Retroduction, set-theoretic configurational approaches and generative mechanisms: some preliminary insights

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Abstract

Retroduction is a thought operation that has been investigated in a limited fashion in Information Systems (IS) research. Yet, it has the potential of reframing IS research because it can shed a new light on the study of causal mechanisms. In this paper, we call for a renewed effort in the use of retroduction in the study of IS phenomena. Specifically, we claim that IS researchers could retroduce causal mechanisms by leveraging Qualitative Comparative Analysis (QCA) counterfactual approach to causation. Preliminary insights are discussed.

Key words: retroduction, mechanism, counterfactual approach, qualitative comparative analysis.

1. Introduction

Retroduction is a thought operation that has been little investigated in Information Systems (IS) research. Notwithstanding this dearth of research, some IS scholars have endeavoured to move the field beyond the dominant paradigms of deductive (positivism) and inductive (interpretivism) logic. For example, in his seminal paper, Mingers (2004: 94-95) argues that retroduction is a thought operation "where we take some unexplained phenomenon and propose hypothetical mechanisms that, *if they existed*, would generate or cause that which is to be explained." (Emphasis in original). Wynn & Williams (2012: 799-800) instead argue that "retroduction is a mode of inference in which events are explained by postulating (and identifying) mechanisms which are capable of producing them." On his part, Tsang (2014: 181) claims that "retroduction presents a logical argument explaining what properties must exist in order for the phenomenon of interest to exist and be what it is." Tsang (2014) goes on arguing that, though retroducing mechanisms is problematic, there are four distinct types of retroduction, namely, overcoded, undercoded, creative and meta-retroduction. Overcoded retroduction occurs when the explanation is obvious from existing knowledge and, therefore, the mechanism that explains a phenomenon is retroduced either automatically or semi-automatically. Under-coded retroduction occurs when there are a number of potential mechanisms and the researcher's task is to select the most plausible mechanism given the specific context under investigation. Creative retroduction instead is a more creative leap where researchers have to literally invent the mechanism because no suitable mechanisms exist. Finally, meta-retroduction may result in paradigm shifts because it may call for re-inventing theoretical or methodological paradigms to ensure a closer fit (or alignment) between empirical observations and theoretical or methodological frameworks.

More recently, Mingers and Standing (2017) have introduced the distinction between retrodiction and retroduction by arguing that the former explains diachronic mechanisms (or processes) occurring *over* time while the latter is a thought operation that discovers synchronic mechanisms that account for the emergence of phenomena at given moments *in* time. Far from being mutually exclusive, both retrodiction and retroduction should be used in concert "to give an overall account of causality as a braiding or intertwining of two forms – event causality and generative causality" respectively (Ibid: 176).

Though IS scholars have made remarkable progress in their investigation of retroduction, there are some outstanding issues that deserve further scrutiny. For example, it is not clear whether retroduction should be conceptualised as a messy and creative process or rather a well-structured sequence of steps that mirrors the Describing, Retroducing, Eliminating, Identifying and Correcting (DREIC) methodology for theoretical research (Cf. Mingers & Standing, 2017: 176; 182). Likewise, it is not clear whether one should turn to retrodiction (and its associated techniques as described by Mingers and Standing, 2017: 176-182) to study event (or diachronic) causality or rather use more traditional process-tracing techniques (Iannacci & Cornford, 2017). The argument of this paper is straightforward. We argue that the reason why retroduction is still an uncharted territory in IS research is because there are too many, and, at times, conflicting conceptualisation of mechanisms. Following in the footsteps of Mingers and Standing's (2017) recent argument, we claim that IS scholars should conceptualise mechanisms as systems of interacting parts rather than processes occurring over time. This systemic approach, in turn, will open up new vistas in IS research because it will focus IS research on relatively-stable arrangements of objects (or parts) that are individually necessary and jointly sufficient for achieving specific outcomes of interest. In the remainder of this paper, we attempt to shed some light on retroduction using a counterfactual approach which is after causes that are Insufficient but Necessary parts of more complex arrangements (or systems) that are Unnecessary but Sufficient (INUS) for achieving the outcome of interest. We draw on recently published research to corroborate our argument. The paper is structured as follows. After setting the scene in the Introduction, we discuss difference-making and production accounts of causality in Section 2. Section 3 develops some preliminary insights in the quest for generative mechanisms interweaving the QCA logic with the DREIC approach.

