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Nodalism

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Abstract

This paper focuses on the use of the trope “x is like a node in a network” in works of critical theory, and shows it to be an indicator of a larger discourse, nodalism, that has its origins in 19th century neuroscience and Associationist models of mind. This discourse provides a relationship between structure and function that is used in attempts to model thought in technological devices, as in the work of Vannevar Bush and JCR Licklider. These technological instantiations of nodalism in turn provide the material basis for the expansion of the discourse into other domains, such as politics and economics. The paper concludes by considering the potential positive and negative consequence of nodalism, and the role of the digitial humanities in the reproduction of this discourse.

At the end of the first decade of the 21st century we find that our conception of the world has taken on a particular form, one of nodes situated in networks. Our language is filled with references to the World Wide Web, Internet, social networking, discourse networks, neural networks; all aspects of life, from the structure of the brain, to the thoughts it thinks, to the social and economic life of its individual owner, are described in terms of the node or knot and its connection or association with other nodes and knots. 1

Faced with so many examples of the nodalistic trope across a range of domains – neuroscience, computer science, sociology, economics, and critical theory, to name just a few – one might begin to suspect that this is something more than just simple coincidence; one might suspect, in fact, that the nodalistic trope is a significant structural metaphor in contemporary thought. But the nodalistic trope is more than just a figure of speech that has spontaneously arisen in contemporary usage – it has a history that involves the convergence of concepts from neuroscience, mathematics, and psychology that eventually find material expression in information technology, which then provides a material basis for the expansion of the trope into a discourse, nodalism, that extends its influence well beyond its point of origin. This discourse has emerged over a period of more than one hundred years, and now, in the beginning of the 21st century, has arguably become a dominant discourse within Western culture. It is obviously well beyond the scope of this paper to chart the entire development of this discourse, or to consider the full ramifications of its consequences. Instead, I want to follow its development along one path – from neuroscience through psychology to specific attempts to model the process of thought in information technology. Examining this process, even if only partially, is useful because, as practitioners and theorists within the digital humanities, we are all involved in the process of reproducing this discourse and its technological manifestations at some level. By looking at its history and implications, we may better understand what it is that we are bringing forth. 2

The Node as Trope and Discourse

The term “node” first appears in print, according to the *Oxford English Dictionary*, toward the end of the 16th Century, and for several hundred years refers to objects of an organic nature, such as knots in wood (which the German equivalent, *Knotenpunkt*, retains) outcroppings of stone, and bony formations. In these usages, there is no indication that the node is part of any larger network of other nodes, though in more poetic usages, it can also be a synonym for an entanglement or “knotty” problem. It isn't until the late 19th century that the node begins to be seen as something located within a network of other nodes. This is a result of its incorporation as a figure within two different disciplines: 3

the study of graphs and graph theory in mathematics (which will lead to Paul Baran's work on distributed communications [Baran 1964], social network analysis, and graph databases), and studies of brain structure in neuroscience. Though both of these disciplines contribute to the origin of the nodalistic trope, this paper will primarily focus on the connection to neuroscience, as this provides the conceptual underpinning for contemporary information technology such as the Internet and hypertext. Graph theory plays its role in contemporary information technology as well, as will be seen in the example of the Freebase graph database discussed in the conclusion of this paper, but the popular dissemination of the nodalistic trope owes much more to assumptions about brain structure and function than it does to mathematics.

The nodalistic trope can be simply described as a figure of speech that is used to portray an object or process in terms of the connection of discrete units by an open network system that has no hierarchical structure. Michel Foucault, for example, uses the nodalistic trope to describe the inter-textual nature of books in *The Archaeology of Knowledge*: 4

> The frontiers of a book are never clear-cut; beyond the title, the first lines, and the last full stop, beyond its internal configuration and its autonomous form, it is caught up in a system of references to other books, other texts, other sentences: it is a node within a network. [Foucault 1982, 23]

In a more contemporary example, Ian Bogost uses the nodalistic trope to describe his concept of unit operations in his book of the same name: “Unit operations articulate connections between nodes in networks: they build relations.” [Bogost 2006, 8]. A third, slightly more complex, variation is provided by Vilem Flusser, in which he formulates a model of the subject and society based on the figure of the knot:

> We must imagine a net of relations among human beings, an "intersubjective field of relations." The threads of this net should be seen as channels through which information flows. The threads knot themselves together provisionally and develop into what we call human subjects. The totality of the threads constitutes the concrete lifeworld, and the knots therein are abstract extrapolations. [Flusser 2005, 325]

The nodalistic trope has currency within popular parlance as well. In Baltimore, the local hacker space is called *The Baltimore Node*, implying that it is but one unit in a worldwide network, while the image of linked nodes is used by Facebook in its logo, and is invoked in the language of social networking sites like LinkedIn. 5

As these few examples show, the nodalistic trope appears today in a wide variety of contexts, and provides a conceptual model, as all metaphors do, for large, complex phenomena. Beyond its descriptive capabilities, the nodalistic trope also privileges certain concepts over others, which leads to the nodalistic discourse, or, more simply, what I call *nodalism*. For example, nodalism reduces phenomena to a topographic structure; it emphasizes the importance of links and connections and stigmatizes disconnectedness and solitude; it sees its objects of analysis as systems of units, though it may champion the emergent and the aleatory over closed systemicity and determination. As it is taken up within a discourse, the nodalistic trope is not just a descriptive metaphor, but a set of values and prescriptions that can be employed in the service of social and political thought. It can be argued that nodalism is at the heart of Post-Structuralism generally, in Deleuze and Guattari's rhizome, for example, or in Foucault's formulations of the operations of power, but it is explicitly championed by anarchists such as Hakim Bey in *The Temporary Autonomous Zone* in opposition to operations of State power. Bey describes, for example, his concept of *the Web* as facilitating the emergence of the Temporary Autonomous Zone: “Generally we'll use the term *Web* to refer to the alternate horizontal open structure of info-exchange, the non-hierarchic network, and reserve the term *counter-Net* to indicate clandestine illegal and rebellious use of *the Web*, including actual data-piracy and other forms of leeching off the Net itself.” [Bey 1991, 108], italics in original. In this quote Bey is building his concept of *the Web* directly from the functioning of the Internet, which brings up a final point about nodalism as a discourse, that it constantly refers back to technology, and representations generated by technology, as its material support. It can do this because the technology owes a substantial part of its own development to efforts to replicate the structure and function of the original nodal system, the human brain. 6

From Neurons to Nodes: Nodalism and the Mind

In *The Interpretation of Dreams*, Freud, in the section on the work of condensation, describes the two major elements from the “Dream of the Botanical Monograph”, the terms “botanical” and “monograph”, as “having found their way into the dream because they possessed copious contacts with the majority of the dream thoughts, that is to say they constituted ‘nodal points’ [*Knotenpunkte*] upon which a great number of dream thoughts converged…” [Freud 1965, 317]. It’s tempting to see an originating moment in Freud’s comparison of the dream element to a node, but here, Freud, still fresh from clinical work in the burgeoning field of neuroscience, is only applying to his analysis of dream thought an insight gained from discussion of the biological structure underlying it. 7

In his essay “The Psychology of the Neuron: Freud, Cajal, and Golgi”, Simo Koppe describes the late 19th century debates on the relationship between brain structure and thought, and relates them to Freud’s writings on the neuron and neuronal energies in *The Project for a Scientific Psychology*, written in 1895, five years before *The Interpretation of Dreams*. Thanks to improved microscopes and staining techniques, the major structures of the brain – the neuron or nerve cell, the axons, and the dendrites – had all been identified by the 1860s, with the neuron acquiring its name in 1891. Questions remained, however, about the function of these elements, particularly around the transmission of nerve impulses from one seemingly disconnected neuron to another. This led to two competing theories: the first, the “nerve net” theory, was championed by the Italian physician and neuroanatomical pioneer Camillo Golgi. This theory, as described by Koppe, held that “all nerve fibers in the entire nervous system form one unbroken nerve net” [Koppe 1983, 2]. The second, “neuron theory”, found its greatest proponent in Santiago Ramon y Cajal, a Spanish physician perhaps best known today for his detailed sketches of neuroanatomy. Neuron theory, now known as the Neuron Doctrine, “supposes that the processes carry out a specific physiological function – they receive impulses – that each nerve cell is isolated from other nerve cells, and that all nerve cells in principle are identical” [Koppe 1983, 4]. Modifications have been made to the neuron doctrine since the 1890s, but Koppe points out that, despite their disagreements over the specifics of physiology, Golgi and Cajal were in agreement on a very fundamental concept: 8

