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Parameterizing the Spillage Left Behind: Datafication, Machine Learning Algorithms, and the Question of Ecological Agency

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Thesis of
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ABSTRACT

With “datafication” practices becoming more common in digital ecologies, humans have become increasingly reliant on emerging technologies and other actors that can store, comprehend, and analyze information. This thesis offers a proposed model of mediative agency to address the importance of interrogating how non-human actors interpret and make meaning from data. Mediative agents contribute to the disbursement of rhetoric, as well as our understanding of information, by granting visibility and assigning value to data. These processes effectively play a role in shaping reality through agents’ parameterization of data broadly, allowing non-human actors to take on a complex agency that can alter rhetorical trajectories. In interrogating the structures of power that contribute to the dissemination of rhetoric within digital ecologies, mediative agency acts as a speculative modeling approach that allows rhetors to theorize various functions of agency and anticipate how non-human agency might further develop as technological environments change in the immediate future.

Keywords: Agency, Ecology, Algorithms, Big Data, Speculative Modeling

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Introduction

As digital technology plays a greater role in our everyday lives, we have undoubtedly entered an era that is dominated by "big data," a term used to describe the vast volume of complex and exponentially growing information that exists as a byproduct of our online activity. The global production of data is projected to double within a five-year period, with more researchers turning to big data analytics to garner insights (Taylor, 2022). The large volume and velocity with which this data move have far surpassed humans' ability to comprehend and organize, leading us to increasingly rely on technology to aid in both the storage and processing of this information.

With its immeasurable size and immateriality, "big data" has become an abstract concept. Data is assigned value, and thus information is turned "into something meaningful" (Mehlenbacher & Mehlenbacher, 2021, p. 17) when extracted from the environment and analyzed by humans and their technologies. In the age of datafication, where many aspects of our online activity are transformed into data, data studies have become increasingly common across disciplines, and rhetoric scholars often examine the rhetorical implications of big data and its applications (Mueller, 2012; Van Horn et al., 2016; Gries 2013; Palmeri & McCorkle, 2017; Lanius & Hubbell, 2017). When this data is exponentially large, it is perceived rhetorically as "something more like a buzzing noise than a message" (Reid, 2017, p. 39) in which the features of the data become difficult to identify or perceive through traditional methods of data analysis. Thus, the alternative methods utilized to analyze big data and the rhetoric contained within have become increasingly complex and the subject of ethical concern.

Large data sets are often reconciled through a non-human agent, usually algorithms, that can process this data efficiently to make quick deductions from the information. Like the term

"big data," the word "algorithm" is regarded with abstract mystification. Algorithms underpin much of the activity on the web, and, yet, their specific operations remain obscured from the average user by design. Algorithms serve us by making both data processing and the general functions on the web more efficient. We exist with algorithms interconnectedly within digital environments, contributing to the spread and analysis of information. Within rhetorical studies, social-ecological models are often utilized to examine the growing interconnectivity between humans and technology as both exist in digital environments as rhetorical agents of their own accord. Within these systems, each agent has the potential, or capacity, to act, which, in turn, can generate relational change across the environment. In a world that hosts myriad agents that have different forms and means of processing information, and thus, different ways of enacting agency, analyzing these processes becomes important to understand how agency functions and effects rhetorical disbursement.

Notably, rhetorical scholars often struggle to analyze and effectively utilize emerging technologies (Brooke, 2009; Larrimore, 2011). Still, with an ever-growing reliance on technology, it becomes essential for scholars to account for the technological elements that contribute to how information is processed so that we can understand how rhetorical processes operate in digital environments. Further, now that this information can be delivered, received, and processed at a greater velocity (Ridolfo & DeVoss, 2009), there is a larger disconnect between us and the ways in which our data are utilized and transformed by technology. Our reliance on algorithms to aid in processing data has granted them a level of agency that our current models of social-ecological systems cannot completely account for because these models ultimately disperse agency in ways that potentially neglect more "powerful" agents and how they

alter rhetorical trajectories.[1] Drawing on Bruno Latour's concept of technical mediation then, I contend that technologies, like algorithms, that can act on their own accord once programmed, have "mediative agency." Mediative agents have the potential to alter the trajectories of the information that exists within our ecologies, ultimately altering how it is both dispersed and received. They have this potential because they act as a liaison between humans and the wealth of data that is present in digital environments.

