brand Trust			
	1a	1b	2	3
Brand Personality			●	
Brand Heritage	●	●		
Brand Nostalgia	⊗	⊗		●
Brand Quality	●	●	●	●
Brand Competitive Advantage		•	●	●
Brand Leadership	•		•	•

fsQCA – PRE TRUTH TABLE ANALYSIS

Necessity Consistency: ∑(min(**Xi**,**Yi**)) / ∑(**Yi**)

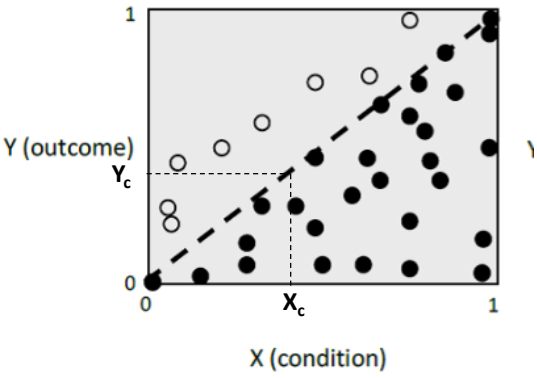


X is necessary for Y [Y ≤ X]
(necessary condition in kind)

Vis, B., & Dul, J. (2016). Analyzing Relationships of Necessity Not Just in Kind But Also in Degree. Complementing fsQCA With NCA. *Sociological Methods & Research* (in press)

UNCOMMON BUT POSSIBLE

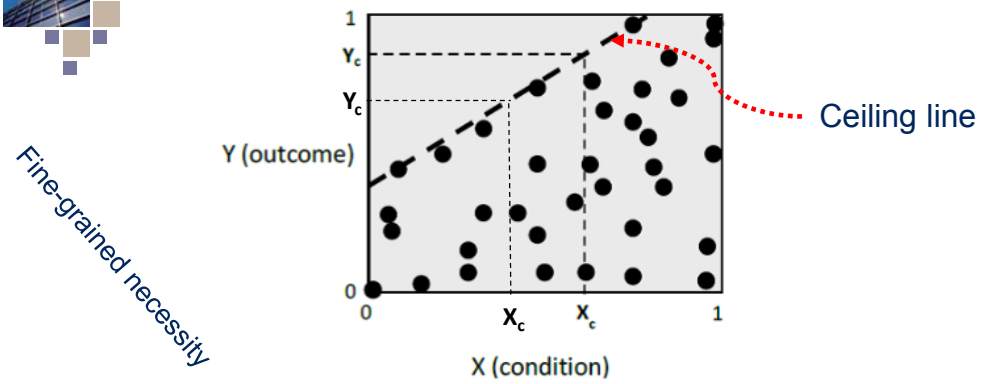
Fine-grained necessity



Xc is necessary for Yc [Y ≤ X]
(necessary condition in degree)

$X_c \geq 0.4$ is necessary for $Y_c = 0.4$ ("more out than in")
$X_c \geq 0.6$ is necessary for $Y_c = 0.6$ ("more in than out")
$X_c \geq 0.8$ is necessary for $Y_c = 0.8$ ("almost fully in")

NCA (NECESSARY CONDITION ANALYSIS)



Xc is necessary for Yc [Y ≤ f(X)]
(necessary condition in degree)

$X_c \geq 0.4$ is necessary for $Y_c = 0.6$ ("more in than out")
$X_c \geq 0.6$ is necessary for $Y_c = 0.8$ ("almost fully in")

CEILING LINE IDEA

- Dul, J. & Hak, T. *Case study methodology in Business Research*. Butterworth-Heinemann/Elsevier, 2008
- Dul, J., Hak, T., Goertz, G., & Voss, C. (2010). Necessary condition hypotheses in operations management. International *Journal of Operations & Production Management*, 30, 1170–1190
- Goertz, G., Hak, T., & Dul, J. (2013) Ceilings and floors where are there no observations? *Sociological Methods & Research*, 42 (1), 3-40.
- Dul, J. (2016). Necessary Condition Analysis (NCA) Logic and Methodology of "Necessary but Not Sufficient" Causality. *Organizational Research Methods*, *19*(1), 10-52.
- Van der Laan, E., Dul, J. & Kuik, R. Estimating ceiling lines and effect sizes in Necessary Conditions Analysis (working paper).

