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Abstract. Studies at the confluence of history and social science address issues of causation in three ways: morphological, variable-centered, and genetic. These approaches to causal investigation differ with regard to their modus operandi, the types of patterns they look for, their underlying assumptions and the challenges they face. Morphological inquiries elaborate causal arguments by uncovering patterns in the empirical layout of socio-historical phenomena. To this end, these inquiries draw on descriptive techniques of data formalization. Variable-centered studies engage causal issues by investigating patterns of association among empirical categories under the twofold assumption that these categories a priori have explanatory relevance and each category empirically has the same meaning across cases. Genetic analyses ground their causal claims by identifying patterned processes of emergence or production.

Keywords: causal inquiry, formal analysis, generative process, mechanism, morphology, process tracing, variable,

Causality and History: modes of causal investigation in historical social sciences

We explain by invoking causes. When our ambition is social scientific, we seek to make these invocations as rigorous and broadly significant as possible. This means elaborating consistent diagnoses duly validated and abstracted from the reference to any particular. When, on the other hand, we engage historical objects as such, that is, in light of their historical temporality, we find ourselves on the shores of irreducible particulars, which we cannot avoid acknowledging. A priori these two epistemic orientations do not go along. How in these conditions do studies at the confluence of history and social science address issues of causation?

This review article distinguishes three broad approaches to causal investigation. All three are exercises in pattern identification. *Morphological* inquiries apprehend causality by uncovering patterns in the empirical layout of socio-historical phenomena. *Variable-centered* studies infer causal claims from patterns of association among empirical categories. *Genetic* analyses elaborate causal arguments by identifying patterned processes of emergence or production. Besides their modus operandi (i.e., the way in which they proceed) and the types of patterns they look for, these three approaches can be contrasted in light of their starting point, their underlying assumptions, and the challenges they face.

A morphological approach tracks formal structures in the apparent maze of historical phenomena. To this end, it draws on descriptive techniques of data formalization. Once formal patterns have

been laid bare, this approach envisions them from a causal perspective. Key to this endeavor is the assumption that the systematic description of the forms and structures discernable in phenomena—their "morphology"—informs us about either their causes or their causal significance. Accordingly, morphological inquiries have to deal with three challenging issues: the tension between the inductive spirit that motivates them and the need to rely on exogenous analytical insights to make sense of patterns, the degree to which a technique of formal description incorporates a theory of social realities, and the possibility of artifactual results.

A variable-centered approach starts with a set of empirical categories under the twofold presumption that (1) these categories a priori have explanatory relevance and (2) each category empirically has the same meaning across cases. Through multivariate statistical analyses or comparative analyses of differences and similarities across cases, this approach probes patterns of association among the categories thus selected. Here the basic premise is that if these patterns of association are robust and genuine, they provide decisive clues for causal diagnoses. Given the centrality granted to inferences based on conjunctions in this mode of inquiry, a variable-centered approach faces challenges related to the possibility of mistaken causal imputations (selection problems, omitted variables, spurious associations) or the lack of specification of cause-effect relationships.

A genetic approach grounds causal analysis in the specification of generative processes. It investigates *how* a type of effects or outcomes is brought about. At stake in this approach is the analytical specification and empirical validation of mechanisms of emergence or production. Historical objects lend themselves to this type of exploration insofar as their evidentiary basis makes it possible to trace the effectuation of change and to test claims about generative processes. For this approach the challenge lies, first, in the imperative to theorize the dynamics of these processes and the factors conditioning their emergence from a genetic standpoint, and, second, in the devising of refutation tests.

The distinction between these three approaches to causal investigation is analytical. In practice, they may constitute different moments in the process of elaborating and validating systematic explanations. The point of distinguishing them is, first, to enhance our ability to become self-reflexive about the praxeology of our causal argument and, second, to investigate under which conditions modes of inquiry complement one another.

One word about the universe of studies under review: the focus is on inquiries that (1) define their object in historical terms and (2) embark on an explanatory project that aims to be of significance beyond the specifics of this object. "Being defined in historical terms" here means "being situated in time by reference to chronological coordinates." This categorization includes studies that account for the present in light of a past chronologically situated (e.g. Paschel 2016). A study is said to be "explanatory" insofar as it seeks to answer a "why" question (e.g., Andreas 2009, p. 2; Chen 2009, p. 7). Its aim is "social-scientific" if the answer it provides is intended to apply to an empirical class as a whole in addition to particular historical cases subsumed to that class (e.g. Krippner 2011, p. 4; Prasad 2006, p. 38; Steinmetz 2007, p. 2).

I. Morphologies

Morphological inquiries go after the formal structure of a historical phenomenon or a class of historical phenomena. Consider Katherine Stovel's (2001) examination of lynchings in the Deep South between 1882 and 1930. Based on yearly data at the county level, this study sets out to identify "common patterns" (p. 859) in the local histories of white on black lynchings. Using techniques of formal description and reduction (optimal matching and block modeling), Stovel identifies eight temporal patterns that can be contrasted in terms of the clustering, the frequency and the timing of lynchings. Narrowing down the focus on Georgia, she then examines the distribution of the four types of lynching distinguished by Brundage (1993)—mob action, terrorist attacks, personal vengeance, and posse lynchings—across counties classified by their sequential profile. Temporal patterns point to different social organizations and thus different etiologies, of racial violence. Counties with lynchings distributed over time ("pulse" patterns) were more likely to experience mob actions and terrorist attacks, that is, ritualized forms of lynching. Conversely, counties in which the lynching history was marked by bursts and fluctuating tempos were more prone to less ritualized forms of murder—personal revenge and posse lynchings (p. 865).

Phenomenal patterns

Stovel's (2001) inquiry exemplifies the three characteristic features of a morphological approach to historical causality. First, studies cast in this mode explore the empirical layout of phenomena situated in time and space. The prime motivation for this empirical work is to probe the existence of patterns or regularities. These can be conceptualized by reference to population characteristics, geography, time, relations or positions. The standpoints embodied in these patterns do not

exclude one another. Demographic and ecological morphologies of population characteristics often are temporally patterned. Spatial morphologies can be interpreted in positional terms. Positions in turn can be inferred from relational structures.