2. Difference-making accounts vs. production accounts of causality

The distinction between synchronic and diachronic causality recently introduced in the IS literature (Mingers and Standing,

2017) mirrors a prior distinction between difference-making accounts and production accounts of causality (Illari and Russo, 2014). While production accounts focus on the temporal process whereby the cause brings about the effect, difference-making accounts try to establish the causal relation between cause and effect by looking at whether the occurrence or non-occurrence of the cause makes a difference to the occurrence or non-occurrence of the effect (Ibid). Another way of distinguishing between these two types of causality is to draw on Mingers' (2014: 76-78) earlier argument that diachronic causality is about the "diachronic chain of one event influencing the next" while synchronic causality focuses on the "synchronic relations that generate what actually happens at each event point." In his influential essay, Brady (2008: 219) draws similar distinctions between manipulation approaches based on counterfactual or experimental designs (difference-making or effect-of-causes accounts) and mechanistic approaches revolving around the definition of mechanisms as capacities that "lead from the cause to the effect", that is, "entities and activities organized such that they are productive of regular changes from start or set-up to finish or termination conditions" (production accounts or causes-of-effects accounts).

These two conceptualisations of causality, in turn, inform different conceptualisations of mechanisms. For example, Glennan (2002) has argued that mechanisms may be thought of as systems of interacting parts or, more simply, as processes, that is, sequences of events. Likewise, in his review of the concept of mechanism, Gerring (2008) has come up with several definitions of mechanisms ranging from mechanisms as pathways or processes (production accounts) to mechanisms as unobservable or easy-to-observe causal factors (difference-making accounts). Notwithstanding the variety of conceptualisations, Gerring (2008) has argued for a minimal (or core) definition of mechanisms as "pathways or processes by which an effect is produced" (Ibid: 177). Similarly, in his influential review of causal mechanisms, Mahoney (2001: 579-580) lists a glossary of definitions ranging from production accounts (e.g., "mechanisms... are analytical constructs that provide hypothetical links between observable events") to difference-making accounts (e.g., "a mechanism is a set of interacting parts - an assembly of elements producing an effect not inherent in any one of them").

The foregoing argument shows that retroduction is riddled with many conceptual ambiguities because it is about the discovery of underlying causal mechanisms which are difficult to define. In the following, we suggest a practical way forward that leverages new methodological developments in the IS scholars' arsenal of tools.

3. Preliminary insights on generative mechanisms

Above, we have argued that the reason why IS scholars are yet to make substantial progress in the domain of "retroduction" is related to the ambiguous use of the concept of causal mechanism. We have also argued that one way to bypass this stalemate is to draw on recent conceptualisations of causal mechanisms that distinguish between synchronic and diachronic mechanisms. We now take stock of recent IS scholarship using QCA (or one of its variants such as fuzzy-set, crisp-set or multi-value QCA) to develop preliminary insights on retroductive thinking.

In their recent study, Park et al. (2017) have explicitly used the word "retroduction" to refer to an iterative dialogue between theoretical ideas and empirical evidence (Ibid: 657). Drawing on the idea that there is a fundamental mismatch between methods and theories in the social sciences (Fiss, 2007), they have called for a paradigm shift. Specifically, they have called for a QCA set-theoretic approach to bypass the assumptions of singular causation and linear relations. Accordingly, Park et al. (2017) have issued a call for meta-retroduction to ensure a closer fit (or alignment) between the empirical study of organisational configurations and the methodological assumptions of QCA. Park et al. (2017) have explicitly advocated that QCA reasoning is both deductive and inductive. It is deductive because causal relations are informed by prior theory. It is inductive because calibration (i.e., the coding of the cases at hand) revolves around the substantive knowledge of the empirical cases at hand (Ibid). Yet, Park et al. (2017) did not discuss how their retroductive reasoning relates to causal mechanisms.

Fiss (2011), however, has made a ground-breaking case for showing the utility of the QCA approach in developing the theory of causal mechanisms in organisations. Challenging the assumption that "all parts of the configuration are equally necessary or important" (Ibid: 396), Fiss (2011) has come up with "a definition of coreness based on which elements are causally connected to a specific outcome" (Ibid: 398). More specifically, he defined "core elements as those causal conditions for which the evidence indicates a strong causal relationship with the outcome of interest. In contrast, peripheral elements are those for which the evidence for a causal relationship with the outcome is weak." (Ibid: 398). Building on these ideas, Iannacci and Cornford (2017) have recently argued that core elements are necessary pre-requisites for achieving the outcome of interest. By contrast, peripheral elements are contingent factors that play a causal role in some contexts rather than other contexts.