For rhetoric scholars attempting to account for the emerging complexities of digital environments, ecological models are a means to conceptualize entanglements between humans and technologies. These models account for the whole of the environment that rhetoric permeates, though they offer few comprehensive methodologies for studying how the agency and meaning making of non-human technologies is enacted. With this in mind, I address some of the limitations of ecological models in examining how agency drives the ways rhetoric fluctuates within digital environments. As Laurie Gries (2016) observes, there is a growing inability to identify how non-human actors alter and assign value to information. Thus, I argue that more microscopic considerations could assist in tracking the trajectories of rhetoric as they exist temporally unstable, ever-changing, and always in flux. I offer a theoretical approach that involves speculatively outlining factors that contribute to the algorithm's parameterization of the data with the goal of cultivating a deeper understanding of to what degree their mediative agency influences the disbursement, circulation, and velocity of rhetoric.

My thesis maintains that looking at the technologies and processes that underpin our understanding of data/information remains an important endeavor. We must address the growing complexity of digital environments by better understanding how agency is enacted when data is

[1] See Daniel L. Hocutt's (2019) "Rhetorical Agency in Algorithm-Centered Digital Activity: Methods for Tracing Agency in Online Research" for an overview of the unseen algorithmic presence in digital assemblages.

analyzed. Mehlenbacher and Mehlenbacher (2021) assert that "data and big data do not simply reveal the world to us" but rather "help to craft the world" (p. 2). With these concerns about how reality is crafted at the forefront, my thesis investigates the question of agency, asking, in part, who or what holds the power to analyze data and how? I first begin by examining the encoded, agency of machine learning algorithms, one of the most prominent technologies utilized for processing data on the web. I then interrogate the limitations of ecological models in examining the "fluctuating" nature of digital rhetoric when mediated by a non-human actor, emphasizing the importance of analyzing their meaning-making potential. Building on Bruno Latour's definition of a "technical mediator," I propose a concept of "mediative agency" to describe how emerging technologies, like machine learning algorithms, assign value to data by way of their encoded mechanisms. I then construct a theoretical approach that accounts for technological mediation by speculatively identifying the ways algorithms parameterize data and act as mediative agents.

Literature Review

Theories of ecology, or relational ontologies, account for the dynamic, interconnected, nature of our being—we are ever-changing in our positionalities. Rhetorical studies embraced these theories towards an "ecological turn" that, among other things, examines our spatiotemporal flux and deemphasizes centralized agency. This ecological turn in rhetorical studies coincides with the emergence of new digital technologies and studies of their impacts on writing. Both perspectives aim to understand how agency is dispersed among networked humans and non-humans. Still, as new technologies emerge and change our writing landscapes, ecological models are not always suitable for examining how these technologies function as rhetorical actors because of several factors.

Ecological Sociality and Materiality

In rhetorical studies, theories of ecology account for the growing complexity of our lived social realities without neglecting the totality of our relationships to each other and nonhuman agents. For example, early ecological theorists in the field reference "technological changes" (Syverson, 1999) as an impetus for embracing new means of rhetorical inquiry. Yet, the technological advances studied primarily expand our understanding of our social networks rather than allow us to deeply attend to how specific actors affect the rhetorical environment. Initial applications of ecological thought to rhetoric and writing studies emphasized the importance of considering the whole, as any text removed from its context loses some of its inherent meaning (Coe, 1975). This centering of context was distinct from previously formulated situational models and challenged them by accounting for dynamic elements outside of the immediacy of the original context of rhetoric. To critically analyze what this dynamic whole encompassed, many early ecological thinkers categorized context as systems, subsystems, and metasystems

(Coe, 1975; Cooper, 1986; Syverson, 1999) with analyses of the functions that occurred within and across systems. These systems were tied to sociality, rejecting the myth of the solitary writer (Cooper, 1986; LeFevre, 1987; Roorda, 1998), and instead proposed that writing occurs through the social systems that writers exist within, while also shaping these same systems. Effectively, early forays in applying ecology theory to rhetorical studies called for a rethinking of cognitive processes of writing that centralized the individual, expanding the scope to examine the ways writers and their audiences are socially enmeshed.