Demographic and ecological patterns highlight the characteristics of a population analyzed from the perspective of vital events and life-course attributes. While the concept of population applies in the first place to biological individuals (Deng and Treiman 1997), it has been extended to organizations (Carroll and Hannan 2000). *Spatial* patterns point out how socio-historical phenomena are structured in geographic space. Maps provide a visual representation of these patterns through the display of events spatially distributed (e.g. Baller and Richardson 2002, pp. 879-881; Tolnay, Deane and Beck 1996, p. 791) or of local indicators of spatial autocorrelation indicating geographic clustering (Whitt 2010, p. 157).

With *temporal* patterns the focus is on the structuring of phenomenal time. Their formats depend on the type of temporality being scrutinized. Evolutionary patterns bring into relief the formal properties of a class of events or phenomena as they take place in chronological time (Noymer and Garenne 2000). Sequential patterns describe regularities in the temporal layout of successive states (Abbott and Hrycak 1990, Bison 2010, Blair-Loy 1999). The event patterns that "event structure analyses" yield objectify necessary antecedents among a chronological set of occurrences (e.g., Dixon 2008, Ermakoff 2015, Griffin 1993, Isaac, Street and Knapp 1994).

Relational patterns capture the formal structure of one or several types of relations. The bulk of the morphological focus has been on inter-individual relations: e.g., activists (Hedström 1994), business partners (van Doosselaere 2011), artists (Uzzi and Spiro 2005), debtors and creditors (Hillmann 2008), event participants (Accominotti, Khan and Storer 2018), information providers (Erikson and Bearman 2006), military allies (Barkey 2008, pp. 48-54), and recommenders (Parigi 2012). This perspective of analysis can be expanded to collective actors (Balian and Bearman 2018, Franzosi 2010b, Wang and Soule 2012) and non-agentic entities such as narrative statements (Bearman, Faris, and Moody 1999).

As for *positional* patterns they describe how a set of entities are positioned vis-à-vis one another. These entities can be: actors located in a "field" of competition and oppositions (Bourdieu 1988, Sapiro 2014), individuals holding equivalent positions in a network structure (Bearman 1993, Gould 1996, Hillmann 2008b, Padgett and Ansell 1992), or textual elements (McLean 2007, p.

124; Monroe, Colaresi and Quinn 2008, Rule, Cointet and Bearman 2015, Schonhardt-Bailey 2006).

Formal descriptions

The second distinctive feature of a morphological approach is the use of one or several techniques of data formalization and reduction. Local and global measures of spatial clustering underpin scatterplot maps of geographic patterns. Network analysis objectifies relational structures and positional characteristics within these structures. Coding based on story grammars extracts relational data from narrative texts (Franzosi 2010). Correspondence analysis, cluster analysis, co-occurrence approaches to content analysis, discriminant analysis, multidimensional scaling and structural network methods shed light on patterns of positions. Sequential analysis, event structure analysis and longitudinal analyses of events explore the structuration of time.

As a result of this plurality of formal techniques, the same class of phenomena—say contention—lends itself to various morphological investigations. Rickard Sandell (2001) identifies the evolutionary patterns underlying the growth trajectories of organizations in three social movements (temperance movements, free churches and trade unions) in Sweden between 1881 and 1930 (pp. 685-689), Biggs' (2005) estimating the cumulative distributions of the sizes of strikes (i.e., the number of firms or workers on strike) in Chicago (1886) and Paris (1889) shows that these distributions follow a power law (pp. 1699-1703). From the standpoint of a relational morphology, Roger Gould (1991) investigates variation in residential levels of insurgency during the bloody week of the Paris Commune (May 21-28, 1871) given the structure of linkages among neighborhoods created by enlistment overlaps (National Guardsmen enlisted in military units outside their neighborhood of residence) (p. 724). Using the information provided by court data on conflict, cooperation, kinship, economic and friendship ties in seventeenth-century western Anatolia, Karen Barkey and Ronan Van Rossem (1997) relate peasant contention to a village' position in the network regional structure (pp. 1364-1371).

From forms to causes

Once formalized, phenomenal patterns inform causal claims in two ways. First, they provide the empirical bases for inferential clues. For instance, having laid bare patterns of intergenerational transmission of status in eighteenth- and nineteenth-century China, Song, Campbell and Lee (2015) observe that in patrilineal societies the characteristics of patrilineages are "shaped by the

characteristics of male ancestors who lived many generations ago" (p. 596). Investigating the trade routes adopted by ship captains employed by the East Indies Company between 1600 and 1833, Erikson (2014) infers from this relational data claims about: the information transmitted from ships to ships via social networks, the captains' propensity to use this information for their own private commercial dealings, and the effects of such opportunistic commercial behaviors on the East Indies Company standing among its competitors.

Second, the focus on specific phenomenal patterns can help probe the empirical relevance of a causal claim or hypothesis. Hillmann and Aven (2011) test the claim that local closure conditions the significance of reputation as a monitoring mechanism by examining patterns of entrepreneurship networks in imperial Russia between 1865 and 1915. Brown (2000) compares the event structures of two instances of union drives in Chicago and Gary (1919-1920) to probe the argument that in a in a split labor market context employers adopt a racial divide-and-rule strategy when "unions develop racially inclusive organizing strategies and minority workers are (or have the potential) to become militant" (p. 662).

To see and to craft

Three issues pose a challenge to a morphological approach to causation. 1. The need to interpret phenomenal patterns may find itself at odds with a strong commitment to induction. 2. The amount of theoretical import a technique of formal description brings in raises the question of the extent to which built-in assumptions shape analytical diagnoses. 3. Analysts cannot avoid examining whether their interventions in the course of making a technique operational have implications for the reliability of the findings.

