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The Institutional Grammar: Evolving Directions in Current Research

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Abstract

This article introduces the special issue of the *International Review of Public Policy* devoted to "Exploring Institutional Dynamics with the Institutional Grammar". In doing so, it: (i) provides a brief introduction to the Institutional Grammar as an increasingly prominent tool for the study of institutions that govern social systems, such as public policies and social conventions; (ii) describes evolving trends in Institutional Grammar research reflected in and beyond the papers included in the issue; and (iii) discusses analytical trade-offs associated with these trends, with specific reference to special issue papers. This introduction to the special issue thus contextualizes the research presented in the issue, while also offering insights and guidance regarding the ongoing use and development of the Institutional Grammar.

Keywords

Institutional Grammar, institutional dynamics, institutional analysis, policy design

Introduction

This article introduces a special issue of the *International Review of Public Policy* that brings together papers exploring institutional dynamics using an increasingly prominent approach for studying the language of institutions used to govern social systems, called the Institutional Grammar. "Institutions" in this case refer to formal and informal rules, norms, and strategies captured, for example, in public policies or social conventions. "Institutional dynamics" refers to formal and informal changes in institutions in the context of evolving social and environmental conditions. It also captures adaptations of institutions that occur as they are interpreted and applied by actors in the policy process and other institutionally governed settings. Each of these manifestations of institutional dynamics has been of enduring interest to social scientists who seek to understand the specific ways in which institutions change and/or are adapted over time, as well as the causes and consequences of institutional dynamism. This special issue packages research and related insights that speak to each of these manifestations of institutional dynamics described above, and in particular demonstrates how the Institutional Grammar can be used to assess them.

The papers in this special issue examine institutional dynamics in the context of environmental governance, which is a particularly apt domain in which to explore this topic. Environmental governance often requires consideration of various forms of change and how these are reflected in, or influence, human behavior and the institutions that govern it (Ostrom, 2005). Environmental governance is often subject to new or changing information regarding the causes and consequences of ongoing and emerging environmental issues that are relevant to institutional design and implementation, reconsideration of how natural resources are managed, and evolving negotiations among the various stakeholders that move in and out of environmental policy processes, among other forms of change (Janssen & Anderies, 2013).

The focus on the Institutional Grammar (hereafter, IG) in the special issue reflects its growing prominence as a robust and reliable method for conducting institutional analysis. Essentially, the IG provides a systematic approach for analyzing the structure and meaning of institutions that govern social systems. The IG has been used extensively to study policy design and to inform simulations of policy scenarios in computational modeling (for an overview of publications see Siddiki et al., 2022). It has also been employed to analyze informal institutions (Watkins & Westphal, 2016). Existing applications using the IG have been conducted to study institutional design and outcomes in a variety of topical areas and geographic settings by scholars from different disciplinary backgrounds (e.g., public policy, political science, computational social science). This existing research has consistently confirmed the theoretical and methodological versatility of the IG, i.e., its applicability to the study of a wide range of concepts linked to different theories, and its ability to be paired with different methods to address different analytical objectives. The papers presented in this special issue further validate the utility of the IG in the context of their respective research studies, while also showcasing the value of the IG as a generalizable approach for conducting institutional analysis within the broader realm of policy studies.

In the following section, we provide a brief introduction to the IG as a basis for discussing the content of the papers included in this special issue and related research themes and opportunities. Following this brief introduction to the IG, we discuss evolving directions in IG research that are reflected beyond and within the papers included in this special issue.

Brief Introduction to the Institutional Grammar

The IG was first introduced in 1995 by Sue Crawford and Elinor Ostrom as an approach to understanding and analyzing institutions (Crawford & Ostrom, 1995). A central motivation for the development of the IG was to help conceptualize different forms of institutions that govern behavior by better describing components of different types of institutions. Essentially, Crawford and Ostrom were interested in identifying a generalizable set of "building blocks" of institutions and using systematic variation in these institutions to identify different institutional types. To this end, Crawford and Ostrom formalized the distinction between different types of institutions by reference to the syntactic components of institutions that are uniquely associated with each type. Grounding the IG in game theory, Crawford and Ostrom were particularly interested in distinguishing among different types of institutions that variably contain components that restrict behavioral discretion and/or communicate enforcement mechanisms. In this way, the syntactic components that make up their "institutional grammar" correspond to aspects of institutions that are relevant to how institutions govern social systems by regulating individual and collective behavior within them. Relatedly, Crawford and Ostrom also identified a generalizable institutional unit of analysis that can be used as a basis for institutional analysis and of which institutional syntactic components are composed, called the "institutional statement."