> The important thing . . . is the psychological assumptions in the two theories and not the neuro-histological specialties. The general scientific climate was dominated by mechanistic reductionism, and therefore nearly every discussion within neuroanatomy included some direct assumptions about the higher psychological functions. To explain the psychological function of the human subject within neurophysiology or neuroanatomy was a troublesome goal of that period. The interesting point is that Golgi and Cajal explicitly defend two different psychological assumptions – that their differences in reference to the microstructure of the nervous system are parallel to their statements about the neuroanatomical basis of the higher psychological functions of human subjects. They both shared the mechanistic opinion of the psychological functions’ reducibility to the nervous system, but they did not agree on the way this was supposed to be done. [Koppe 1983, 3]

Koppe goes on to describe Cajal’s position in regard to the relation between thought and structure: “He stated that the higher psychological functions (thinking, perception, memory) have to be due to the relations between the nerve cells and to hypothetical chemical devices.” [Koppe 1983, 4] Regardless of whether one follows Golgi’s nerve net theory and its attendant consequences for cortical localization, or Cajal’s theory and the reduction of thought to relations between individual cells, both see higher psychological functions as resulting from interaction among structures of the brain.

In these early theorizations of the relationship between neuroanatomy and thought we can see the formation of a basic assumption later underlying the nodalistic trope: that thought is the result of interaction between units or nodes, in this case neurons or areas of the brain, and that it is reducible to these structural components. Freud’s use of the *Knotenpunkte* in *The Interpretation of Dreams* can thus be seen as an attempt to relate a thought process to an anatomical structure. Before moving on to a closer examination of Freud, there is one further point that Koppe makes, in regard to the relation between theory, in this case Associationism, and structure, that should be brought out. 9

Koppe provides a brief outline of Associationism as it develops from empiricist philosophy in the 17th and 18th centuries up until the 19th century, but states that, throughout its modifications: 10

> [A] decisive argument was maintained: reduction of the mental activities to impression units (also

called atomism). . . .

> Perception, memory, and thinking are different ideational or representational processes. Ideas are activated in perception, reproduced in the active memory and connected with other ideas in thinking. The individual idea consists of a number of associated elements which all have a sensory origin. The elements of an idea are identical with the impression units and all ideas consist exclusively of more or less complicated connections of impression units. [Koppe 1983, 5]

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Koppe then makes the connection between Associationism, cortical localization theory, and neuron theory: 11

> . . . neuron theory in itself became the seal of the alliance between associationism and the localisationists. As Cajal formulated it: “the impression unit is stored up in one neuron” 1895, p.368 . . . . Here we have the material correlate of sense impressions – one unit, one neuron, and each neuron connected with others to form ideas via the association fibers. [Koppe 1983, 6]

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If we now turn back to Freud’s model of dream thought and its underlying structure, we can see that is not as eccentric as it might seem on first reading, that it is, in fact, an attempt to explain dream thought in a matter that is perfectly consistent with Associationist and neuron theory models that prevailed in neuroscience at the time. He begins by asserting that the elements of dream thought have their origin in sense impressions made during the day, such as seeing a “botanical monograph” in a shop window: these sense impressions are then stored in individual neurons, and dream thought is the result of these neurons finding connection to other neurons that contain similar impressions. The process and product of dream thought is thus co-extensive with neurological structures: function (thought) and structure (neurons) are brought together in the node. Freud’s innovation is in finding a figure, the node, which can function in both the biological and linguistic domain, uniting the two: the node is both a figurative representation and a biological structure at the same time. 12