1. Inasmuch as induction sets a guiding principle (Franzosi 1995, p. 7), a morphological mode of causal inquiry betrays a great deal of suspicion towards any hard-nosed explanatory pre-commitment: "theory involves denying data" (Bearman et al. 1999, p. 508). In letting the data speak for itself, morphological explorations actually have the ability to uncover regularities that modeling hypotheses and aggregate measures fail to capture (Abbott and Tsay 2000, p. 26; Stovel, Savage and Bearman 1996, p. 388). A phenomenal pattern, however, warrants neither intelligibility nor interpretation. When the task is to causally account for its existence, the hints provided by a formal structure may stop at the threshold of a bundle of processes—some of them confounding in terms of outcome—that form an intricate causal complex (Bloome 2014, p. 1197).

To disentangle the web, other empirical observations become necessary along with theoretical claims to connect the dots. Theory then gets surreptitiously brought in through some back door.

2. While techniques of formal description operate as magnifying lenses—powerful enough to enable analysts to discern structures that would otherwise remain shapeless and therefore invisible—the lenses these techniques provide are not theoretically neutral. In "parsing the social world in particular ways," these techniques bring in "elements of an implicit social theory" (Abbott 2001, p. 189). For instance, blockmodelling assumes that actors who display the same pattern of ties, and thus can be considered equivalent in terms of structural positions, develop a sense of identity and interests related to their position (Bearman 1993, pp. 10-12). Optimal matching imposes a "unilinear" conception of social reality (Abbott and Tsay 2000, pp. 12-13, Bison 2010, p. 421) that contrasts with action-based formalizations of sequences (Abell 1987).

3. Techniques of data formalization vary with regard to the number and the scope of the interventions they imply. At one end are methods that request from the analyst a substantial degree of involvement (optimal matching, network analysis, event structure analysis). At the other are more "hand-off" methods such as linguistic and co-occurrence approaches to content analysis (Franzosi 2005, 2010, Reiner 1998). Yet, even in the latter case, analysts exercise some discretionary choices (Franzosi 2010, p. 52; Vicari 2010, pp. 510-513). As the lenses of the technique get set up, they also prove to be relative. Depending on the operational choices being made, patterns have a different configuration. Could it be then that the patterns we discern are the products of the lenses we use? "The danger lies … in the possibility of substantial interpretation of artifactual results" (Abbott and Tsay 2000, p. 16). One direction for future methodological developments lies in the elaboration of sensitivity and diagnosis tests for assessing which interventions modify findings and to what extent.

II. Variable-centered

A variable-centered mode of causal investigation infers causal claims from patterns of association among a set of empirical categories. This mode of causal inquiry draws on two families of methods. *Multivariate statistical analyses* probe the statistical significance of correlations and imputed effects. *Comparative analyses* sort out combinations of attributes across cases. Each operational procedure leans on a validation protocol. Multivariate statistical analyses adjudicate explanatory hypotheses in light of significance and robustness tests. Comparative analyses rely on

standards of logical inference and simplification to arrive at parsimonious expressions of causal equations.

Whether the analysis is statistical or comparative, two cardinal assumptions undergird the formulation of causal claims. The first is a conception of cause as a reliable conjunction between an antecedent and an outcome. The second assumption posits that each category included in the set of possible explanatory factors "captures a dimension of variation" (Ragin 2014, p. xxiii), and has the same empirical meaning for all the cases under consideration (assumption of semantic uniformity). An empirical category that satisfies this twofold assumption qualifies as a variable. The two following studies exemplify the modus operandi of each approach.

Mara Loveman and Jeronimo Muniz's (2007) inquire into the whitening of the Puerto Rican population in the first half of the twentieth century. After having established that the vast majority of Puerto Rico's whitening between 1910 and 1920 was the result of intercensus racial reclassification (p. 920) and that this reclassification was not the byproduct of demographic factors or bureaucratic practices, they examine whether individuals were reclassified as whites because they acquired new traits (boundary crossing) or because the criteria for ascribing racial status changed (boundary shifting). To do so, Loveman and Muniz proceed in several steps: (a) they estimate the counterfactual probability of being white in 1920 had the "association between a given characteristic and enumerators' propensity to classify individuals as white" remained the same between 1910 and 1920; (b) they compare this simulated probability with the actual probability of classification as white in 1920; (c) they observe that, according to this counterfactual analysis, only a relatively small proportion (one fifth) of the difference between simulated and actual probabilities can be imputed to changes in individual characteristics; (d) they corroborate further the claim that changes in the enumerators' criteria account for most of Puerto Rico's whitening by assessing the probability of a child's racial classification in light of a multinomial logistic regression including, among others, the race of mother and father as independent variable.

Colin Beck (2014) sets out to explain the revolutionary wave that swept Middle Eastern and North African countries in 2011. The dependent variable captures variation in levels of contention in sixteen countries: "no protest," "protest," "revolutionary situation" and "political revolution" (p. 218). Previous work on revolutions and transnational movements (e.g., Goodwin 2001, Kurzman 2008, Sohrabi 2002, Hung 2011) informs the selection and construction of five "independent variables" at the country level: embeddedness in the world culture, economic

pressure, Polity measure of democracy, demographic pressures, and a history of opposition (pp. 210-211). To identify patterns of association between these independent variables and the four outcomes defined as explananda, Beck relies on the method developed by Ragin (2008, 2014), which has become standard in comparative historical analyses. Drawing on Boole's algebra and the calibration of cases' "degrees of membership" to empirical sets operationalized as variables, this method (hereafter: Boolean comparative analysis) systematizes the recording of differences and similarities across cases, and minimizes the patterns of associations thus obtained to produce a parsimonious causal "recipe" (Ragin 2014, p. xxiii, p. xxviii). For four of the six cases of "revolutionary situation" in 2011, a Boolean comparative analysis identifies two shared conditions ("a country's relative embeddedness in world society", and "exclusionary political institutions") and two additional conditions: "no significant youth bulge" (Tunisia), "a history of opposition against the state" (Syria, Egypt, Yemen) (p. 211). "Secondary analyses" discuss which transnational, state-centered and subnational factors were at play in the other cases (pp.212-214).