According to Frantz and Siddiki (2022), who recently published a revised version of the original IG proposed by Crawford and Ostrom, institutions typically consist of two types of institutional statements: regulative statements and constitutive statements. Regulative institutional statements are those that direct the behavior of actors by specifying, with varying degrees of prescriptiveness, what specific actors do within specific contexts. Constitutive statements, on the other hand, constitute features of social systems by, for example, defining institutionally relevant artifacts, venues for collective action, and roles, rights, and responsibilities.

Regulative statements are composed of some or all of the following components: (i) a responsible actor, referred to as an *Attributes* (A) ; (ii) an action regulated by the statement, referred to as an *Aim* (I); (iii) a statement context, referred to as *Context* (C); (iv) a receiver of an action, referred to as an *Object* (B) ; (v) a prescriptive operator that describes how strongly an action is compelled or restrained, referred to as a *Deontic* (D); and (vi) a consequence of violating the regulated action, referred to as an *Or else* (O), which can be represented as its own institutional statement comprised of the aforedescribed syntactic components. Attributes, Aim, and Context are considered necessary components of regulative statements, meaning that all regulative statements contain at least these three components. The remaining components are considered sufficient: they are only sometimes explicitly encountered in regulative statements. Furthermore, Attributes can be further decomposed into *Attributes* and *Attributes properties* (A,p), where the latter are descriptors of the former. Objects can be further decomposed into *Direct* (Bdir) and *Indirect* (Bind) Objects, where the meaning of each is consistent with the distinction in English grammar. The distinction between first-order component and associated properties in the case of Attributes also applies to the Object component. Contexts can be further decomposed into *Activation conditions* (Cac) and *Execution constraints* (Cex). Activation conditions instantiate settings in which the focal actions of statements occur, and execution constraints qualify the action temporally, spatially, procedurally, or otherwise.

Constitutive statements are composed of some or all of the following components: (i) the entity that is being constituted or directly modified within a statement, referred to as a *Constituted Entity* (E); (ii) a parameterizing function that introduces or otherwise characterizes the

Constituted Entity in relation to the institutional setting and potential Constituting Properties, referred to as the *Constitutive Function* (F); (iii) the statement context, referred to as *Context* (C); (iv) properties that serve as inputs to the constitutive function, called *Constituting Properties* (P); (v) a modal operator that defines the extent to which the constitutive function of an institutional statement is required (necessary) or merely possible (optional), referred to as a *Modal* (M); and (vi) a consequence associated with the non-fulfilment of the function referenced in the constitutive function, referred to as an *Or else* (O), which can be represented as its own institutional statement comprised of the aforedescribed syntactic components for regulative or constitutive statements.[1] As with regulative statements, constitutive statements have necessary and sufficient components. The Constituted Entity, Constitutive Function, and Context represent the necessary components.

Below is an example of a regulative statement and an example of a constitutive statement, each of which has been decomposed[2] into relevant syntactic components.

Example of regulative statement:

> Within one year of the effective date of these rules and regulations, the owners of all existing wastewater treatment plants shall submit an operations and maintenance plan to the Department unless a treatment plant has been granted an exception or else the Department will suspend the treatment plant's license to operate.

Attributes: owners of all existing wastewater treatment plants

Deontic: shall

Aim: submit

Direct object: operations and maintenance plan

Indirect object: department

Activation condition: within one year of the effective date of these rules and regulations

Activation condition: unless a treatment plant has been granted an exception

Or else:

> Attributes: Department
>
> Deontic: will
>
> Aim: suspend
>
> Direct object: treatment plant's license to operate

"The following is an inline coding of the above statement, i.e., a coding that follows the original statement structure and uses the acronym identifying each component (e.g., A, B) to indicate the content associated with each syntactic component, referred to as IG Script[3]. Such inline coding is an emerging convention in the syntactic annotation of institutional statements.

1 — More details about the distinctive differences of Or else statements on regulative and constitutive statements is provided later.

2 — Frantz and Siddiki's Institutional Grammar 2.0 provides guidelines for coding at three "levels of expressiveness": IG Core, IG Extended, and IG Logico. Coding at the IG Core level is considered basic structural coding, in which the institutional analyst deconstructs institutional statements along syntactic categories without attempting to capture in more detail the actions of institutional statements that are communicated indirectly through parts of institutional statements (as would be done with IG Extended coding), or without attempting to semantically annotate parts of institutional statements that correspond to different syntactic categories (as would be done with IG Logico coding).

3 — Details on the IG Script syntax are available at https://github.com/chrfrantz/IG-Parser.

> Cac(Within one year of the effective date of these rules and regulations), the[4] A(owners of all existing wastewater treatment plants) D(shall) I(submit) an Bdir (operations and maintenance plan) to the Bind(Department) Cex(unless a treatment plant has been granted an exemption) or else O{A(Department) D(will) I(suspend) Bdir(treatment plant's license to operate)}.