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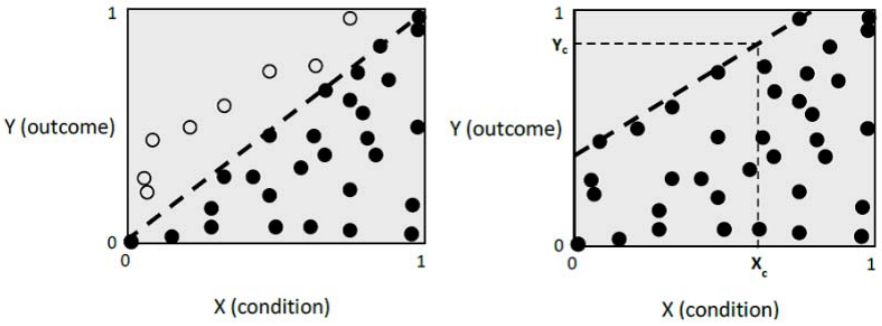
NCA

Ceiling line on data (reference line)
Effect size = fraction scope that is empty
"Deviant" case are "best" cases
"fine-graned necessity"



Xc is necessary for Yc [Y ≤ f(X)]
(necessary condition in degree)

NCA

- Like QCA: **cross-case** analysis
- Like QCA pre TTA: Specific **separate** necessity analysis (no Bolean logic)
- Calculates necessity **effect size** of **all single conditions**
- Uses the **ceiling line** in a scatter plot as reference line
- Identifies a condition as necessary **in kind** if area above reference line is relatively empty (effect size > 0)
- Identifies also necessary conditions **in degree** (ceiling line)
- Can be performed on orginal data and calibrated data

EXAMPLE

Contents lists available at ScienceDirect

Journal of Business Research

Understanding configurations of relational attractiveness of the customer firm using fuzzy set QCA

Zsófia Tóth [a,*], Christoph Thiesbrummel [b], Stephan C. Henneberg [c], Peter Naudé [a]

[a] University of Manchester, United Kingdom
[b] University of Paderborn, Germany
[c] Queen Mary University of London, United Kingdom

EXAMPLE: NECESSITY TEST (TÓTH ET AL.)

Potential necessary conditions for
Relational Attractiveness of the Customer (RAC)

- Trust (TRU)
- Dependency (DEP)
- Financial Benefits (FINB)
- Non-financial Benefits (NONFB)
- Costs (COS)

EXAMPLE: DATA (TÓTH ET AL.)

Sample:

- 107 firms

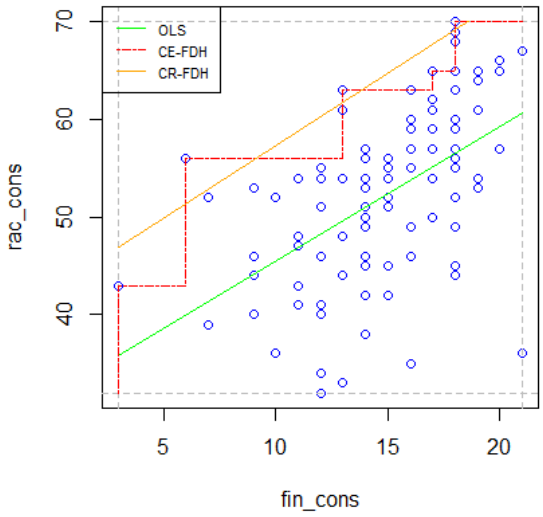
Original Data:

- obtained via informants (business customer managers)
- validity and reliability tests: meaningful data

Calibrated data

- direct calibration (logistic function, anchors: 10-50-90 th percentiles)

ORIGINAL DATA



QCA Consistency -
NCA effect size 0.31

CALIBRATION IN JBR

2016 volume of Journal of Business Research: **199(!) QCA papers**

- **Calibration** (80% of papers specify the calibration) :
  - ~40% Indirect calibration
  - ~60% Direct calibration (scale values, data-percentiles)
    - 100% logistic membership function
      - 100% functional form not justified
      - 100% anchors not justified

DIRECT CALIBRATION

"The piecewise logistic function has been the default because it is automatically applied by the current version of the widely used fs/QCA software."