Which challenges might a variable-centered approach encounter on its way? Selection biases crucially jeopardize the reliability of causal inferences. Studies cast in this mold of investigation have therefore to confront the possible biases induced by the selection of cases, sources and variables. This is the first issue. A second issue lies in the handling of historical time and the risk of reification inherent to the language of variables. The third challenge concerns the possibility of mistaken or underspecified causal imputations.

Selecting, constructing

Cases. In a variable-centered framework, a "case" designates a "unit" on which variables are measured or classified (Gary, Keohane and Verba 1994, p. 117; Gerring 2007, pp. 22-24). Different epistemic contributions can be expected from cases (Seawright and Gerring 2008). Whichever contribution is being considered, at issue is whether the criteria for selecting cases stack the odds in favor of some explanatory variables. Choosing cases in light of their values on the dependent variable—"selecting on the dependent variable"—has been of prime concern since it leads to faulty inferences regarding either the estimation of causal effects (multivariate statistical analyses) or the identification of explanatory factors (comparative analyses) (Geddes 2003, p. 92).

Multivariate statistical analyses deal with the issue by randomizing selection (e.g., Gould 1993, pp. 726-727), controlling for group parameters susceptible to bias representativeness (Traugott

2002, pp. 191-195) and sampling on all possible outcomes (Hagen, Markovi and Bearman 2013). For comparative analyses, the challenge lies in a clear and rigorous delineation of the "bounds" assigned to the theory being tested or explored. Two strategies are possible. One specifies the empirical class to which the theory is expected to apply in light of "initial conditions" or the "attributes implied by the theory (Geddes 2003, pp. 95-98). A second strategy selects cases on the basis of explanatory variables (King et al 1994, pp.137-138; Mahoney and Goertz 2005, p. 659).

The devil, however, lies in the details. Selecting cases on the basis of independent variables will be of little help if these are chosen "by rules that are correlated with the dependent variables" (King et al. 1994, p. 115). This drawback is present when the definition of the "outcome variable" includes, or implies, the independent variables expected to explain it. Similarly, selecting on the basis of independent variables will not do much if these variables are so loosely defined that cases can be assigned values without much constraint. For instance, identifying cases of "state breakdown" and "peasant revolt" remains an exercise in approximation as long as we do not know when a state can be said to have broken down and when conflicts in rural areas can be classified as "peasant revolt" (Mahoney and Goertz 2005, p. 667).

Sources. To code or construct their case(s), it is routine for historical social scientists comparing macro entities that span the medium or the long run to rely on secondary sources, that is, sources historical actors have not produced. The practice has elicited two main criticisms. 1. Secondary sources may not be fine-grained enough to lend themselves to unambiguous coding and classification (Kreuzer 2010, p. 672). 2. They allow their users to select and interpret them as they see fit (Goldthorpe 2007, p. 33-36). As a result, they open the door to convenience and confirmation biases: the practice of relying on the sources most readily accessible, and of giving precedence to accounts confirming one or several preferred hypotheses (Lustick 1996, p. 608; Møller and Skaaning 2018, p. 3).

To check such biases, it is obviously judicious to be transparent about "the analytical lenses through which [sources] have been analyzed," and about historiographic controversies (Kreuzer 2010, p. 372; Lustick 1996, pp. 615-616). Similarly, selecting secondary sources that invoke definitions consistent with the analyst's, are theoretically not in line with the analyst's vantage point, and draw on updated evidence may provide additional checks (Møller and Skaaning 2018, pp. 8-13). These recommendations and selection criteria notwithstanding, the debate on secondary sources may easily lose sight of the key point: historical social scientists draw on these sources to extract empirical claims—claims in light of which they impute values to variables and

code their cases. These claims rest on the categories and the concepts they use. However scrupulously they abide by the selection criteria noted above—definitional consistency, theoretical discrepancy and updated evidence—if these categories and concepts are loose, empirically indeterminate and prone to self-validating arguments, the validation problems pointed by critics remain.

In fact, analysts relying on secondary sources are unlikely to confront the liabilities of their dependence on these sources unless they enter the fray, discuss evidence, gauge possible biases, consider objections to descriptive inferences and weigh correctives provided by other secondary accounts *for the empirical claims that are most crucial to their coding and argument*. This means adopting a critical stance and, for the sake of these empirical claims, putting on the lenses of the historian. Quite revealing on this score is for instance the exchange between Marcus Kreuzer (2010), Carles Boix (2010) and Thomas Cusack, Torben Iversen, and David Soskice (2010) about the origins of electoral systems in the late nineteenth and early twentieth centuries.

Variables. Both multivariate and comparative analyses start their investigation by selecting a set of variables (Griffin and Ragin 1994, p 10; Rohwer 2011, p. 733). Ultimately, their causal diagnoses are a function of the empirical categories they select for explanatory purposes. If the selection is off the mark, the diagnosis will be off as well. The issue of variable selection bears upon the issue of variable construction insofar as the use of diffuse empirical concepts, which by setup encompass multiple phenomena at once, short-circuits the specification of additional variables. The problem is of particular significance for causal investigations deployed on a grand scale and that, as a result, cast a wide net on historical phenomena.

Time and reification

How do causal assessments set in the language of variables deal with the temporality of historical phenomena? Multivariate statistical analyses apprehend the time of history by modeling the remanence of the past, shifts and ruptures, and the present time of historical actors. Long-term correlations (e.g., Dell 2010), lag effects (e.g. Møller, Schmotz and Skaaning 2015, Wimmer and Min 2006) and autocorrelations capture the legacies of the past. "Temporally recursive regression"—I.e., the estimation of regression coefficients by incrementally moving the window of time on the time series—helps identify shifts and ruptures in relations of conditionality among variables (Isaac, Street and Knapp 1994, p 123; Griffin and Isaac 1992). By modeling cohort and period effects (Voss 1993, chapter 5), event rhythm (Andrews and Biggs 2006) and the impact of

duration on the probability of occurrence of an event, event history analysis highlights different modalities of historical actors' present time (Isaac, McDonald, and Lukasik 2006).