Constitutive statement example:

> Within the State, effective May 1, 1997, "effluent" means water that flows out from a treatment process.[5]

Constituted entity: effluent

Constitutive function: means

Constituting properties: water that flows out from a treatment process

Activation condition: effective May 1, 1997

Activation condition: within the State

An inline coding of this statement is provided below:

Cex (Within the State), Cac (effective May 1, 1997), E ("effluent") F (means) P (water that flows out of a treatment process).[6]

Institutions, as described in this article, are understood to be composed of a mixture of regulative and constitutive statements that work independently or together to govern what happens within a particular institutional setting. IG-based institutional analyses typically involve two stages of institutional parsing.[7] First, from the institutions under study [e.g., public policy documents or corpora capturing institutions in use (e.g., interview transcripts or ethnographic field notes)] the analyst extracts and catalogs the institutional statements contained therein. Second, institutional statements are broken down into syntactic components. This process is not entirely exclusive, as parsing at the statement level requires (even implicit) recognition of the presence of certain syntactic components or configurations thereof, given that statements are defined in terms of the presence of certain necessary components. In this way, statements may not correspond to other units of linguistic text (e.g., sentences), although they sometimes conveniently do. Table 1 uses an excerpt from a public policy document[8] to illustrate the two-stage parsing described above.

4 — Normally, articles are not annotated with other statement information corresponding to a particular syntactic component.

5 — This statement does not contain an Or else component. Or else components are rarely found in constitutive statements. Or else components, while having the same definition in both regulative and constitutive statements, are practically different in the two types of statements due to the different functions of regulative and constitutive statements in the governance of social systems. Whereas an Or else in a regulative statement typically conveys a circumstantial penalty associated with a particular behavior (or absence thereof), an Or else in a constitutive statement typically conveys an existential consequence resulting from the statement not being carried out as prescribed.

6 — See note 5.

7 — It is possible for an institution (e.g., a public policy document) to consist of a single institutional statement but this is uncommon.

8 — Excerpt taken from New York State "Rules and Regulations for the Protection from Contamination, Degradation, and Pollution of the New York City Water Supply and Its Sources," pp. 24. The sample regulatory and constitutive statements provided in this section are adapted versions of statements found in this policy document.

Table 1. Institutional Decomposition Using the Institutional Grammar

Institutional Excerpt	**Institutional Statement Level Parsing**	**Syntactic Parsing (IG Core)**
If an applicant for Department review and approval of a regulated activity requests that the Department conduct a site visit and evaluation to determine and flag the presence of a watercourse, reservoir, reservoir stem or controlled lake on the applicant's property the Department shall do so as soon as is practicable. If the applicant supplies the Department with a surveyor's map of the property which includes a representation of the flagged watercourses, reservoirs, reservoir stems or controlled lakes identified by the Department, the Department shall confirm or annotate the findings upon the surveyor's map within 20 business days of receipt thereof. A confirmed survey map shall be binding upon the Department for five years following the date of the confirmation.	If an applicant for Department review and approval of a regulated activity requests that the Department conduct a site visit and evaluation to determine and flag the presence of a watercourse, reservoir, reservoir stem or controlled lake on the applicant's property the Department shall do so as soon as is practicable.	Cac(If an applicant for Department review and approval of a regulated activity requests that the Department conduct a (site visit [AND] evaluation) to (determine [AND] flag) the presence of a (watercourse [OR] reservoir [OR] reservoir stem [OR] controlled lake) on the applicant's property) the A(Department) D(shall) I(do so) Cex(as soon as is practicable).
	If the applicant supplies the Department with a surveyor's map of the property which includes a representation of the flagged watercourses, reservoirs, reservoir stems or controlled lakes identified by the Department, the Department shall confirm or annotate the findings upon the surveyor's map within 20 business days of receipt thereof.	Cac(If the applicant supplies the Department with a surveyor's map of the property which includes a representation of the flagged (watercourses [OR] reservoirs [OR] reservoir stems [OR] controlled lakes) identified by the Department), the A(Department) D(shall) I(confirm [OR] annotate) the Bdir(findings) Bind(upon the surveyor's map) Cex(within 20 business days of receipt thereof).
	A confirmed survey map shall be binding upon the Department for five years following the date of the confirmation.	A E(confirmed survey map) M(shall) F(be binding) P(upon the Department) Cex(for five years following the date of the confirmation).

Source: the authors

One implication of the two-stage parsing that institutional analysts typically perform when applying the IG is that they can analyze institutional information at the statement level or at the syntactic component level. Assessments at the institutional statement level typically involve describing the number and types of statements encountered within a particular institution under study. In characterizing statement types, scholars have typically categorized institutional statements according to the rule typology associated with the Institutional Analysis and Development (IAD) framework (Ostrom, 2005, 2011), which provides a structured approach to classifying "rules" based on their functional properties. With the recent introduction of the Institutional Grammar 2.0 (Frantz & Siddiki, 2022), the typological classification of institutional statements may also refer to the ratio of regulative to constitutive rules encountered in a given institution.