3.1 Interweaving the QCA logic with the DREIC approach

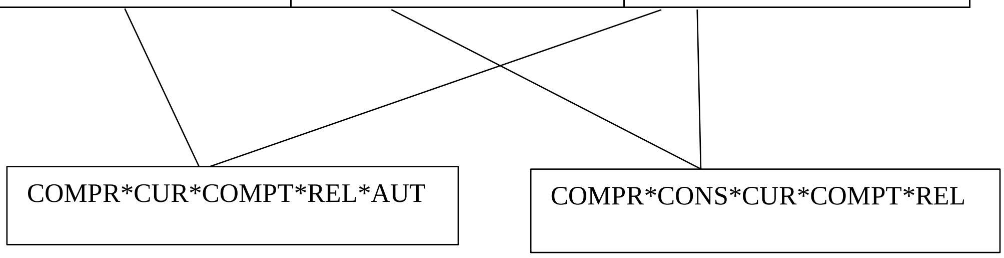
Leveraging the insight that QCA can be used as a paradigm shift for developing a theory of causal mechanisms in organisations, we now suggest how one could apply the QCA logic as a methodology for theoretical research.

The first step in QCA consists of breaking down the cases at hand in terms of theoretically-relevant configurations. Accordingly, based on an in-depth analysis of relevant literature, one can *describe* these cases as set-theoretic configurations of causal conditions. Once cases are conceptualised as theoretically-relevant packages, one proceeds with their calibration by scoring cases' set membership using an iterative dialogue between theory and empirical evidence (Ragin, 2000). Calibration enables scholars to locate cases in those configurations where their membership is greater than 0.5. At this stage, the analyst can achieve a more fine-grained *description* of the cases by producing a truth-table, that is, a table that lists all logically-possible combinations of causal conditions both present and absent with their associated outcomes (Ibid). A truth table has 2^k rows where K is the number of causal conditions. The empirical cases can then be assigned to these rows on the basis of their values for the causal conditions, with some rows containing many cases, some rows just a few, and some rows containing no cases at all.

The second step uses counterfactual analysis as a *retroductive* strategy to propose hypothetical recipes (or causal configurations) that, *if they existed*, would lead to the outcome of interest. Essentially, at this stage, the analyst must decide whether to bar all empty rows (or remainders) from the analysis or include a few rows for counterfactual analysis. Ragin (2008) distinguishes between "easy" and "difficult" counterfactuals depending on whether they are in line with theoretical and substantive knowledge. By being consistent with existing knowledge, "easy" counterfactuals are more exacting than "difficult" counterfactuals and, therefore, they only enable a fraction of the pool of remainders for analysis. Conversely, "difficult" counterfactuals may not align with theory-guided hunches. As a methodology for theoretical research, QCA allows for three solutions, that is, three distinct combinations of causal conditions that are jointly sufficient for the outcome of interest. Complex solutions occur when analysts bar all remainders from their analysis. Instead, intermediate and parsimonious solutions entail the inclusion of "easy" and "difficult" counterfactuals respectively. Since the incorporation of counterfactuals produces simpler or shorter solutions, it follows that complex solutions are a subset of intermediate solutions which, in turn are a subset of parsimonious solutions (where all counterfactuals are being incorporated regardless of their plausibility).

The third step consists of *eliminating* alternative competing hypotheses (Mingers and Standing, 2017). This step is related to step two when using QCA. Let us consider, for instance, Iannacci and Cornford's (2017) study of causal configurations for a positive impact in the European Social Fund context. These scholars have discovered two configurations sufficient for positive impact. Both configurations exhibit common factors in terms of compatibility, comprehensiveness, currency and reliability. However, one configuration is characterised by automated monitoring systems whereas the other configuration exhibits manual systems that leverage the presence of a consistent set of indicators thanks to the "four-eye" principle. With the presence of six conditions (k=6), their truth table (or table of logical possibilities) features 2^6 rows (that is, 64 rows). Nevertheless, only a fraction of these rows would be populated with cases because of the small N. Accordingly, Iannacci and Cornford (2017) had to speculate about the outcome of these empty truth-table rows by proposing hypothetical configurations (or generative mechanisms) that, *if they existed*, would generate or cause the outcome of interest (this is the *retroduction* logic discussed in step two using counterfactual thinking). Potentially, all empty truth-table rows are candidates for the outcome of interest. Accordingly, Iannacci and Cornford (2017) had to decide whether to incorporate all empty rows in their analysis regardless of whether they entail "easy" or "difficult" simplifying assumptions or, more simply, allow for the incorporation of "easy" counterfactuals only. Though the incorporation of "easy" counterfactuals leads to more conservative solutions (labelled "Intermediate" solutions in the QCA lingo), these solutions effectively bar difficult counterfactuals from the analysis, thus *eliminating* alternative competing mechanisms. Table 1 shows the simplification process that Iannacci and Cornford (2017) have implicitly applied using the fsQCA software programme.