While macro comparisons that do not resort to Boole's algebra historicize variables by making their effect time-dependent (Orloff and Skocpol 1984, Ertman 1997), Boolean comparative analysis proves much more handicapped to investigate the temporality of its historical referents. Consider John Foran's (2005) Boolean analysis of Third World revolutions, which examines thirty-nine cases classified with regard to their outcomes in terms of the presence and the type of a revolutionary attempt (pp. 248-249). For cases coded as "political revolutions," this comparative analysis yields the following equation:

"Political Revolution = Bcde + aBce" (Foran 2005, p. 243) [1]

"B," "c," "d," "e," and "a" designate explanatory factors conceptualized as variables. "B" means a "repressive, exclusionary, and personalist state," "c" the absence of a political culture of resistance, "d" the absence of an economic downturn, "e" the absence of a "world-systemic opening" (p. 18) and "a" the absence of dependent development. From this equation we infer that two combinations of factors are associated with the outcome "Political Revolution:" "Bcde" and "aBce." This approach to causal claims has three implications regarding the epistemic status of time in general, and historical time in particular.

First, in this representation of causality explanatory variables are deprived of temporality. They have no time of their own. Each is, so to speak, temporally transparent, without substance. A Boolean equation flattens out the "time" of causal factors and outcomes (Goldthorpe 2007, p. 46). Second, their effect is not time varying or time dependent. Third, and correlatively, a Boolean equation establishes no temporal order between variables. Within each combination of factors ("Bcde," "aBce"), the factors at play are not indexed on a temporal order of succession. These three implications—the lack of intrinsic temporality, the lack of temporal effects and the lack of temporal order—explain why comparative analysts resorting to Boole's algebra can move around,

[1] The sign "+" in Boolean algebra designates the logical operator "or." By convention, upper and lower case letters respectively denote the presence and absence of explanatory variables. The "absence" of a given variable actually means the presence of its complement as a set of empirical conditions. For instance "a" in Foran's Boolean analysis of Third World revolutions designates the set of economic developments different from "dependent development" (designate by variable "A").

and factor, explanatory variables. All in all, a Boolean comparative analysis abstracts causes from their temporal unfolding, and thereby conveys a static representation of historical causality.

Analysts may choose to assign temporal characteristics to variables (Caren and Panofsky 2005, p. 164). The drawback of this procedure is that it very quickly leads to a proliferation of variables and undercuts the prospect of parsimonious equations. Furthermore, assigning temporal characteristics does not fundamentally alter the atemporal argumentative logic inscribed in the Boolean comparative setup. Variables endowed with their temporal characteristics still operate as monads producing effects devoid of temporality.

More broadly, an extensive use of the language of variables applied to history is prone to reification. We reify concepts and categories as we transmute them into causal agents and, in so doing, hollow out their empirical content. The discursive marker of this usage is an imputation of agency (e.g. "institutions … are especially capable of seizing opportunities provided by contingent events" … "contingent events select institutions" in Mahoney 2000, p. 515, p. 519). Reified concepts move things around. They do the action. We then forget that they are but shorthand: convenient tools abstracting specific empirical realities away from the configurations in which these realities are embedded in order to operationalize theoretical arguments. As causal agents, variables tend to wrap themselves in the mantle of autonomous, self-propelling and self-enclosed entities. They acquire monad-like capacity.

From associations to causes

Remains the issue of interpretation. Interpreting patterns of association among variables in causal terms faces two challenges. The first is the possibility of mistaken causal imputations. Associations between variables provide a basis for causal inferences only if these associations can be shown to be reliable. Measurement errors (Lieberson 1994, p. 1232), omitted explanatory variables, confounding factors, reversed causation between "dependent" and "independent" variables, and artifactual correlations (Koçak and Carroll 2008, Voas, Crockett and Olson 2002) crucially imperil the prospect of sound causal inferences about historically situated phenomena. The second challenge relates to the lack of clear-cut specifications of how a given factor produces its effects on an outcome ("black-box" problem).

Multivariate statistical analysis handles the possibility of mistaken causal imputations through various techniques (Gangl 2010)—techniques which historical inquiries have been using for their own purposes. Fixed effect models control for the impact of omitted variables resulting from

unobserved or unmeasurable heterogeneity (e.g., Goldstein and Haveman 2013). Historically grounded investigations can hone their causal diagnoses by relying on a counterfactual framework, which estimates the difference in outcome resulting from exposure to a given condition (treatment) compared with the counterfactual world in which such exposure would not have taken place (e.g. Lin and Tomaskovic-Devey 2013). To check reverse causation and endogeneity, historical inquiries can take advantage of the chronological character of their data (Kim and Pfaff 2012, p. 201), and of natural experiment settings bequeathed by history as a result of events exogenous to the dependent variable (Banerjee and Iyer 2005).

Boolean comparative analyses are no more immune to omitted variables (unobserved heterogeneity), reversed causation, and measurement and coding errors than multivariate statistical analyses. While statistical multivariate analysis has devised diagnoses for model misspecification due to omitted variables, Boolean comparative analysis has not (Schneider and Rohlfind 2016, p. 561). Practitioners have addressed the issue by interpreting contradictory combinations, i.e., combinations of factors yielding divergent outcomes, as indicative of the need to include additional explanatory variables (e.g., Brown and Boswell 1995, p. 1502). The issue of reversed causation remains unaddressed most likely because of the method's difficulties in handling time. Measurement and coding issues, on the other hand, have received systematic attention. Causal recipes are highly sensitive to coding decisions and the method used to calibrate the degree of membership of cases to fuzzy sets (Goldthorpe 2007, p. 46, p. 226-227; Hug 2013, p. 260-261; Lucas and Szatowski 2014, p. 47). In the absence of clearly specified empirical criteria, these decisions rest on the analyst's subjective appreciation.

In addition, assessments based on various simulations work have generated doubts and debates regarding the ability of Boolean comparative analysis to adequately identify correct patterns of association among variables (Fiss, Marx and Rihoux 2014, Lucas 2014, Lucas and Szatrowski 2014, Ragin 2014). In particular, simulations generating a universe of cases from a given Boolean causal equation show that the procedures assigning outcome values to nonexistent combinations of conditions yield causal recipes at odds with the true equation (Seawright 2014). These methodological observations raise concerns on the reliability of the approach as a technique of inductive causal inferences while suggesting that the method is best used as a heuristic device to explore possible lines of research (Collier 2014, p. 124; Goldthorpe 2007, p. 54; Lieberson 2004, p. 13).

