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Editors:

Prof. Dr. Miomir Stanković and Prof. Dr. Vesna Nikolić

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Nature Prefers Sustainable Structures: Implications for Large-Scale Political Self-Organization

Jacob C.W. Billings¹

¹Independent Researcher, USA

¹billings.jacob@gmail.com

Abstract—At this moment in history, humanity has the unique capability to hold a conversation, with all of her members, in real time. While we (currently) tend to utilize global telecommunications technologies to affect directed information exchange between a “rich-club” minority and a lay majority; it is within our capability to establish an equitable “global public-sphere”, wherein we might decide, collectively, what constitutes an intersubjective version of “the good”. The following paper formalizes the assertion that analyzing the semantic content of public-sphere conversation can reveal existing, as well as improvements to, humanity’s organizational norms.

Keywords - Managing Knowledge for Global and Collaborative Innovations, Big data and knowledge extraction, Cognitive knowledge, Global Public Sphere

I. INTRODUCTION

“Action, the only activity that goes on directly between men without the intermediary of things or matter, corresponds to the human condition of plurality” - Arendt [1].

“Since all knowledge and every choice is directed toward some good, let us discuss what is in our view the aim of politics, i.e., the highest good attainable by action” - Aristotle [2].

Several global issues face humanity. The increasing trend towards global pandemics, including COVID-19, forces us to restructure our societal norms. Anthropogenic climate change compels us to reconfigure our economies. While chronic poverty, war, and famine serve as ongoing reminders that, “until we are all free, we

are none of us free,” in the face of these global issues, how can humanity move towards more sustainable ways of life? My approach to this humanistic question provides a democratic answer, one rooted in the biology of complex self-assembly.

II. NATURE SEEKING ALPHA

According to the Second law of Thermodynamics: the configuration of mass/energy in the universe tends towards disorder. The fact of the eventual entropic death of the universe begs the question: “How did complex systems, like people and politics, get here in the first place?” The omni-directional expansion of the universe requires that complex systems emerged through a bit of circumstantial luck: entropy was at a minimum at the time of the “Big Bang.” But, even while the dawn of time was unexpectedly information-rich (low-entropy), the total energy of the universe, crammed together into a singularity, made things too hot to sustain much patterned differentiation. Large scale systems, like galaxies, and fragile complexes like ecosystems and politics, were unable to stabilize until the universe expanded and cooled. Furthermore, because the distribution of matter and energy in the universe was never homogeneous everywhere, inclusions of thermodynamic disequilibria allowed systems to locally self-assemble along the energy gradient of free expansion in space-time.

Formally, Prigogine defines the process of natural self-assembly as the minimization of the local rate of entropy production [3,4]. Put another way: at any point in time, natural systems may either thermally randomize, or self-

assemble, into patterned structures that channel thermodynamic gradients into useful work, like internal homeostasis, and population growth. Aristotle reminds us that the self-assembly of societies into disorder-minimizing structures is called “politics” [2]. It is convenient to refer to “the good” - that goal for which all self-assembled systems perform work - using the variable α .

III. POLITICS IN THE ABSTRACT

Arendt [1] characterizes politics as the essential definition of a people. To better address the pluralistic aspects of politics, I specify populations P as composed of individuals, p . Moreover, I refer to groups of people of size n as P_n .

Of course, all politics is local. Furthermore, every person in the population, $p \in P$, performs work to gain a subjectively defined $\alpha | p$. To better conceptualize the individualistic aspect of politics, I define the equation:

$$x(p) = \alpha | p - \varepsilon. \quad (1)$$

where $x(p)$ is work performed by an p , and where ε indicates the generation of entropy. To define a group-level “good” $\alpha | P_n$, we have the union:

$$x(P_n) = \bigcup_{p \in P_n} x(p) = \alpha | P_n - \varepsilon. \quad (2)$$

Focusing on work as a means to understand politics offers a useful frame of reference. For instance, the upper limit on any group size $|P_n|$ is established by the physical limits on $x(P_n)$ to connect people. As an example, for any P_n utilizing exclusively oral communication, $|P_n|$ is generally limited to the few hundred persons of a tribe [5]. Inscribed communication enabled $|P_n|$ to expand to the size of city-states. Meanwhile, the capitalization of printing presses is believed to have ushered in the age of the modern nation-state [6].

IV. OF POLITICAL NETWORKS

If politics is described in terms of a graph, G , where the p are nodes and the $x(p)$ constitute directed edges, then the α are the apparent structures that emerge among the set of $P_{0 \leq n \leq N}$

nodes via the set of $x(P_n)$ edges. By way of example, consider Locke’s “state of nature”. In this condition, people seek α through $x(P_n)$ that are uniformly accessible to all people, i.e., through spoken language [7,8]. Quantitatively, this state corresponds to a G , in which there exists a relatively uniform count of the number and the type of $x(p)$ edges stemming from any node, p . By contrast, some novel x , like printing presses, possess a high utility, yet low availability. Such technologies encourage P to organize around hubs in which, otherwise separate, P_n communicate with one another via those few p , who have access to the novel x . Quantitatively, these kinds of networks are termed “small-world” networks. Hubs of small-world networks are defined as having many more $x(p)$ edges than expected from the average [9].