Syntactic component-level assessments of institutional information typically entail descriptions of institutional information by syntactic component, such as descriptive summaries of Attributes (actor), Aim (action), or Deontic (prescriptive operator) information. Such summaries provide valuable insights into who institutions apply to, the array of actions addressed within institutions, and institutional stringency. Descriptive summaries along other syntactic components provide different kinds of insights. Assessments at the syntactic component level can also include descriptions and complementary visualizations (e.g., via social network diagrams), of how information corresponding to different syntactic components is connected within and across institutional statements that comprise a given institution or a set of institutions. Syntactic information can also be used for the algorithmic representation of directives or behavior modeled in the context of computational simulations of institutionally governed behavior.

Ultimately, how one analyzes institutional data derived from an application of the IG will depend on the specific research questions that an institutional analyst seeks to answer. Extant IG research, including that featured in this special issue, exemplifies some of the myriad ways in which scholars are drawing on select IG syntactic components and IG data collected at different scales to pursue their research aims. In the following section, we briefly describe the papers featured in this special issue in relation to a broader set of evolving trends in IG research.

Evolving Directions in Institutional Grammar Research

We begin this section with an overview of the four articles included in this special issue.

Chen et al. report on a new application of the IG in which they use a semi-automated approach to study public policy change in the legislation of shale oil and gas development in six U.S. states. From 2007 to 2017, the team assessed the change in 105 legislative bills between the time the bills were introduced and the time they were adopted. In contrast to the prevailing IG approaches mentioned in the previous section, this study used an entire legislative bill as the basic unit of analysis instead of an institutional statement. This facilitated the semi-automated extraction of selected IG syntactic components from the policy texts, which were then categorized by domain-relevant terms. Specifically, *Aims* were extracted to identify both actions and proposed actions as indicators of rules. Objects were divided into inanimate and animate and classified as indicators of either issue areas (inanimate Objects) or actors (animate Objects). In combination, the IG coding of Aims and Objects within entire policy texts focused on the broad identification of the presence of certain actions and objects instead of a more detailed identification of individual actions and objects. Additionally, the research team captured the deontics present within each legislative bill as an indicator of legislative stringency.

The goals of the study were three-fold. First, to identify changes in policy composition in proposed and enacted bills based on the configuration of Ostrom's rule types (e.g., payoff, boundary rules), legislative stringency (e.g. required, permitted, or prohibited actions), issue areas (i.e., topical targets of policy rules, e.g., infrastructure, environment, and health), and the diversity of actors involved in each policy. The study found that based on overall averages across states, changes in the legislative content of bills from inception to adoption reflected an expansion rather than a contraction of IG components. This included a significant increase in the number of government actors involved in the policies, as well as an expansion of the topics addressed in all 105 bills passed in the six states during the study period. These findings seem counterintuitive to theory, which suggests that the tendency to negotiate competing interests leads to fewer rather than more institutional components. The study also revealed other dynamics between bill inception and adoption, such as an increase in the mandatory actions in politically moderate states, while the number of mandatory actions decreased or remained the same in politically conservative states, as well as differences in the composition, type, and amount of change in IG components from initial to final bill versions.

Perez-Ibarra et al. address an existing gap in the application of the IG to social conventions such as informal rules. The research focuses on analyzing the impact over time of government policy, social, and environmental changes on institutional adaptation in the context of informal rules used by farmers in self-organized, small-scale crop-livestock systems in a semi-arid region of Spain. The team hypothesized that greater institutional diversity leads to more sustainable use of shared natural resources. Since the rules were not written down, the authors interviewed farmers to identify and document them. The interview transcripts were subsequently analyzed using the IAD and IG to identify rules, norms, and shared strategies, as well as institutional rule types and their configurations. The team used a three-pronged approach in which they first extracted institutional statements from the interview transcripts that specify required, permitted, and forbidden actions. Treating institutional statements as the focal unit of analysis, they categorized institutional statements by rule type to understand the prevalence of different types of rules. They also used a syntactic coding of institutional statements, delineating statements as strategies, norms, or rules.[9] Finally, they proposed a summary of syntactic components found in institutional statements comprising institutions from different regions.

Among the article's key findings are that community size, resource size, and socio-demographic changes all influence institutional design. Regarding the application of the IG specifically, the authors report that collecting institutional statements through interviews allowed for flexibility in communicating with farmers and capturing institutional diversity. At the same time, the authors had to construct institutional statements from interviewees' oral communications which were not readily classifiable as strategies, norms, and rules.