It should be noted here that, for Freud, thought is still inherently linguistic, and word play provides the interaction among the nodes. The linguistic nature of thought within his model both helps and hinders his representation of it; though he is able to spin out a narrative that is then amenable to analysis, he must confine his representation of a distributed process to a linear medium. As a result, his nodes exist only as typographic convention (double quoted in the original, italics in contemporary editions), and his associations depend upon admittedly idiosyncratic linguistic formations. Freud’s model of thought is bound within language and the medium of print, and is distinctly unempirical, in the sense that it cannot be reproduced within another systems. Only when models of thought and its processes have reached a sufficient degree of abstraction will thought be able to find its reproduction within other, primarily technological systems. 13

The Memex and ARPANET: Nodalism and Technology

Two papers published in the 1940s, McCulloch and Pitts' “A Logical Calculus of the Ideas Immanent in Nervous Activity” [McCulloch and Pitts 1943] and Vannevar Bush’s “As We May Think” [Bush 1991a] both provide a basis for the migration of the nodalistic model into technological systems. “A Logical Calculus” is generally acknowledged to be a landmark paper in the history of cybernetics, and its genesis and influence has been widely discussed. Tara Abraham describes the paper’s general goal as “to represent the functional relationships between neurons in terms of Boolean logic: to embody the mental function of reasoning in the actual physiology of the brain.” [Abraham 2002, 20]. McCulloch and Pitts are thus engaged in the same project of mechanistic reduction as their 19th century counterparts, and, like them, Abraham points out, they are forced into making certain assumptions to support this project. Some of these are based on previous neuroscience, such as the nervous system being made up of a network of neurons, while some arise from their own model, such as a neuron being either on or off, the “all or nothing” model of being excited or quiet. Most remarkable, however, is a further point made by Abraham: 14

> Although McCulloch and Pitts spent the first and last sections of the paper reviewing the physiology

> of neurons and the implications of their model for psychology and psychiatry, the bulk of the paper is devoted to mathematical considerations. In fact, their only citations are to the work of mathematicians or logicians. Almost anticipating the criticisms of more experimentally oriented neurologists, McCulloch and Pitts made it clear that they do not wish to extend the *formal* equivalence of the behavior of neural networks and the logic of propositions to *factual* equivalence, noting that continuous changes as well as discrete ones are relevant. [Abraham 2002, 21]; italics in original

Although McCulloch and Pitts may have wanted to avoid conflating the formal with the factual, they sound quite confident of the equivalence of the two when they write: "The role of brains in determining the epistemic relations of our theories to our observations and of these to the facts is all too clear, for it is apparent that every idea and every sensation is realized by activity within that net . . ." [McCulloch and Pitts 1943, 131], and "Thus both the formal and final aspects of that activity which we are wont to call mental are rigorously deducible from present neurophysiology." [McCulloch and Pitts 1943, 131] As with their earlier forebears, McCulloch and Pitts see mental activity as the result of processes inherent in neuroanatomical structure, though they have now "deduced" that a logical calculus, rather than Freud's word play, is the mechanism that governs the relation between neurons and generates thought out of their individual states. This establishes an analogy between structure and function that can be replicated technologically; if thought (defined as the working out of propositions in Boolean logic) is the product of interaction between neurons that function as yes/no on/off switches, then it should be possible to replicate thought through electronic circuits that function in the same way. 15

In his 1945 essay "As We May Think," Vannever Bush lays out a different approach to the technological instantiation of thought processes, but is still working from the same model as Freud and McCulloch and Pitts, one in which thought is based on the association and relationship between discrete units. In this essay, Bush describes a device called the "memex" that would enable researchers to more adequately process the copious amounts of data available to them. There are many interesting features of the memex, but for the present discussion the most significant is the indexing feature. A major problem for the researcher, according to Bush, is not simply the abundance of material, but the ability to store and retrieve it in a way that makes sense to the researcher. Bush's solution is a feature within the memex that would enable the researcher to create links between individual items. In a letter from 1944 that was written after the essay but before its publication, Bush explicitly relates this to an associational model of thought: 16

> When items are thus tied together in a chain, when any item in the chain can be caused to be followed by the next, instantly and automatically, wherever it may be, there is formed an associative trail through the material. It is analogous to the trails formed in the cells of the brain, and it may be similarly employed. [Bush 1991b]

In the essay itself, Bush makes the same analogy: "It [the human mind] operates by association. With one item in its grasp, it snaps instantly to the next that is suggested by the association of thoughts, in accordance with some intricate web of trails carried by the cells of the brain." [Bush 1991a, 101] Many cite Bush's essay as the inspiration for the development of hypertext and the World Wide Web, and developers of these and associated technologies, such as Ted Nelson, Douglas Engelbart, and Tim Berners-Lee, all cite Bush as an influence; but if the memex is the original technological ancestor of these technologies, their philosophic roots are in the late 19th century.