Last, but not least, neither correlation coefficients nor the algebraic expressions yielded by Boolean comparative analysis tell us *how* causes produce their effects. We learn which factors, and which combinations of factors among those initially selected, are associated with the outcome to be explained. But we do not know the modus operandi of these causes—how they operate. In this analytical framework, the way in which a cause (i.e., an independent variable) produces, or contributes to producing the outcome (dependent variable), remains a "black box" (Goldthorpe 2007, p. 53).

III. Genetic

A genetic approach apprehends causality through the systematic investigation of generative processes. Consider Petersen's (2001) account of rebellion against Soviet occupation in Lithuania after the Second World War. This inquiry aims to explain the emergence of an underground social movement by examining how individuals get involved in high-risk activism. To do so, Petersen theorizes "triggering" mechanisms," which initiate involvement, and "sustaining mechanisms," which prevent disengagement. He then proceeds to assess the plausibility of these processes in light of first-hand evidence—testimonies and interviews—documenting both their occurrence and the factors, whether group-based or situational, conditioning their emergence. Regarding this last point, Petersen argues that social relations displaying the characteristics of "community relations" (Taylor 1988, p. 68)—i.e., relations that are direct, many-sided, reciprocal, and pervaded by a sense of equal status—allow individuals to overcome collective action problems. By way of consequence, these relations increase the likelihood of processes triggering and sustaining involvement in high-risk activism.

Both the analytical and empirical investigations deployed in Petersen's inquiry are geared to the identification of a generative process—the process generating involvement in high-risk political activism. Underlying this explanatory project is the epistemic presumption that in analyzing how change—i.e., a shift in states—takes place we accede to the etiology of the effects, or outcomes, we want to explain. The study thus addresses the question "why?" through the question "how?" It tackles this question by specifying a set of "mechanisms," defined as "specific causal patterns that explain individual action in a wide range of settings" (p. 10). And it explores the empirical relevance of these mechanisms in light of primary historical evidence.

Studies committed to a genetic mode of causal exploration through history are dealing with two major tasks. First, they need to theorize the process whereby a type of change or outcome is

brought about. As Petersen's (2001) analytical strategy makes clear, the notion of "mechanism" provides a rallying point for this endeavor. Second, they need to validate their theoretical claims about generative processes. Each task raises challenges of its own. Theorizing a generative process requires specifying not only how a set of units undergo change but also the factors conditioning the occurrence and likelihood of this process. The task of validation for its part requires tracing a generative process in time, or alternatively, when processual evidence is not available, gauging observable implications. A simulation exercise can complement both validation strategies.

Mechanisms

Definitions of mechanisms abound. They differ with regard to the units of analysis they posit (events, phenomena, entities, actors, variables) and the claims they make about whether mechanisms are observable, predictable and grounded in a probabilistic understanding of causality (e.g., Bates et al, 1997, p. 12-13; Elster 1998, p. 45; Hedström and Swedberg 1998, p. 11-13; George and Bennett 2005, p. 137). Underneath this profusion of definitional stances runs an injunction for analytical specificity: if the identification of a generative process is specific enough, we should be able to provide an analytical description shorn of the reference to any case and its specifics. From this perspective, a mechanism can be defined as the analytical specification of the effectuation of change. This definition is consistent with the different definitional takes mentioned above.

Two consequences follow. First, We cannot identify a generative process unless we analytically describe how a set of units—however we name them—undergo change. This work of analytical specification is necessarily dynamic and sequential. Hence, invoking a mechanism implies an "empirical commitment on the part of the theorist as to how a process would unfold if the assumptions upon which it rests were well founded" (Hedström 2005, p. 31, p. 108). Second, we can hardly claim to have theorized a mechanism if we leave the factors that condition its likelihood unspecified. The two go hand in hand. Without the specification of conditional factors, both the generalizability and refutability of the mechanism is questionable. Conditional factors, it should be noted, are more specific and pinpointed than "scope" or "boundary" conditions, i.e., the universe of situations in which the process or phenomenon under consideration has been shown to occur (King et al 1994, p. 101). While scope conditions broadly delimit the possibility of a theory, conditional factors state under which situational and contextual parameters a generative process is likely to take place.

Consider the distinction between behavioral and inferential processes of collective alignments in situations of collective uncertainty (Ermakoff 2008, chapter 6). Alignment is behavioral when actors commit to a line of conduct given the information they have about others' commitment. This process unfolds if actors have access to this information and perceive their sense of risk to be assuaged. When these conditions do not obtain, the choice of a line of conduct is conditional on the formation of expectations about collective behavior. Actors can infer these expectations from the signals provided by either interpersonal contacts (local knowledge) or public events (tacit alignment). These provide the opportunity to coordinate expectations insofar as actors can presume among themselves a shared understanding of an event's impact on their collective stance.

Levels of analysis

At which level of analysis can we expect generative processes to be adequately specified? The distinction between levels rests on the distinction between units of analysis. An inquiry adopts a micro outlook when the individual actor is its unit of analysis. Such a perspective is large scale when it encompasses a high number of individual actors (e.g. Muller 2012). "Macro" refers to supra-individual realities of a composite character. "Meso," if needs be, designates a single supra-individual entity (e.g., an organization). This clarification in hand, two considerations underscore why the requirements of clear-cut and refutable analytical specifications of generative processes are more difficult to deliver at the macro or meso levels than at the micro one.

For one thing, macro-specifications face the risk of bundling together processes that, although confounding with regard to their effects, should be differentiated and specified as distinct mechanisms. More broadly, inquiries that strive to pin down generative process shoot themselves in the foot when they rely on notions of such empirical breadth that these are bound to evoke and conflate different phenomena at once. Claims cast in terms of critical juncture and path dependency are a case in point. A conjuncture is deemed "critical" insofar as its historical legacy is "path-dependent." In other words, the notion is primarily defined through its effects. This means that, apart from its consequential character, it has no content proper and is bound to blend multiple processes at once.