Deslatte et al. apply the IG alongside the Coupled Infrastructure Systems (CIS) framework (Anderies et al., 2016) to assess the design of institutions and their impact on system robust-

9 — In the original IG, Crawford and Ostrom distinguished between institutional statements of shared strategy, norm, and rule types based on the presence of specific syntactic components that essentially conveyed the varying degrees of behavioral prescription and enforcement conveyed within statements. According to Crawford and Ostrom, institutional statements of the shared strategy type contain Attributes, Aims, and Conditions (reconceptualized in the Institutional Grammar 2.0 as Context, inclusive of Activation conditions and Execution constraints,). Institutional statements of the norm type contain Attributes, Aims, Conditions, and Deontics. Institutional statements of the rule type contain Attributes, Aims, Conditions, Deontics, and Or elses. Objects was a syntactic component subsequently added by Siddiki et al. (2011) and is therefore not referenced in Crawford and Ostrom's syntactic component-based classification of institutional statements as strategies, norms, and rules.

ness in the governance of water utility investments in Phoenix, Arizona. Specifically, the authors use the IG to analyze the formal institutions that govern water utility investment, and then connect the institutional statements extracted from them through network diagrams that map the pathways of information flow in certain situations. Finally, they incorporate the data collected through key informant interviews, participant observation, public records, and administrative data into a process tracing exercise through which they seek to evaluate how institutions influence actual rate case decisions and the resulting policy changes. Deslatte et al. are particularly interested in characterizing the institutional voids and dependencies that exist within governing institutions and the impact of both on decision making.

Their manuscript contributes to extant IG research through its unique mixed-methods approach which supports understanding the link between institutional design features and institutional adaptation in practice. Among the team's key findings is that institutional voids in the study context facilitate the incorporation of diverse views and information. Deslatte et al. also find that actors fill institutional design gaps. In their specific case, they report that "actors holding institutionally defined positions worked across both [institutional] dependencies and voids to assess and augment information on a climate-related threat, update prior predictions, and frame a rationale for a posterior CIS [coupled infrastructure system] investment determination." (Deslatte, 2022, p. 19).

Siddiki and Frantz use IG-coded regulations governing the organic farming industry in the United States alongside survey and interview data to design an agent-based model that evaluates how farmer compliance changes under different institutional scenarios. The IG coding is used to construct the decision making constraints that agents face in different regulatory decision making situations, while the survey and interview data are used to endow agents with attributes that influence how they respond to different decision making constraints. Drawing on the different data sources in the modeling exercise, Siddiki and Frantz specifically investigate how variation in the social value orientations (i.e., individualistic, mimetic, prosocial) of farmers participating in the U.S. voluntary organic farming regulatory context shapes aggregate emergent compliance outcomes and compliance trends. Their analysis explores the effects of two experimental conditions: (i) variation in the composition of regulated agents in terms of their social value orientations; and (ii) variation in the frequency of monitoring and intensity of sanctioning, aggregate and sub-group compliance.

Siddiki and Frantz's study contributes to a long line of research that seeks to integrate the IG and computational modeling, where the IG is used either in the up-front parameterization of the agent-based model or in the post-hoc characterization of institutions (operationalized in terms of behavioral regularities) that emerge through the modeling exercise. Among Siddiki and Frantz's key findings is that the composition of the farmer agents can have a decisive effect on the regulatory environment, specifically as it relates to the levels of compliance observed. Their work also suggests the need for more careful exploration of the behavioral assumptions associated with different types of agents, particularly mimetic agents.

Engagement of Computational Methods in Institutional Data Extraction and Analysis

Two of the articles featured in this special issue – Chen et al. (2023) and Siddiki and Frantz (2023) – employ computational methods to support their IG research. Chen et al.'s study entails the use of computational methods in the classification of institutional (i.e., policy) texts. Siddiki and Frantz's study involves the use of computational approaches in the analysis of simulated behavior within institutional constraints derived from a coding of real-world institutions (i.e., policy text). The two uses of computational methods exemplified in these articles

represent the prevailing use of computational methods within existing IG research in general (Rice et al., 2021; Smajgl, 2008; Frantz & Siddiki, 2022). The pairing of the IG with agent-based modeling is not new. Indeed, the first journal article following Crawford and Ostrom's in 1995 involved the application of the IG within an agent-based modeling exercise (Smajgl, 2008). Scholars have continued to build on this initial work.

Key features of the IG that make it particularly well-suited to agent-based modeling include the following. First, institutional data are captured along categories that conveniently map to agent-based model parameters. For example, referencing the syntactic components of regulative institutional statements, Attributes information conveys the array of agents to be included within a model. Coupled Aim, Deontic, and Context information conveys the action sets associated with different types of agents (Attributes), the degree of behavioral discretion associated with those actions, and the specific situations in which different actions are required, allowed, or forbidden, respectively. Finally, Or else information not only conveys information about the payoffs associated with specific actions for particular agents, it also communicates agent roles (e.g., monitor, enforcer) that should be captured within a model. As with the syntactic components of regulative statements, the syntactic components associated with constitutive institutional statements also map to important model parameters, including systemic artifacts (i.e., Constituted Entities) upon or through which agents individually and collectively act.