From Freud, to McCulloch and Pitts, and Bush, we can see a change in the material representation of the concept, but the concept and its premises are the same: thought is a matter of association between discrete objects that is determined by physical structure. Proceeding by analogy, if the process of thought is determined by the physical structure of the brain, if each individual thought element is equivalent to a neuron, and thinking is the result of association among these neurons, then replicating the human thought process is only a matter of building a system that enables individual items to be linked together in an infinite number of ways. Function is a product of structure to the degree that if we want to re-create function, it is a matter of building the correct structure. 17

With McCulloch and Pitts, and Bush, the main question is developing a way to model and replicate individual thought. 18

But an important feature of the nodalistic trope is that it is scalable; if it holds that the thought of individuals is the product of interaction between units, then can't thought be created at a higher level if those nodes are individuals who are linked together by a system that allows them to communicate collectively in the same way that neurons are connected by electrical pathways?

Paul Baran's 1964 study for the RAND Corporation, "On Distributed Communications," is generally regarded as providing the blueprint for ARPANet, which evolved into today's Internet. However, Baran's paper, in which he demonstrates that a communication system of nodal relays would have better survivability in event of an attack, was not taken up until the concept of a civilian network linking major ARPA research centers, such as Stanford and MIT, had been introduced by JCR Licklider during his tenure as Director of Behavioral Sciences Command & Control Research at ARPA. Baran's work, in conjunction with that of Donald Davies, established the technical component of the ARPANet based on packet-switching technology, and brings the graph theory component of nodalism into convergence with the neuroscientific, but it was Licklider's vision of an "Intergalactic Network" of linked systems that could share programs and data, outlined in his 1963 memo "Memorandum For Members and Affiliates of the Intergalactic Computer Network," that truly set things in motion.[1] 19

As early as 1960, in his paper "Man-Computer Symbiosis," Licklider was considering the ways in which computers could be used to extend human thought, resulting in new ways of thinking. In outlining his vision of human-computer symbiosis he writes, "The hope is that, in not too many years, human brains and computing machines will be coupled together very tightly, and that the resulting partnership will think as no human brain ever thought and process data in a way not approached by the information-handling machines we know today." [Licklider 1960, 4] In a paper co-authored with Robert Taylor, also of ARPA and a former neuroscience student, "The Computer as Communication Device," Licklider describes what this thinking might look like through the example of a project meeting. In a project meeting, Taylor and Licklider argue, what takes place is a process of communication that involves the comparison of mental models held by participants to produce new information. As they describe it: 20

> Any communication between people about the same thing is a common revelatory experience about informational models of that thing. Each model is a conceptual structure of abstractions formulated initially in the mind of one of the persons who would communicate, and if the concepts in the mind of one would-be communicator are very different from those in the mind of another, there is no common model and no communication. [Licklider and Taylor 1968, 22]

Here "information" is the product of thought, which in turn is conceived of as a process of communication between two individuals. Given this model of thinking, it should come as no surprise that Licklider and Taylor distrust the disconnected individual:

> By far the most numerous, most sophisticated, and most important models are those that reside in men's minds. In richness, plasticity, facility, and economy, the mental model has no peer, but, in other respects, it has shortcomings. It will not stand still for careful study. It cannot be made to repeat a run. No one knows just how it works. It serves its owner's hopes more faithfully than it serves reason. It has access only to the information stored in one man's head. It can be observed and manipulated only by one person.
>
> Society rightly distrusts the modeling done by a single mind. Society demands consensus, agreement, at least majority. Fundamentally, this amounts to the requirement that individual models be compared and brought into some degree of accord. The requirement is for communication, which we now define concisely as "cooperative modeling" - cooperation in the construction, maintenance, and use of a model. [Licklider and Taylor 1968, 22]