Country/Configuration	COMPR*cons*CUR*COMPT*REL*AUT	COMPR*CONS*CUR*COMPT*REL*aut	COMPR*CONS*CUR*COMPT*REL*AUT (Easy counterfactual)
Austria	0.00	**0.51**	0.49
England	0.25	0.25	0.25
Flanders	0.49	0.25	0.25
France	0.25	0.25	0.25
Germany	**0.75**	0.25	0.25
Greece	0.00	0.25	0.25
Hungary	0.49	0.25	0.25



Legend: COMPR= Comprehensiveness; CONS= Consistency; CUR= Currency; COMPT= Compatibility; REL= Reliability; AUT= Automation. Lower case= Absence; Upper case= presence

Table 1: Inclusion of "easy" counterfactuals to arrive at Intermediate Solution

In the fourth step, analysts must *identify* the correct mechanism. For example, Iannacci and Cornford (2017) have *identified* two mechanisms that are jointly sufficient for positive impact. Specifically, they have argued that the achievement of an efficient and effective monitoring process requires monitoring systems that collect a comprehensive and up-to-date range of indicators and that depend on reliable technologies with compatible communication protocols. Though this bundle of conditions lies at the core of their mechanisms, Iannacci and Cornford (2017) have *identified* more contingent (or peripheral) conditions depending on whether the monitoring system is fully automated or, alternatively, is still relying on manual verifications but based on consistent definitions of monitoring data and indicators. Accordingly, in this fourth step, IS scholars can *identify* generative mechanisms as INUS configurations where the so-called cause is "an insufficient but necessary part of a condition which is itself unnecessary but sufficient for the result" (Ragin, 2008: 154).

In the fifth and final step, IS scholars should *correct* scientific knowledge in the light of their (provisional) findings (Mingers and Standing, 2017). For example, Iannacci and Cornford (2017) have reappraised the causal and temporal influences underpinning the DeLone and McLean's IS success model in the European Social Fund context (DeLone and McLean, 1992). On their part, Park et al. (2017) have reinvigorated a contingency-theory approach in the study of organisational agility. More specifically, they have highlighted the role that Business Intelligence tools and Communication Technologies play in achieving organisational agility in different organisational and environmental contexts.

References

Brady, H. E. (2008). Causation and explanation in social science. (Box-Steffensmeier, J. M., Brady, H. E. & Collier, D, Eds.). Oxford Handbook of Political Methodology. Oxford, Oxford University Press, pp. 217-270.

DeLone, W. H., & McLean, E. R. (1992). Information systems success: The quest for the dependent variable. Information systems research, 3(1), pp. 60-95.

Fiss, P. C. (2007). A set-theoretic approach to organizational configurations. Academy of management review, 32(4), pp. 1180-1198.

Fiss, P. C. (2011). Building better causal theories: A fuzzy set approach to typologies in organization research. Academy of Management Journal, 54(2), pp. 393-420.

Gerring, J. (2008). The mechanismic worldview: Thinking inside the box. British journal of political science, 38(1), pp. 161-179.

Glennan, S. (2002). Rethinking mechanistic explanation. Philosophy of science, 69(3), pp. 342-353.

Iannacci, F., & Cornford, T. (2017). Unravelling causal and temporal influences underpinning monitoring systems success: A typological approach. Information Systems Journal (Forthcoming).

Illari, P., & Russo, F. (2014). Causality: philosophical theory meets scientific practice. Oxford: Oxford University Press.

Mahoney, J. (2001). Review essay- Beyond correlational analysis: Recent innovations in theory and method. Sociological Forum, 16(3), pp. 575-593.

Mingers, J. (2004) 'Real-izing information systems: critical realism as an underpinning philosophy for information systems', Information and Organization, 14(2), pp. 87-103.

Mingers, J. (2014). Systems thinking, critical realism and philosophy: A confluence of ideas. Oxon, UK: Routledge.

Mingers, J., & Standing, C. (2017). Why things happen–Developing the critical realist view of causal mechanisms', Information and Organization, 27(3), pp. 171-189.

Park, Y., El Sawy, O. A., & Fiss, P. C. (2017). The Role of Business Intelligence and Communication Technologies in Organizational Agility: A Configurational Approach. Journal of the Association for Information Systems, 18(9), pp. 648-686.

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

Ragin, C. C. (2008). Redesigning Social Enquiry, Chicago: The University of Chicago Press.

Tsang, E. W. (2014). Case studies and generalization in information systems research: A critical realist perspective. The Journal of Strategic Information Systems, 23(2), pp. 174-186.

Wynn Jr, D. & Williams, C. K. (2012). Principles for conducting critical realist case study research in information systems. MIS Quarterly, 36(3), pp. 787-810.