Another feature of the IG that promotes its convenient integration with agent-based modeling is its foundation in game theory. As noted above, the IG was originally developed to aid in the delineation of different types of institutional statements that convey varying degrees of prescriptiveness and enforcement in instances of behavioral noncompliance. This differentiation allowed for the study of strategic collective action in the context of different forms of institutional constraints, in particular the role of behavioral discretion and enforcement mechanisms in informing it. Agent-based modeling, also grounded in a game theoretic approach, allows for the assessment of games at scale (i.e., the analysis of multiple games occurring among a greater number of players within a broader set of institutional constraints) while also allowing agents to be imbued with more sophisticated decision making models (Janssen, 2005).

The other dominant use of computational methods in extant IG research involves the application of computational text analysis tools to the extraction and/or classification of institutional (i.e., policy) texts (Heikkila & Weible, 2018; Rice et al., 2021; Vannoni, 2022). In general, these approaches are designed to support IG coding at scale. The approaches published to date have successfully done this. However, these approaches are tailored to the IG in different ways. For example, the approach employed in the Chen et al. study uses an "off-the-shelf" software that extracts action, object, and prescriptive operator words which are then categorized based on a pre-defined study domain-specific dictionary. Semantically, while these words are generally consistent with Aims, Objects, and Deontics, they do not exactly map to these IG components because the authors do not take into account where the words appear in a given statement. Turning to research beyond this special issue, Vannoni (2022) also uses an off-the-shelf parser to code text according to English grammar syntax, and maps words associated with English grammar components to IG grammar components. While the institutional syntax is not exactly akin to a linguistic syntax, given the behavioral and social theory that underlies its syntactic components, Vannoni demonstrates a reasonable mapping of components across the two forms of syntax. Rice et al. (2021) offer the most tailored approach to the IG coding of policy texts in particular, as their approach is based on a machine-learning exercise that relies

specifically on IG-coded texts.

The computational approaches being engaged in IG research, within and beyond this special issue, suggest an enduring trend that holds promise in supporting the development of new insights into institutional design and dynamics.

Coupling the Institutional Grammar and Network Analysis in the Study of Institutional Design

As part of their study, Deslatte et al. pair an IG coding of institutional (again, policy) texts with network analysis methods. Their application showcases the utility of network methods in visualizing patterns in institutional design and in particular patterns that reflect how institutional statements are configured (or not) along syntactic components. Their particular application interprets the patterns revealed by network visualizations in terms of institutional voids and dependencies, which in effect capture the absence of institutional guidance on particular subjects or the contexts (conditions and qualifiers) of actions conveyed in institutional statements. The methodological and conceptual approach used by Deslatte et al. has been applied in other contexts by other institutional scholars interested in institutional network analysis (Mesdaghi et al., 2022). Other scholars have also coupled the IG and network methods to understand institutional patterns, although in different ways. Olivier (2019) has developed an approach for analyzing networks of prescribed interactions (NPIs). Olivier's NPI approach is relational as it focuses on the inclusion of constructed networks statements that mandate positive relations (i.e., those that must or may occur) and link animate actors (Olivier, 2019, p. 169). Still other applications that couple IG with network methods simply seek to show how statements that govern particular situations addressed in institutional design are configured (Frantz and Siddiki, 2022).

But while there are differences in the specific ways in which IG data are incorporated into network analyses, underlying all studies pursuing this pairing is a recognition of the value of understanding institutional statements in configural terms. Importantly, this research conveys that even though institutional statements are the focal unit of analysis in IG research, understanding institutional dynamics requires consideration of how institutional statements work together to govern social systems. Furthermore, analyzing individual statements in isolation threatens an incomplete understanding of the complex ways in which individuals regulate behavior within a governed setting, or define features of those systems. It also compromises the ability to discern how changes in certain statements may propel, prohibit, or disconnect others.

The reality that institutional statements work in constellation to govern systems, coupled with the faculty to support connectivity among statements across multiple components that relay relational, topical, and contextual linkages, suggest that the pairing of the IG with network methods will be of enduring interest among IG scholars.

Application of the Institutional Grammar to the Study of the Institutions-in-Use

Perez-Ibarra et al.'s application of the IG focuses on capturing institutional statements conveyed in farmers' oral communications regarding their current and evolving farming practices. The authors rely on the extraction of institutional statements from interview transcript data. Perez-Ibarra et al. are one of the few research teams to publish research that applies the IG to the study of institutions-in-use (Watkins & Westphal, 2016). This research makes an important contribution to IG scholarship in that it addresses an outstanding limitation of much IG scholarship, namely "top-down" depictions of institutional design that, while providing valuable insights into what is intended to happen in governed settings, have tended not to provide

a complementary understanding of the manifest behavior therein.