Furthermore, systematic accounts of large-scale historical processes underscore that we cannot presume to understand how collectives behave unless we pay attention to interactive dynamics in their midst (Andrews 2004, Markoff 1996). In more analytical terms: intra-group dynamics

condition group stance and, by derivation, inter-group dynamics (Ermakoff 1997, Tsebelis 1991). It follows that to satisfy the specificity requirements of mechanism-based arguments claims about the connections between macro-entities have to be explicated in terms of arguments involving actors, their interactions and the outcomes of these interactions—in short, micro-arguments (Lindenberg 1977, Hedström and Swedberg 1998, p. 23; Raub, Buskens and van Assen, 2011). The point applies to phenomena that we usually view as the epitome of macro processes such as industrial development (Chibber 2003) or the diffusion of nationalism (Wimmer 2013, chapter 3).

To say that the specification of generative processes ultimately calls for a micro-analytical investigation is not to say that this investigation is bound to address social action in rational choice terms, contra the programmatic agenda of the "analytical narrative" framework (Bates et al. 1998, p. 12). The axiomatic theory of rational choice has been shown to lack empirical relevance in various domains of activity including some in which decisional contexts and incentives would lead analysts to expect behaviors driven by utility maximization (DellaVigna 2009). Given this empirical evidence, an endorsement of rational choice a priori goes counter to the some of the "analytical narrative" approach's own methodological precepts according to which analysts should evaluate causal claims by examining whether the assumptions fit the facts and the implications find confirmation (ibid, pp. 14-18).

Analytical specificity

If adopting a micro perspective does not mean committing oneself to a rational choice understanding of actions and interactions, it means on the other hand arriving at a specification of generative processes precise and "crisp" enough so that it can be empirically probed and refuted (Jacobs 2015, p. 56, p. 59). In this endeavor, formal analysis appears to be a prima facie natural ally. The point here is less about the use of symbolic language per se than about the search for a level of precision and specificity that makes claims about generative processes amenable to symbolic transcription. The potential benefits are threefold.

First, analyses that fulfill the precision requirements of formal claims help differentiate processes that standard usage collapses under the same descriptive category. For instance, "collective action" encompasses quite distinct processes of informational cascades (Kuran 1991, Lohmann 1994) and collective alignment (Ermakoff 2008). Power management in authoritarian regimes rests on different mechanisms of contention, supervision and cooptation (Gandhi 2008, Svolik 2012). The diffusion of innovative practices, such as the invention of the partnership system in

late medieval Florence, involves processes of transposition, transformation and feedback across network domains (Padgett and McLean 2006, p. 1494-1539).

Second, the search for analytical precision hones our attention to the "'noise' of history, these apparent 'small' details that actually can carry considerable analytical weight" (Ermakoff 2008, p. xxvi; Freeland 2001, Greif 2006, pp. 333-6, Kalyvas 2006, Pfaff 2006). Theoretical specificity then has the potential of unearthing empirical observations that without this analytical exposure we would not notice because of their apparent insignificance. For instance, Chong's (1991, p. 55-71) game-theoretical analysis of the civil right movement underscores the significance of reputational concerns and their impact on the dynamics of interpersonal commitments. In delineating which pieces of information are worthy of attention, precise causal specifications by the same token directs attention to the type of evidence needed for refutation purposes.

Third, a high degree of analytical specificity invites analysts to pay systematic attention to the factors conditioning the likelihood of a generative process (e.g., Stasavage 2003, p. 38). As the previous remarks about the regulative horizon provided by a micro focus suggest, these conditional factors if duly theorized, refer to individual parameters (e.g., status, beliefs, positions, interests, resources). The heuristic gains derived from such a focus further relate to issues of generalizability and refutability. In specifying conditional factors, we make claims about mechanisms generalizable. This is the paradox: arguments about generative processes achieve general significance and, to a certain extent, acquire predictive content when we specify them as conditional.

Tracking generative processes

Once we have specified a generative mechanism, three validation strategies are conceivable: tracing its temporal unfolding, gauging observable implications and simulating. Temporal tracing bets on the possibility of observing the mechanism *en acte* by documenting historical actors' beliefs and behaviors. Analysts are likely to fall back on an empirical assessment of observable consequences when the evidence for tracing mechanism in time is lacking. Simulation complements either temporal tracing or implication assessment by providing the opportunity to examine whether, and to what extent, the fit between simulated and actual outcomes corroborates causal claims cast in genetic terms.

Temporal tracing. This validation strategy traces a generative process in historical time by reconstituting the temporal sequence of actions and interactions leading a group of actors to

undergo a change in beliefs and/or behaviors (e.g., Ansell 2001, Walder 2009). The analysis is dynamic and focused on actors' stances and experience. It tries to get as close as possible to their subjective states or the behavioral markers of these states (e.g., Go 2008, Haydu 2008, Gorski 2003). Underlying this research design is the epistemic claim that a cause is at play at a given moment in time if it operates through actors' beliefs or motivations. Temporal tracing as a validation strategy thus implies (1) clearly delineating the groups of actors involved (since group and situation parameters condition mechanisms), (2) documenting action and interactions as they unfold in time (since the etiology at play lies in this temporal unfolding), and (3) adopting a forward-looking outcome (since any retrospective analysis starting with the outcome is likely to induce hindsight bias and stultify counterfactual insights).

This last point deserves attention. Accounts labeled as process tracing can easily let their empirical assessments be colored or informed by the knowledge of the outcome. At times, retrospective bias gets merged with a judgment of necessity—what happened was bound to happen—couched as a statement of fact or as a "retroactive prediction" (Kurzman 2005, p. 135). Subverting teleology requires, first, the ability to identify moments of collective indeterminacy in which collectives waver between different behavioral stances, and second, the ability to gauge the range of possible collective scenarios and their likelihoods at different points in the process (Ermakoff 2008, 2015, Eidlin 2016, Gerteis 2007, Haydu 2008, pp. 14-16).