The project meeting provides Licklider and Taylor with an ideal model of "thinking" insofar as each member of the meeting is a node that possesses specific information that can be shared with other nodes, thus resulting in a shared mental model, or "thought". The computer comes into play as a device that enhances, or even makes possible, this interaction among nodes. Given this model of communication and thought, it is little wonder that Licklider and Taylor 21 sought to expand the scale of this project meeting from individuals to institutions, though, in a sketch of the ARPA Network from 1969, Licklider indicates only “4 nodes.” [Waldrop 2001, 259]

Nodalism in Theory and Practice

Nodalism begins as speculation upon the process of thought and its relation to the observed structures of the brain, specifically the neuron. These speculations are then incorporated into information technology in an attempt to replicate or imitate human thought processes. However, many of these early assumptions about the relationship between neurons and individual thought elements have, in fact, proven to be wrong. In his illuminating work on the relationship between neural structures and language, *From Molecule to Metaphor*, Jerome Feldman stresses that, while we don't yet fully understand the relationship between structure and function, the idea that an individual neuron is equivalent to an individual unit of meaning, what he calls the “Grandmother cell” theory (so called for the idea that one neuron is equivalent to everything one knows about one's grandmother) is not supported by our understanding of neurological function. As Feldman explains: 22

> The simplest form of the grandmother cell theory makes no sense; any neuron has meaning only in terms of its connection patterns in a circuit. A possible, but also provably false, variant is that everything you know about your grandmother is linked to a single cell that is active if and only if your grandmother comes to mind. There aren't enough cells in the brain to dedicate one to every possible concept. Further, such a coding system would be crippled by damage to a single key cell and would also have no way of representing graded concepts. [Feldman 2008, 111]

More likely, Feldman says, is a model in which several neurons overlap in relation to one another in the formation of a concept, and a single neuron may play a partial role in the modeling of many concepts. However, as with earlier theories of the brain/mind relation, this is still theoretical, though supported by strong biological evidence.

In terms of nodalism, however, the cat is already out of the bag, with both the trope and information technology reinforcing the concept of discrete units connected in a network or web of relations that function in a way analogous to the neurons in the human brain. And as the trope, “x is like a node in a network”, along with its variations on units, nodes, nets and webs, leaves neurological structures behind to become a structural metaphor with application outside the domains of neuroscience, psychology, and information technology, nodalism develops as a true discourse. This then raises the question of what values and positions it supports, and in what ways the digital humanities and other technological projects reify these values and positions. 23

One key issue revolves around difference, conflict, and antagonism; in a network model each unit, though different in itself, is part of an overall smoothly functioning system; conflict is non-functional, something to be routed around, or, at least, decreased to the point where it can be re-incorporated into the system. Here it's worth recalling Licklider's description of cooperative modeling: “Society rightly distrusts the modeling done by a single mind. Society demands consensus, agreement, at least majority. Fundamentally, this amounts to the requirement that individual models be compared and brought into some degree of accord.” Difference between nodes may be the starting condition of the system, but overall functionality demands that this difference not be so great as to cause disruption – the very definition of the social, according to Licklider, is consensus. 24

This model of the network as a completely integrated system has made its way into both popular political discourse and critical theory, and in both cases, the banishment of negativity should provide an occasion for pause. For example, in his *New York Times* column of December 9, 2010, David Brooks contrasts “network liberals” with “cluster liberals,” where the primary distinction between the two involves the degree of conflict they are willing to bring to the political process: 25

> Cluster liberals (like cluster conservatives) view politics as a battle between implacable opponents… Network liberals share the same goals and emerge from the same movement. But they tend to believe — the nation being as diverse as it is and the Constitution saying what it does — that politics is a complex jockeying of ideas and interests. They believe progress is achieved by leaders savvy enough to build coalitions. Psychologically, network liberals are comfortable with

> weak ties; they are comfortable building relationships with people they disagree with. [Brooks 2010, A35]