Furthermore, it is important to recognize that despite a relative dearth in IG applications to the study of institutions-in-use, there is nothing inherent in the approach that limits its conceptual applicability for this purpose. Rather, the limited application is largely due to operational challenges, as we discuss in more detail later in this paper.

Exploration of Policy Design Dynamics using the Institutional Grammar

Chen et al.'s comparative study of the design of shale oil and gas regulation contributes to a broad base of IG research that specifically applies the IG toward a robust understanding of public policy design (Dunlop et al., 2021; Heikkila & Weible, 2018; Siddiki et al., 2011). Specifically, they add to this body of scholarship by examining institutional dynamics and how policy designs change from the time they are first introduced to the time they are adopted. In doing so, Chen et al. respond to recent calls from policy design scholars, particularly those who conceptualize policy design in terms of policy content, to move beyond cross-sectional, descriptive assessments of policy content (Siddiki & Curley, 2022). Underlying this call is a push to improve understanding of the causes, consequences, and trajectories of policy designs as they are vetted, adopted, diffused, and otherwise experienced in the policy process. In recent years, policy scholars employing the IG have demonstrated how empirical assessments of policy design and related phenomena can be grounded in theories of the public policy process (Carter et al., 2016; Dunlop et al., 2021; Lien et al., 2018). Beyond showcasing the utility of grounding IG-based assessments of policy design in theories and frameworks of the policy process, these studies further reinforce the conceptual and theoretical versatility of the IG. Namely, they show how the IG can be used to operationalize a wide range of concepts associated with prevailing theories used by public policy scholars. This evolving direction in IG research thus provides a valuable complement to others presented in this section, which have largely addressed methodological advances in IG research and the wide range of analytical approaches with which the IG is compatible.

The following section will build on the discussions of evolving directions in IG research by discussing in more detail specific analytical considerations and related trade-offs.

Evolving Directions in IG Research: Considerations and Trade-Offs

The evolving directions of IG research described in the previous section reinforce the conceptual and methodological versatility of the IG. They also seem to promise increased diversity in IG applications, that is, diversity in how the IG is used to understand a wide range of institutional phenomena. However, as the papers included in this special issue have shown, the versatility and utility of IG research also comes with conceptual and methodological limitations and trade-offs that are worth considering before engaging in a particular approach. This section aims to elucidate some of these based on the context of the IG research presented in the special issue.

Balancing Complexity and Scale

Scholars who employ the IG at the institutional statement level, either through manual coding or computational methods, face an inherent tradeoff in the nuance with which institutional statement information can be captured. Manual coding helps to capture the nuance and complexity embedded in institutional statements. When engaging in manual coding of institutional language, the institutional analyst can account for idiosyncrasies in the construction or communication of language in ways that computers may not be able to. More importantly,

humans are able to draw out implicit information that is not overtly conveyed in institutional statements but is otherwise important to fully understanding how they are intended to govern behavior or systems. At the same time, manual IG coding is rather time intensive and involves subjective interpretations of institutional language that may result in coding inconsistencies. This challenge can be partly overcome with detailed coding guidelines and intercoder reliability testing to mitigate these issues (Carey & Gelaude, 2008).

The use of computational methods in data collection (i.e., institutional coding) supports larger scale institutional coding and analysis. The ability to capture institutional information at scale is important if the institutional analyst intends to use quantitative methods in the downstream analysis of institutional data. It also enables comparative assessments of institutions over time as well as the study of institutional change, since such applications typically require coding of larger volumes of information than single-case or cross-sectional analysis of institutions. At the same time, computational methods are limited in their ability to account for textual particularities and to capture implicit information and how it configures with the overt. Furthermore, the effectiveness of computational methods in generating valid coding of institutional information can be limited by whether the institutional analyst is using an IG-tailored computational text analysis package as well as by the quality of the data on which such packages are trained. Rather than intercoder reliability issues, computational IG coding is prone to "garbage in, garbage out" transgressions, where errors in data input or instruction result in problematic outputs (Babbage, 1864; Mellin, 1957), due in part to the need to reformulate or restructure institutional information.

The use of computational methods on the analysis side, for example through the use of agent-based modeling approaches, raises a different set of issues. For example, for agent based modeling, institutional directives relayed in institutional statements must be reformulated in algorithmic terms. The IG 2.0 offers an approach to address the needs of manual and computational IG coders at the "front end" by providing guidance on how to code institutional statements initially to serve as meaningful inputs to agent-based modeling and to structure manual coding efforts.