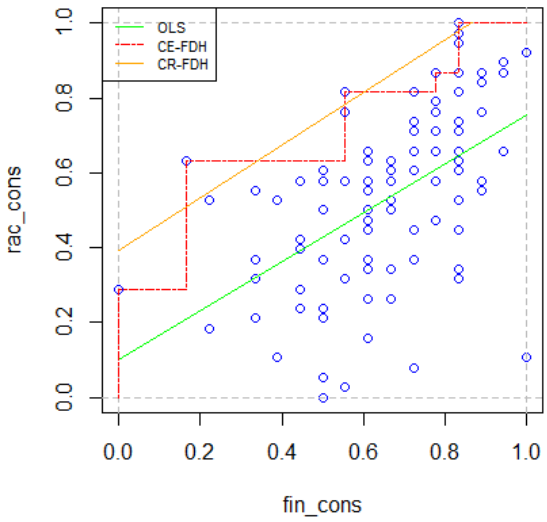
"There is no ex ante reason for why the logistic function should be preferable to the linear function …"

Thiem, A. (2014) Membership function sensitivity of descriptive statistics in fuzzy-set relations, *International Journal of Social Research Methodology*, 17:6, 625-642

I WONDER

1. Should we transform data and change the distribution if transformation cannot be justified?
2. If we cannot justify transformation, can we then standardize the data (range [0,1]), while maintaining the distribution?

ORIGINAL DATA (STANDARDIZED)



QCA Consistency 0.95
NCA effect size 0.31

CALIBRATION EVALUATION TOOL

- On the NCA-website is the link the calibration evaluation tool:
- https://www.erim.eur.nl/centres/necessary-condition-analysis/faq-and-contact/faq/nca-and-other-data-analysis-methods/nca-and-qca/

CALIBRATION IN EXAMPLE

	"Logistic transformation"	"Standardized transformation"
"fully out the set" (0)	10th percentile	Lowest observed value
"cross-over point" (0.5)	50th percentile	Mid between lowest and highest observed value
"fully in the set" (1)	90th percentile	Highest observed value
Membership function	logistic	linear

(Tóth et al.)

fs-QCA 'S NECESSITY TEST (PRE-TTA)

Necessary condition	Necessity consistency Logistic	Necessity consistency Standardized
Trust (TRU)	0.73	0.84
Dependency (DEP)	0.65	0.84
Financial benefits (FB)	0.78	0.95
Non-financial benefits (NFB)	0.69	0.91
Costs (COS)	0.68	0.88

(Tóth et al.)

NCA'NECESSITY ANALYSIS: EFFECT SIZE

Necessary condition	Effect size Logistic	Effect size Standardized
Trust (TRU)	0.00	0.12*
Dependency (DEP)	0.01	0.10*
Financial Benefits (FINB)	0.04	0.31**
Non-financial Benefits (NONFB)	0.05	0.31**
Costs (COS)	0.00	0.11*

0< *d* <0.1 "small effect"
* 0.1≤*d*<0.3 "medium effect"
** 0.3≤*d*<0.5 "large effect"
*** *d*≥0.5 "very large effect"

IS FINANCIAL BENEFITS NECESSARY ?

Results fsQCA's necessity test (Tóth et al. ,2015) :
"financial benefits .. is not a necessary condition".

Results NCA's necessity test:
Financial benefits is necessary for *higher levels of RAC* (> 0.4)
Financial benefits is not necessary for *low levels of RAC* (< 0.4).

WHY DOES NCA IDENTIFY MORE NECESSARY CONDITIONS THAN fsQCA

- NCA identifies fine-graided necessary conditions (in degree)
- QCA's calibration can obscure necessary conditions

Suggestions:

- Use NCA to identify **all** necessary conditions
- Incorporate them in **all** sufficient configurations (how?)