This focus on social ecologies lingered as rhetorical studies entered what has now been termed its "ecological turn." Jenny Edbauer's "Unframing Models of Public Distribution: From Rhetorical Situation to Rhetorical Ecologies" arguably spurred this "ecological turn" in adding depth to the proposed ecological systems that came before her. Edbauer (2005) drew on the public nature of rhetoric, looking at ecologies as something that "recontextualize rhetorics in their temporal, historical, and lived fluxes" (p. 9). This emphasis on flux was further exemplified in her gestures towards the viral-like circulations of rhetoric in the "Keep Austin Weird" campaign. In focusing on the spread, distribution, and recontextualization of this movement throughout Austin, Edbauer (2005) dismantled the situated nature of rhetoric and argued that rhetoric is instead "encounter[ed]" (p. 23). Thus, as the environment itself constantly morphs and changes, the social dimensions of rhetoric shift within the relational network, blending the human and non-human in a distributed emergence.

The "encountering" of rhetoric within publics further challenges notions of rhetorical individual agency through its rejection of linear causality. The concept of rhetorical flux gives way to the notion that rhetoric exists at "the edge of chaos" (Dobrin, 2011) due to the "fluid" (Dobrin, 2011) nature of systems that promote the hyper-circulation of rhetoric. This view

differed from early ecological theorists who claimed that complex systems were more "purposeful than utter chaos" (Syverson, 1999, p.4). The trajectories that rhetoric could potentially take were simultaneously viewed as both unstable and networked, fueling a dynamic perception of how it permeates across systems. The unpredictability of elements that contribute to the dissemination of rhetoric within an ecology allowed for a decentering of individual subjects. As such, the fixity of rhetoric and writing became dismantled, with scholars proposing that "rather than objects causing effects or subjects determining ends, they combine with many other elements in the environment to create conditions of possibility" (Hawk, 2004, p.83). The intertwined, abundant elements within social ecologies were perceived as fluctuating, accounting for the lack of control writers have within a complex system of actors. Thus, rhetoric and writing studies began to look beyond the human subject to better understand the conditions that fuel the emergence and distribution of rhetoric.

Fragmented Agency, Instability, and Technology

To account for the complexity of the social sphere in its circulation of rhetorics among interconnected communities, what had been traditionally thought of as "background" to rhetorical studies was now highlighted as constitutive to rhetoric's reception and movement. With the move away from traditional agents/subjects in ecological models and a turn to materiality, a "posthuman" perspective of agency helps highlight the inherently dynamic (Cooper, 1986) and viral (Ridolfo & DeVoss, 2009; Edbauer, 2005) dissemination of rhetoric. This view facilitated a fruitful exploration of de-anthropocentrized rhetorical studies, in which ecologies could host both human and nonhuman entities that carried fluctuating agency. The rise of digital technologies and user-generated content on the web allowed for the perception that agency was "one equal element in a larger, more complex set of relations" (Hawk, 2004),

intertwining human and non-human actors to emphasize the unpredictable nature of emerging social situations in a larger, digital ecology. This ecological, posthuman notion of agency retained a social and material focus as technology began to take on a greater role in writing studies.

Digital affordances both modified and challenged contemporary composing practices and means of expression, all the while expanding our conceptualization of existing social-relational ecologies. The growing potential of digital technologies as an apparatus for rhetorical invention was on the horizon, with many scholars turning to a system-based approach to better understand how these technologies would come to transform our understanding of agency and writing studies broadly (Hayles, 2002; Ulmer, 2003; Geisler, 2005; Arroyo, 2005). These approaches, however, could not account for impending technologies that would possess more agency than previously thought possible. Emerging technologies posed novel possibilities for understanding how rhetoric is composed, delivered, and moved throughout social networks. Later research at the intersection of digital media studies and rhetorical studies continues to focus on tracing associations between ecologies and the instability of rhetorical outcomes.

To this end, contemporary rhetorical theorists have expanded on the groundwork laid by relational ontologies. This perspective accounts for complex, networked environments and gives way to the understanding that "flux" underpins all relations (Mays, 2015). Thus, scholars analyze digital practices to understand how the scope of relations might impact our rhetorical objectives, specifically that of delivery and circulation. Digital communication altered our delivery of rhetoric as a "techne" (Porter, 2009) and the speed and recomposition of rhetoric by way of "rhetorical velocity" (Ridolfo & DeVoss, 2009). These frameworks denounce linearity and assert

that while rhetors could have tentative and strategic considerations when approaching digital delivery, they could not fully anticipate the multitude of possibilities that occur afterwards.