Brooks' network metaphor bears a striking resemblance to Licklider's “cooperative modeling,” in that while both acknowledge potential difference or “disagreement” as a starting state, the ultimate goal is to achieve consensus and compromise through the eradication of negativity. Significantly, Brooks uses the term “cluster” to describe this negative position, suggesting blockage and positions that are outside the network. Though a desire for consensus-building in a highly polarized legislative body may seem innocent enough, one should not overlook the fact that this network metaphor is being deployed by an (ostensibly moderate) speaker for the Right; it serves the conservative political cause by enabling anyone who does not cooperate within the network to be portrayed as a “radical”, and asserts that genuine negativity and antagonism that should be part of the political process can be reduced to disagreement that can ultimately be discarded in favor of overall system functionality. When nodalism is deployed within the political sphere, the first point to examine should always be whether it is being used to banish negativity, and for what reason.

That Brooks should arrive at this concept of the network as a space of pure positivity should come as no surprise, however, since it is constantly reinforced by social networking applications - there are no “enemies” on one's Facebook profile - and social network analysis, which can only represent the efficiency of transmissions (whether of information, ideas, or disease) within a system. If a node is non-functional, or plays only a marginal role, it will either not appear within a social network analysis graph, or be pushed to the margin. This can provide significant new information about the system itself – for example, the Republic of Letters project at Stanford has provided a new understanding of the transmission of ideas by means of correspondence through Enlightenment Europe - and engender new forms of scholarship, but, in the end, such analysis can only represent agreement, since disagreement, antagonism, and conflict cannot be incorporated into the system. In his critique of humanist idealism in second-order cybernetics, Cary Wolfe makes this same point: “… Maturana and Varela's call for an ethic of love constitutes a radical disavowal of what Ernest Laclau, Chantal Mouffe, and Slavoj Zizek have called ‘social antagonism’.” [Wolfe 2000, 190] What's at stake in both second-order cybenernetics and the representation of the social field in social network analysis is the place of negativity; does it play its own role in establishing the social world, and, if so, how can that be expressed within nodal models of the social? The point is not to say that social network analysis is invalid, but to recognize the limitations of what it can represent, so that the representation is not taken to be the real, nor an absolute model of how the real *should* function. 26

Given that nodalism can only represent positive linkages, a different mode of description seems necessary to re-incorporate the negative, which would be that of narrative. N. Katherine Hayles, again critiquing Maturana and Varela's systems theory, has argued that narrative is a necessary supplement to systems theory in order to break out of the latter's oppressive operational closures and re-introduce the element of contingency: “. . . systems theory needs narrative as a supplement, just as much, perhaps, as narrative needs an implicit system to generate itself. Narrative reveals what systems theory occludes; systems theory articulates what narrative stuggles to see.” [Hayles 2010, 138] In Hayles' approach, narrative functions as a contradiction within systems theory that allows one to see what systems theory omits. In the case of nodalism, narrative functions in the same way; nodalism can represent factuality – these individuals are connected, this unit interacts with this unit – but it cannot answer *why* these connections exist, or, more importantly why other connections do *not*. History, as an explanatory narrative progression, is discarded in favor of compiled sets of data points that flatten events into a positive system. As Hayles points out, the discernment of a system within seemingly scattered events may in fact lead to the creation of a new narrative – again, using the Republic of Letters example, discovering the system of letter transmissions may lead one to inquire after new historical explanations for the development of the European Englightenment – but as nodalism has gained in discursive power, so has its hostility toward its contradiction, narrative. This is best illustrated in the debate between ludologists and narratologists within game criticism, but also has its representation within the digital humanities and other technological projects. 27

An example of this can be seen in a project I was involved with in 2009, the Freebase open database that was under development by Metaweb Technologies, which was recently acquired by Google. Freebase was based on a graph database, in which each data object functioned as a node that could be connected to other objects by means of a query 28 language. On the front end, a user would see topics that functioned as containers for different data types, each of which had its own set of properties. For example, the topic “Arnold Schwarzenneger” was nothing more than a frame that contained several different data types – Political Figure, Celebrity, Award Winner – each of which had a set of associated properties. What was missing from this topic was any kind of narrative description, and in fact, the ability to enter text within a topic had been disabled in an early iteration of the system because, as I was told, that “wasn't the point”. By use of the query language, one could ask very sophisticated questions of the database – who were all the German-born political figures between 1900 and 2000, and what offices did they hold – but all the system could do was produce lists, and only lists that could be represented within the logic of the query language and the data model. Any information about the topic that could not be represented as properties within a data model was simply left out; the world as represented by Freebase was one of pure factuality, but it could say nothing about quality or change.