RECENT NCA PAPERS

METHODOLOGICAL PAPERS

- Dul, J. (2016) Necessary Condition Analysis (NCA): Logic and methodology of "necessary but not sufficient" causality. *Organizational Research Methods 19*(1), 10-52.
- Dul, J. (2016). Identifying single necessary conditions with NCA and fsQCA. *Journal of Business Research,* 69(4):1516-1523.
- Vis, B. & Dul, J. (2016) Analyzing relationships of necessity not just *in kind* but also *in degree*: Complementing fsQCA with NCA. *Sociological Methods and Research* (in press).

SUBSTANTIVE PAPERS

- Karwowski, M., Dul, J., Gralewski, J., Jauk, E., Jankowska, D.M., Gajda, A., Chruszczewski, M.H., Benedek, M. (2016). Is creativity without intelligence possible? A Necessary Condition Analysis. *Intelligence* 57:105-117).
- Van der Valk, Sumo, R., Dul, J. & Schroeder, R. (2016) When contracts and trust are necessary for innovation in buyer-supplier relationships? A Necessary Condition Analysis. *Journal of Purchasing and Supply Management* 22(4), 266-277.
- Vries, J. de , Koster, R. de, Rijsdijk, S., and Roy, D. (2017). Determinants of safe and productive truck driving: Empirical evidence from long-haul cargo transport *Transportation Research Part E: Logistics and Transportation Review*, 97 (1) 113–131.