The study of digital rhetorics embraced relational models for their ability to offer a framework capturing the complexity of the internet's structure, the abundance of public communication hosted by platforms, and the accelerated disbursement of information. Collin Gifford Brooke's (2009) *Lingua Fracta: Towards a Rhetoric of New Media* called for a rethinking of the rhetorical canons through an ecological lens to "focus our attention on a temporarily finite set of practices, ideas, and interactions without fixing them in place or investing too much critical energy in their stability" (p. 42). In emphasizing the instability of the digital sphere through ecological perspectives as Brooke prescribes, we move away from static measures of rhetorical performance to accommodate new forms of rhetorical transformations resulting from our digital interconnectedness. These accommodations sometimes mean that researchers overlook emerging technologies as rhetorical agents unto themselves because the technologies are often perceived as unstable, fragmented, or erratic based on social-ecological models. Bennett (2010) asserts that this ecological perspective should become "more a matter of responding to harms than of identifying objects of blame" (p. 102) to prevent us from attributing an act to a singular agent within complex environments. This "action-oriented" (Bennet, 2010, p. 102) perception promotes a disruption of the subject-object dichotomy, in that the action can be attributed to both human and non-human interaction. Thus, beyond accounting for the enmeshment of actors within ecologies, the novel "harms" that technologies with emerging capabilities pose demand closer analysis.

Retroactive Measures of Decentralized Agency

With instability underpinning how rhetoric is examined, instability also extends to the rhetorical conception of agency, which took on a more dispersed character. Seas (2012) expands on Edbauer's previous ecological model and proposes that "effectiveness" is a "quality that is retroactively assigned to the ecology as a whole and not to any particular actor or idea within it," (p. 63) thus, attributing agency to the whole of the ecology as opposed to the agents hosted within it. This retroactive prescribing of agency or "effectiveness" deviates from the posthuman view of dynamic agency in that the perspective decentralizes agency from actors entirely and instead grants it to the whole of the actors' relations to one another.

The conceptualization of agency as a networked bifurcation between humans and technological objects is largely attributed to actor-network theory (ANT), where emphasis is placed on the associations between agents, as opposed to the agents themselves. All agents, both human and non-human, contribute to the action, as "action is a property of associated entities" (Latour, 1994). Although it is maintained that only humans can carry out the final agential act, emboldened by the objects within the given environment. This bestows objects with agency, but also assumes that they cannot act alone. Ecological theorists have adopted this perspective, with Sean Cubitt (2019) proclaiming, "there are only connections, and the connections produce the 'things.' … in an ecology, everything mediates, and everything is a medium" (p. 1). Relational models for understanding rhetoric, then, increasingly deemphasize the agency of individuals (whether human or nonhuman) in favor of attributing agency on a macroscale as a force contingent on relationality. This view overlooks the unique agential power of emerging non-human actors within these ecologies, potentially deemphasizing their importance and need for closer examination. Technological advancements challenge these macroscopic disbursements of

agency in that emerging technologies have begun to carry an unprecedented amount of agency. This agency stems from their ability to act on their own accord after being programmed to do so. Johnson (2017) maintains there is a "crisis of agency" in which "algorithms further trouble notions of agency by casting doubt on what makes any behavior uniquely human" (p. 197). While both posthuman agency and decentralized agency could account for technological apparatuses (Hayles, 2002) that must be wielded by a human to carry out an act, the introduction of non-human technologies that independently act call into question how we measure agency and what effects the human-like actions algorithms have on digital environments.

Scholars in circulation studies have embraced retroactive measures of applying decentralized agency to illustrate the viral dissemination of rhetorics occurring within ecologies. More scholars have taken on the task of tracking the movement of different forms of rhetoric to examine the ways that networked communication functions (Ryder, 2010; Chaput, 2010; Jones et al., 2022). Laurie Gries (2016) took to iconographic tracking to examine the distributed emergence and recomposition of Shepard Fairey's Obama Hope image. A new materialist examination of the image's movement allowed Gries to acknowledge the role human actants played in its spatiotemporal distribution. Gries additionally draws on ANT to acknowledge the "multiplicity of actants" (p. 21) contributing to the image's movement, yet the role of emerging non-human technologies as a key actor requires additional scrutiny. Despite the ecological notion that both human and non-human actors take part in the fluctuation of rhetoric, especially when considering digital practices, it appears that the role non-human technologies play is sometimes unclear, unaccounted for, or undocumented, in part, because of how these technologies are

designed.[2] With algorithmic technology playing a greater role in our everyday lives, especially pertaining to the circulation of rhetoric, acknowledging their unique agential capabilities can provide more insight into how they play a role in altering rhetorical trajectories.