Freebase encapsulates the power and potential risks of nodalism; it is, like the Internet and hypertext, a technological instantiation of nodalism, in this case, one based off of graph theory in mathematics. As such, it opens up new connections between and understanding of objects in the material world, and does so through processes of analysis and re-combination that display systemic relations. Its weakness, however, is that it can only produce statistical information (answers to the question *how many*) or representations of a particular state of the system as determined by the data within it. It is also a purely positive representation of the “world”, in which every object is available for free combination with other objects. In the end, it is an extremely powerful system for creating and using structured data, but in its distrust of “words,” described in the introduction video on the Freebase site, it emphasizes the tension between nodalism as a way of representing the world as system, and narrative as a means for describing what cannot be encompassed within the system. This tension is inherent in all digital humanities projects, and most digital humanities practitioners evince a strong awareness of what is at stake between reducing the world to data properties that can be manipulated according to the codes of a particular technological system, and representing it as a conflicting set of narratives. 29

There is a risk, however, that the seemingly hard factuality of a system imparted to it by its technological representation may lead one to believe that the representation is the end point of inquiry. In a November 17, 2010 article on the digital humanities in *The New York Times,* Tom Scheinfeldt, managing director of the Center for History and New Media at George Mason University, is quoted saying that the academic world has “moved into a post-theoretical age.” [Cohen 2010, C1] This is a striking statement, since it represents both a desire and a seduction; a desire to finally be done with the conflicts over “theory” in the academic world, and a seduction by the belief that technological systems hold the key to ending this conflict. But if the end of research is to be lists, statistical graphs, and charts of systemic relations, then I would argue that we have not moved beyond theory, if that can generally be taken to mean an analytical framework for understanding phenomena. Rather, it would seem that we are on the point of taking up another type of theory, one that effaces its conceptual underpinnings through the materiality of its end products – data analysis systems – and the representations of the world these systems produce. Because these representations are produced through “hard” data being processed by “neutral” machines, they are seen as having more validity than those produced by the “soft” words of theory, but this ignores the fact that the machine is never neutral; it is itself the end result of a long theoretical discourse, and, as such, can only reproduce that discourse in its representations of the world. 30

Nodalism has many of the qualities of a myth, as defined by Roland Barthes. It is a way of perceiving the world, of presenting a certain factuality of things and overcoming conflicts, that is taken to be completely natural, a rendition of “things as they are,” that is strengthened through its association with hard data and computing machinery as purely neutral methods of representation and analysis. Like Barthes' myths, nodalism can be deployed to serve specific interests, to reify network models of political and economic structures in which conflict and negativity are rendered non-functional, in which difference exists as something only to be overcome, and where the ultimate goal is to finally bring every node into functional connection with others. It is thus perhaps no coincidence that nodalim has gained currency in conjunction with globalism, and in fact, the two are linked by the material product of nodalism, the Internet; globalism is not possible without the instant communication among distributed operational units afforded by the Internet, and the resulting experience of the "networked world" lends greater credence to nodalism as a discourse. 31

The most significant aspect of the Barthesian myth for the purpose of this paper, however, is that it effaces its own 32 history; it presents itself as fully naturalized, without memory of its own construction or original purpose. One counter to mythologizing, then, is to historicize, and thus, the purpose of this paper. Nodalism has become a dominant myth of the early 21st century, and, as such, significantly affects our perception of the world around us, from our understanding of our individual selves within “social networks” to the functioning of our social, political, and economic systems. In critical theory and the digital humanities, we play a particular role in propagating this myth, but we can also play a role in demythologizing it. In this short examination of the history of the node, its material and conceptual origins, its technological instantiations, and its discursive life, I hope to have made at least a preliminary contribution to this process.

Notes

[1] See Chapter 7 in Waldrop 2001[Waldrop 2001] for a complete description of ARPANet's founding and the significance of Licklider's memo.

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