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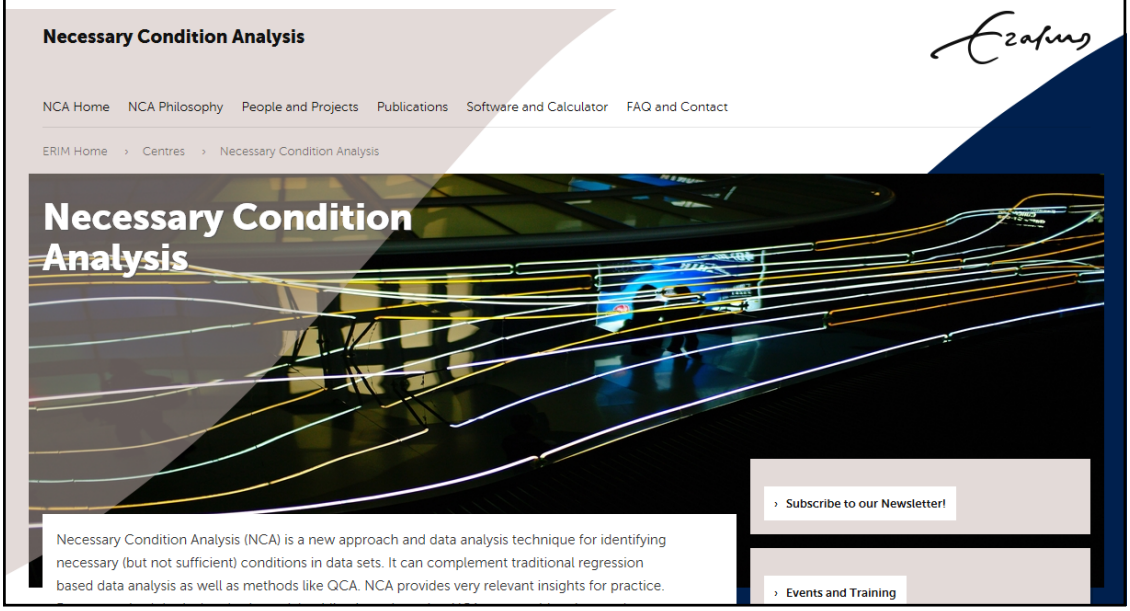
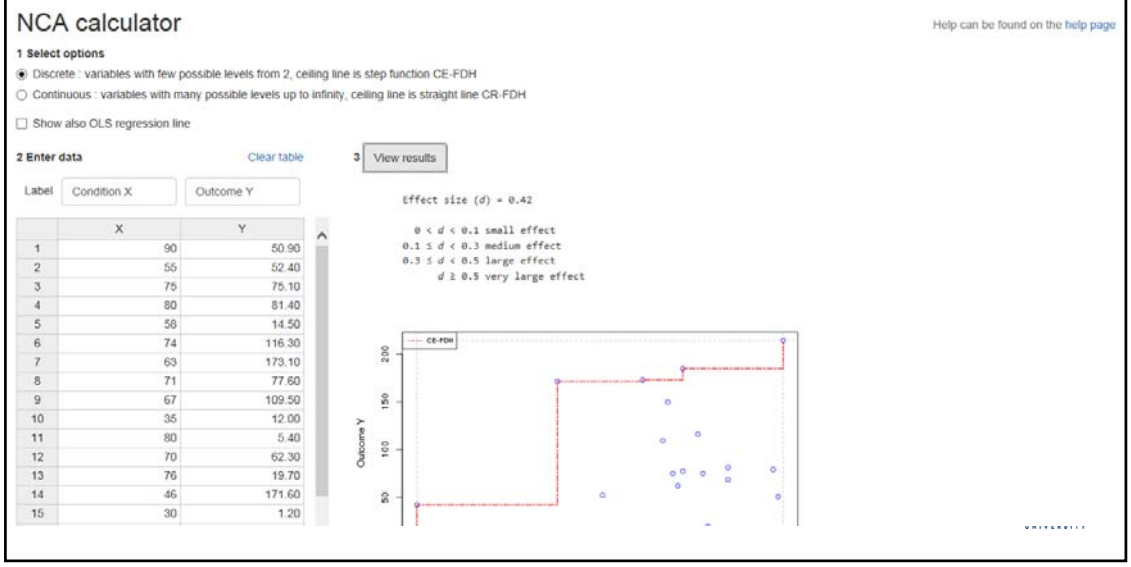
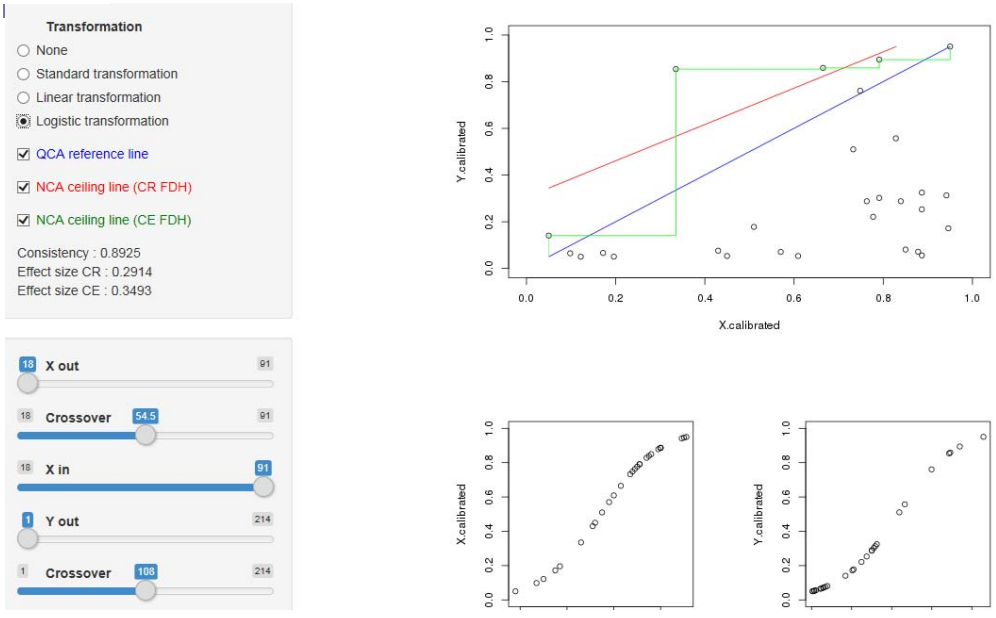
NCA WEBSITE: WWW.ERIM.NL/NCA



NCA CALCULATOR (ON NCA WEBSITE)



CALIBRATION EVALUATION TOOL (ON NCA WEBSITE)



NCA SOFTWARE IN R