Lurking in the background of this validation strategy are two questions. First, can we trace generative processes on different time scales? Second, what type of evidence is needed? The answer to the first question brings us back to the epistemic claim mentioned above: if a cause is at play at a given moment in time, we should be able to trace it through actors' behaviors, motivations or beliefs. This claim points to two research protocols addressing processes from a medium or long-term perspective. One traces the schemes of thought, dispositions and strategies of action displayed by one category of actors over several decades (e.g., Biernacki 1995, Fligstein 1990, Fourcade 2009, Lachmann 2002). The other narrows the focus on moments of challenge and confrontation punctuating a long-term temporality under the presumption that these moments provide particularly magnifying lenses for analyzing historical actors' motives and understandings (Geva 2015, Goldberg 2007, Steinmetz 1993).

Second, which evidence is required to trace generative processes in the making? The task is to dig out a type of evidence documenting processes from the ground level. If the past is recent, interviews and surveys can prove up to the task (Dobbin 2009, MacKenzie and Millo 2003, Opp

and Gern 1993, Seidman 1994). If the past is too far removed, analysts rely on primary historical sources—i.e., sources produced by historical actors—of a behavioral or discursive type. Behavioral evidence records actions and their outcomes in time and space: administrative data (Gerteis 2007, Voss 1993), association membership (Riley 2005), court records (Gould 1999, 2000), data provided by newsletters and gazetteers (Carruthers 1996, Su 2011), enlistment records (Traugott 2002), police reports (Ansell 2001, Pfaff 2006), and voting roll calls (Wilde 2007) among others.

Discursive evidence has the format of statements by contemporaries. On the public-private scale, these run the full gamut: parliamentary debates (Dobbin 1994), statements in newspapers (Babb 1996, Ellingson 1995, Jansen 2017, Sohrabi 2013, Wilde and Danielsen 2014), published accounts, testimonies delivered before a collective body with a mandate to subpoena (Ermakoff 2008), administrative correspondence and reports (Chibber 2003), professional association reports (Haydu 2008), accounts intended to remain confidential (diaries, letters, private notes) (Freeland 2001). In triangulating different types of documents pertaining to the process they investigate, analysts can seek to "emulate historical ethnography" (Emigh 2009, p. 12).

Each type of source is amenable to biases (e.g., for newspapers: Earl, Soule and McCarthy 2005). Consequently, each calls for checks and correctives. Statements produced at the time of an event, in its immediate wake, or in a setting geared to critical examination can be hypothetically presumed to be less prone to mistakes. It is possible to gauge the likelihood of misleading statements in light of criteria of consistency and constancy (Anderson 2013, p. 41), the author's position, the context of production of the document and its formal structure (Ermakoff 2008, chapter 9, Appendix A): actors who provide statements with a narrative (diachronic) structure are likely to disclose much more pieces of information about themselves and others than they think.

Observable implications. If the evidence documenting the unfolding of a generative process in time is lacking, an alternative validation strategy consists in confronting observed and predicted outcomes. For instance, Przeworski and Sprague (1986) gauge whether, in the course of the twentieth century, Leftist parties' decision to appeal to non-workers decreased their attractiveness within the working class, by constructing and assessing a trade-off index based on voting results over several decades. When different generative mechanisms are conceivable given contextual conditions, the focus should be on the "implicative core" of each in order to minimize their overlap in terms of observable implications (Caporaso 1995, p. 458; Geddes 2003, p. 39-40).

Agent-based simulation. Although multi-agent modeling remains underdeveloped as a method for exploring historically situated processes of change, its micro-analytical underpinnings are fully in line with the specification requirements of a genetic mode of causal inquiry (Cederman 2005, Manzo 2015, pp. 29-34). This strategy of empirical assessment therefore holds great promises for genetic inquiries of historical objects. Reproducing the dynamics of generative process by simulating actions and interactions among individual actors has three potential benefits. First, as we operationalize analytical claims about the micro underpinnings of actions and reactions into a set of program commands, we probe further the precision and specificity of these claims. An ambiguous claim—i.e., a claim bundling up two or more possible interpretation regarding micro specifications—cannot be properly simulated. Second, simulation exercises make it possible to contrast simulated and observed outcomes (Hedström, Sandell and Stern 2000). Third, simulation exercises inform us on the extent to which changes in initial conditions and parameter values affect outcomes (e.g., Bhavnani 2006, p. 664).

Coda

This review of approaches to causal inquiry in historical social sciences brings into relief several observations. First, analysts interested in honing the analytics of their causal claims and in sounding the empirics of their case have much to gain from a serious engagement with history. Historical complexity pulls analysts out of their comfort zone. It compels them to reflect critically on the operational choices they make as they implement a formal description of their data, on the empirical content of their variables, and on the claims they set forth about the effectuation of change.

Second, and related, a close focus on the practices of causal investigation moves us away from dichotomies such as qualitative versus quantitative, cases versus variables, structure versus agency, induction versus deduction or even ideographic versus nomological. Studies that seek to strengthen their case by exposing themselves to critical scrutiny and refutation, often pursue not one but several modes of causal investigation. Some inquiries cast their hypotheses in process-theoretic terms, in accordance with a genetic approach, before resorting to a variable-centered framework to test the empirical relevance of these claims (Kaufman 1999, Kiser and Linton 2002, McAdam and Su 2002, McVeigh, Cunningham and Farrell 2014, Olzak 1992). Others draw on a variable-centered analysis before reconsidering their case from a genetic standpoint (Beissinger

2002, Voss 1993). Still others resort to morphological observations to test hypotheses about correlates (Gould 2000) or generative processes (Mitschele 2014).

The problem, and this is the third observation, lies with invocations of causality that reify the notion of cause and make it seem that from the moment we "name" a cause we indeed have in hand a sound explanation or an explanation that has empirical meaning. Causality talk amounts to a scholastic exercise when it elides the challenges posed by validation strategies. The paradox here is that as we confront our causal claims with the hard stuff of historical evidence, that is, as we expose our claims to refutation, we also increase the likelihood that they might contribute to cumulative knowledge. The closer we get to history, the more Popperian our causal world becomes.