Further, tracking the circulation of rhetoric can only occur after the rhetoric is already introduced into the environment. Thus, scholars are always "behind" the movement of rhetoric. Sundvall (2019) notes this shift towards a "reactive" response that occurs "after-the-fact" (p. 6) when examining rhetoric itself and emergent technologies, proposing that we should utilize "speculative modeling" (p. 7) to prepare for advances in technology that will undoubtedly shift our studies of rhetoric. One of the ways we carry out this speculation is to reexamine the existing technologies and their relationship with writing and rhetoric and "explore modes of critical speculation into the transformative effect of emerging technologies, particularly as a means to speculate on future shifts" (Sundvall, 2019, p.12). By closely and critically examining the transformative functionalities of these technologies and what implications they might pose for the present and the future of rhetorical studies, we garner a deeper understanding of their present and potential impacts. Speculative modeling aids in proactively acknowledging the material impacts that technological shifts pose to rhetoric studies, positioning "rhetoric and writing scholars as proprietors of our technological future" (Sundvall, 2019, p.12). This entails that they contribute to the analysis of technology not only as critics, but as stakeholders that advance the understanding of the broader functions of technology. In adopting this practice to critically examine the ever-growing agency of big data and algorithms, we might better account for their potentialities.

[2] Black boxed models have become more frequently utilized when designing algorithms, for more information on this topic see Rudin (2019) "Stop Explaining Black Box Machine Learning Models for High Stakes Decisions and use Interpretable Models Instead."

Information as Data and Agential Technologies

Digital studies that analyze the circulation of rhetoric throughout systems, or how it exists in flux, often garner their information by collecting data. Methods of data analysis offer insight into the environments in which rhetoric is dispersed and can help identify trends within the systems to reveal larger conclusions. Many scholars contend that it is necessary to study the whole of the ecology and better understand the digital networked environment we share with non-human actors (Dobrin, 2011; Van Horn et al., 2016; Hocutt, 2018). This pursuit requires an abundance of information to provide a model, visualization, or analysis of how systems function. Still, this call for more macroscopic investigation would benefit from implementing a critical examination of the specific agents that contribute to shaping both the data and the systems themselves. This examination could potentially elucidate the agential structures that compose and change the network.

As we enter an era where technologies, such as computational programs and algorithms, have been granted unprecedented control and influence over how data, and rhetoric as a result, are dispersed, we must rethink models of decentralized agency. Models that decentralize agency and are contingent on a larger relationality often focus on the instability of the environment in which rhetoric exists in flux, while sometimes overlooking the "material histories" (Jones, 2021) that have shaped the dynamics of power that underpin this digital flux. Reeves (2013) contends that the web takes on a "chaotic facade" and that notions of a decentralized and randomized digital sphere do not consider the "constraints [that] govern the liberated audience through flows of online activities" (p. 325). Reeves states that these constraints arise from the "flowing" web experience that is rhetorically constructed to actively engage online audiences. What Reeves overlooks in this claim is some of the emerging technologies, such as machine learning

algorithms, that make this "flow" possible in altering rhetorical trajectories by assigning value and hierarchically presenting information to users.

The growing potential of algorithms to take on an agential role requires more in-depth analysis of their rhetorical capabilities. Many internet users are dependent on algorithms to navigate online spaces, and this is especially the case when utilizing search engines to seek out information online. Some researchers anticipate that we are entering an "algorithm era" (Rainie & Anderson, 2017; Goodman et al., 2023) that has, and will have, large scale effects on our communication practices because of their prominence. If "persuasion is grounded in the procedures of algorithm, including how they include and exclude information" (Beck, 2016, p. 33), then algorithms that are granted the ability to mediate information online can be agentive by design. Thus, rhetorical studies of how these algorithms enact this agency could potentially provide more insight into how algorithms alter the trajectories of information in our ecologies.

Within our digital networked reality, the co-action of both human and non-human entities is broad and overwhelming. Ecological models that emphasize instability and relational conceptualizations of agency attempt to accommodate for the multitude of agents that contribute to the dissemination of rhetoric across networked systems. This turn to more macroscopic models of rhetoric is additionally fostered by "information overload" (Koltay, 2017) in which we cannot contend with the sheer amount of data at our disposal, leading us to accept the "chaos" (Dobrin, 2012) as opposed to deeply interrogating the structures of power that contribute to its design. In analyzing the agential power of new technologies by understanding their design, scholars can better understand how information is disbursed throughout digital ecologies, and how agency is materialized each step of the way.