Unit of analysis used in research

As Chen et al.'s research has shown, there is also a separate, though not unrelated, question of what unit of analysis an analyst will focus on in their analysis. The IG treats institutional statements as the primary unit of analysis. Starting with institutional statements as the focal units of analysis, the IG 2.0 provides a rigorous method to extract syntactic components of which statements are composed in order to better understand stasis or change among them over time. Chen et al.'s use of an entire policy as the primary unit of analysis offers another opportunity to explore institutional design patterns at scale. Their approach, which also leverages computational methods in the extraction of institutional data, presents advantages for institutional analysts seeking to analyze large quantities of policy text.

At the same time, it precludes the ability to contextualize syntactic information to fully understand the particular ways in which institutional directives are intended to govern behavior and social systems more broadly. In the context of studying policy change specifically, the noted trade-off is not so much a loss of validity as it is a compromise between foregoing understanding of the substantive details of policy change in favor of gaining a better understanding of the broad, general policy changes that occur over time. Ultimately, the usefulness of either approach, in light of the noted trade-offs, depends on the research questions that the institutional analyst seeks to answer and the concomitant data needs. And, any gaps in understanding can be addressed, for example, by coupling policy-level coding with additional coding of relevant policy segments at the statement or syntax level.

Emphasizing Design or Behavior (or Both)

The assessment of institutions using the IG has overwhelmingly focused on structural depictions of institutions, with an emphasis on what institutions are intended to do or how they are intended to govern behavior. Supporting analysis has often relied on descriptive summaries of IG-coded institutions. However, computational and network methods have also been used to depict institutional structure and design. Nevertheless, when analyzing formal institutions using the IG, the structure of the formal institution can be clearly identified. The analytical black box here is human behavior and interpretation, i.e., the institutional analysis of formal institutions involves deducing how formal IG-coded institutional design may affect policy operationalization and implementation. The challenge for reliable data lies not so much in the IG coding itself but in the examination of its effects on policy outcomes.

At the same time, as the study by Perez Ibarra et al. shows, using the IG to capture institutions-in-use involves more subjectivity in the interpretation of the institutions. Here, the analytical black box represents the set of formal rules used to govern a system. Identifying these involves deducing the formal rule structure from informal reports of rules-in-use made by those who use the rules. While the IG is well-suited to this task, the subjectivity in the interpretation of informal institutions poses a direct challenge to the reliability of IG-coding, even if the coding is substantively and contextually valid. To date, there is no protocol for analyzing institutions-in-use using the IG. Thus, as there is growing interest in applying the IG to the study of institutions-in-use, it is also important to consider that there are currently tradeoffs between reliability and validity.

Supporting Adaptability and Reliability in IG Applications

Applications of the IG may involve the selective use of IG features. Indeed, this is one of the explicit capabilities of the Institutional Grammar 2.0. And it may also be a feature related to methodological choices. Some approaches, particularly those that are focused on capturing syntactic information at scale or determining the prescriptiveness of policies, may lend themselves to particularly selective or limited feature extraction. Other methods, such as agent-based modeling, may require extensive feature selection.

However, selective application of the IG also means that the IG is applied differently. While this may support versatile and analytically tailored applications, it also limits the applications that support the development of generalizable insights. For a burgeoning field, such generalizability is increasingly important as scholars and practitioners seek to better understand the structure and change of policies over time to assess their impact on policy implementation, operationalization, and behavior change.

Ultimately, we argue that what is most beneficial to the comparability, reliability, and rigorous application of the IG is the selective use of IG features, rather than an altered understanding of syntactic components or other central units of analysis that bear specific conceptual meaning within the IG.

Balancing the versatility of IG applications with the overarching need for comparability, reliability, and rigor calls for a set of coding standards that support specific applications of the IG that rely on the selective use of features and coding at different levels of expressiveness, while at the same time conveying best practices that support consistent application of the IG. Attempts to develop these standards and best practices for IG coding have recently been undertaken by Frantz and Siddiki (2022) and others associated with an international research network convening institutional analysts using the IG, called the Institutional Grammar Re-

search Initiative. The next steps for this community may be to (i) provide syntax updates for IG 2.0; (ii) construct a database that organizes institutions by features toward the development of institutional taxonomies; and (iii) create a publicly accessible library of coded policies.

Conclusion

Interest in the IG continues to grow, as evidenced by its increasing use within and across disciplines. The IG is generalizable and versatile, making it attractive to scholars across disciplines, or even to those from the same discipline, who ground their institutional analyses in different conceptual and methodological approaches. The articles in this special issue showcase different uses of the IG but also highlight the types of applications of the IG that are becoming increasingly popular. This introduction to the special issue presents these articles and contextualizes them within broader IG research trends. It also presents the tradeoffs associated with different uses of the IG that scholars seeking to contribute to or build on these trends are likely to encounter. Taken together, these articles are intended to support ongoing IG and new IG research efforts and to provide a glimpse of the future potential of IG research.

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