While the modern constitutional republic emerged around the constraints of high-utility/low-availability forms of x [10], this style of politics is problematic because information is always lost when filtered through communication bottlenecks. Furthermore, well-connected hubs in P may form what’s known as a “rich club” network, wherein the hubs preferentially connect to one another [11]. Consolidation of political power within a rich club tends to widen differences in $\alpha | p$ between richly and poorly connected $p \in P_n$ [12].

V. EVOLVING POLITICAL DYNAMICS

Fortunately, many of humanity’s current communications technologies boast high-utility and high-availability. For instance, approximately half of the global population has regular access to the internet [13]. And that number is only set to increase, as cellular and satellite relays eventually connect all of us into a global public sphere [14]. This infrastructure provides the necessary backbone through which we might finally just ask one another to define a mutually beneficial $\alpha | P$ towards which we all might work.

One of the key tools used to handle massive quantities of unstructured data is the “knowledge database” K_B , composed of elementary “subject predicate object” statements [15]. This technology supports popular services, such as search, recommendation, and text completion. Computationally, statements are saved as triples,

containing an emitter, k_e , a receiver, k_r , as well as a directed predicate, $y(k_e, k_r)$. Given this conception, ensembles of triples form a “knowledge graph”, K_G , in which nodes are an $k \in K$, and edges are an $y \in Y$. The set $[K, Y]$ is termed an “ontology”.

Much as the conception of politics in terms of G presents the observation of political realities, $\alpha | G$; the conception of knowledge (about G) in terms of K permits the elucidation of political ideals, $\beta | K$. Interestingly, for the proper subset $P \subset K$, there is the relationship $\alpha | P \in \beta | K$ [16]. Put another way, a thorough-going transcription of human knowledge contains, within it, a population-level sense of “the good”. Moreover, machine-learning applied to an accessible (and complete) digital public sphere can drive the discovery of optimal political assemblies.

A facile example of optimizing political assemblies simply observes latent political groups, $P_n \in P$, who emerge as clusters in K , as connected via shared edges, y . A slightly more complicated clustering follows from the methods of [17], wherein P_n are derived from the principal components of an adjacency matrix formed by the many y of K .

Furthermore, a clustering over the nodes in (graphs such as) K can be seen as an analysis of topological objects in dimension zero [18]. Higher order topological features describe, for example, directed paths - chains of logical syllogisms - in dimension 1. It is also possible to reformulate K in a way that is amenable to Topological Data Analysis (TDA). Typically, TDA imposes a filtration over weighted edges to detect stable topological features. One way to reformulate K into a weighted single-layer graph is by assigning a single number to the multiple edges of y that connect pairs of emitter and receiver nodes. Then, filtering out weaker and weaker links, it is possible to visualize, for instance, the most stable link(s) connecting two P_n groups who hold opposing views on a topic. By tuning how K is collapsed into a single layer network through, e.g., selectively adding/ablating y w.r.t. semantic objects of interest, one may actively discern how contingent are structures in K w.r.t. select semantic objects.

A wide range of such machine-learning approaches are available to elucidate the intrinsic structure of social networks, $\beta | K$, so-as-to elucidate more optimal political unions, $\alpha | G$. Such approaches constitute a ripe domain wherein we might encourage the evolution of our political dynamics.

VI. DISCUSSION AND FUTURE DIRECTIONS

It is clear that, possessed of a will to do thusly, humanity could - in mere weeks - recruit off-the-shelf technologies to connect nearly every man woman and child into a global conversation. From a systems-level perspective, provisioning more efficient methods of internal communications improves the capacity for bodies to maintain homeodynamic stability over large scales. From a sociological perspective, provisioning a global public sphere to discuss intersubjective values lays the foundation for political decisions that recruit our collective capabilities to meet and exceed our needs.

However, the will to act as a well-functioning global civil society currently eludes us. This impasse imposes upon the research community an obligation to better organize extant (digital) conversations to reify, for any lay observer, the existence of a nescient collective will.

The present manuscript details how the format of the knowledge database may be recruited to organize free-form semantic text in a way that visualizes likely collective sentiments. In the immediate future, researchers could work along two paths that: 1) assemble and share an expanding knowledge database of intersubjective values; and 2) analyze the associated knowledge graph to visualize potential areas of collective accord. It would be very interesting to see the emergence of an interdisciplinary empirical political science that directly queries humanity towards the elucidation of political norms.

VII. CONCLUSIONS

Being itself a natural system, humanity will naturally prefer to evolve towards greater and greater homeodynamic stability. But while the physical process of spontaneous structural self-assembly is relatively slow and uncertain, we can actively take part in humanity’s ongoing efforts to establish healthy, sustainable, and productive civil-society by building infrastructure in support of a vibrant global public sphere. Indeed, humanity is in a unique position to sustain, in real

time, a dialogue that equally includes all of her members. Certainly “perfection” and “eutopia” are mythical goals – no system holds the knowledge of, and the capacity to negotiate all potential issues. None-the-less, humanity maximizes her knowledge about the issues that might exist, and she increases her wellspring of creative solutions for those issues, by assembling a union of perspectives from all persons. Drawing political decisions from a more complete space of global perspectives should afford many improvements to each individual’s quality of life.

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