The Ecological, Mediative Algorithm

Algorithms serve us by making both data processing and general web functions more efficient. Without their assistance, there would be no way for humans alone to feasibly store, interpret, and categorize the sheer amount of information at our disposal as rapidly. The fact that so many of us are simultaneously reliant on algorithms, yet unaware of the role they play in our everyday lives makes them powerful, non-human agents. In looking at the general processes of algorithms concerning big data especially, I contend that machine-learning algorithms have a "mediative agency" that substantially shapes ecologies. This mediative agency is observable in the innate subjectivity that they are encoded with and their impenetrability.

On a fundamental level, algorithms are tools that function using input and output mechanisms. The term "classical algorithm" (MacCormick, 2011) is utilized to describe algorithms that produce output values from a specific data set that is finite in nature. Thus, these algorithms have no room to expand beyond the bounds of their trained computation, and if given an input that it cannot compute through the data set, an error will occur. John MacCormick (2011) refers to this function as a "mechanical recipe" (p. 12) in that they are programmed to follow a specific sequence of steps to yield the "correct" or desired output. This specific sequence of steps includes provisions that are predefined by the algorithm's creator(s) and the data set on which they are trained. Recently, algorithms have become increasingly complex with the advent of digital technology, allowing them to provide predictive outputs instead of errors when prompted with an input. This complexity serves to accommodate the large quantities of data that multiply at an infinite rate, demanding a need for tools that can process, analyze, and store this information.

To meet the demands of increasingly larger data sets, machine learning algorithms were developed. Machine learning algorithms are frequently encountered by online users, and they are comprised of multiple algorithms that learn from the accumulated data that they are fed (Ray, 2019). These "stacked" algorithms come together to construct a larger whole, forming a system-like structure that makes these algorithms ecological in design. The ecological nature of machine learning algorithms is what makes them both efficient and complex enough to produce reliable outputs when culling and sorting the data. For example, consider Google's "Page Rank" algorithm, which utilizes hundreds of algorithms to sort webpage search results based on relevant search engine optimization (SEO) keywords, reliability of the webpage (based on readability and security), and linking hierarchies (the more a webpage is internally linked by other webpages, the more trustworthy it is deemed) (Joshi & Patel, 2018). These algorithms work in conjunction with each other, made possible by "web crawlers," or bots that search, examine, and catalogue millions of webpages in a fraction of a second (Kumar et al., 2017). This efficiency and reliability arguably add to the mystification of algorithms, as they are seemingly intangible and abstract.

If we turn back to the basic function of algorithms, as a provisional sequence, contingent on a finite, linear input-output determinacy, this process becomes more tangible. Unlike classical algorithms that function on a strict, pre-defined input-output relationship, there is a level of prediction needed to make machine learning algorithms work. This prediction is necessary because such algorithms do not function with linear instructions and instead "learn" by recognizing patterns within data. Since both the input and output become much more complex, contingent on a large database of information, prediction becomes a necessary component to arrive at an output. There are no "correct" answers, rather, estimations from the large corpus of

data to present users with findings. The output then is best defined as a "result" as these algorithms continuously learn from the surrounding digital ecologies to make predictions with a low possibility of error as they are fed more data by users.

Making accurate predictions with large scale data would be an impossible task for a human, or even a large team of humans, to undertake while still providing the same level of predictive accuracy. Machine learning algorithms can do so because they are ecological, fluidly connected to networks granting them access to large quantities of data. As data multiplies rapidly, new rhetoric emerges, and as a result, online ecologies shift, fluctuate, and expand their relations. Machine learning algorithms are not bound to the same temporal limitations that humans are and can comb through multiple sites, fluctuating in both time and space, before arriving at an output.

Further, machine learning algorithms continuously adjust how they handle the flow of data (learning from it) to ensure this output is reliable. This state of fluctuation, granted by an algorithm's ecological design, gives them the ability to move with the flow of data and shift as ecologies themselves shift. As non-human actors, algorithms are firmly embedded in ecologies. Ecologies are all-encompassing, containing a "complex array of influences, both human and non-human" (Dobrin and Weisser, 2002, p.127). Within this array, algorithms have an unprecedented amount of agency that can be examined through their processing capabilities, which allow them access to a significant quantity of information in online ecologies that they, in turn, use to make decisions. Thus, these types of algorithms often mediate information, acting as a liaison between the user and the large body of data that is hosted on the web. Without machine learning algorithms, navigating the web would be a difficult task, and so, when seeking out information online, users are oftentimes dependent on algorithms to locate the information they require.

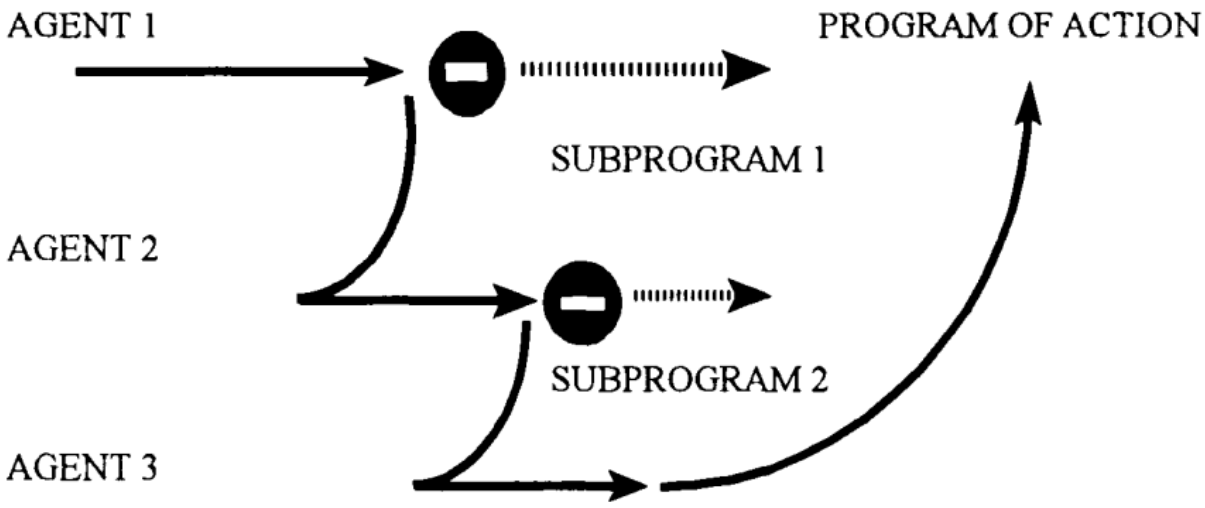
Because machine learning algorithms are constructed ecologically, they can also shape their ecologies. These programs work with the flow of information to gather an understanding of the data present across web platforms when prompted with an input. In turn, the algorithms then control this flow by producing predictive outputs that make them visible to users. For example, if a user types a question into the Google search bar, it must first go through the various algorithms before an "answer" is produced via a webpage. The order in which these webpages are displayed for a user is determined by the algorithms as well, and thus, they govern the ultimate "answer" that the user will receive. Considering all internet activity is mediated by algorithms in some capacity, their agency should not be understated. Thus, I contend that algorithms are not just agents, but "mediative agents," in that they determine what is made visible in the ecology as well as what is not. The disbursement of digital rhetoric is determined by their mediation, as they filter the raw data that underpins its movement and reception. By altering the flow of rhetoric in categorizing and sorting through this data, algorithms enact rhetorical agency.

My definition of mediative agency draws on Bruno Latour's concept of a technical mediator. Mediators "modify the meaning of elements they are supposed to carry" (Latour, 2005, p. 39) in that they are an object that "enlists" or is "enlisted" (p. 39) by an agent to fulfill a goal. This complicates agency by not putting the onus on one actor, rather fusing the actor with the mediative object to disperse agency. Latour utilizes the argument that "guns kill people" (Latour, 1994, p. 30) to illustrate how a mediator carries agency not "by virtue of its material components" (p. 31) but rather because the gun carries the mediative potential to mobilize the actor into carrying out the action by way of translation, thus fusing the gun and the human into a hybrid actor (gunman). Action then, becomes a "property of associated actants" (Latour, 1994, p.35). In Figure 1, Latour diagrams the composition of mediation, in which tools are utilized to

enact subprograms before carrying out a program of action. Subprograms arise when an agent uses other agents prior to carrying out the actual action and can involve both human and non-human agents. In breaking down the subject-object relationship, Latour emphasizes the relationality of actions and emphasizes that cumulatively, responsibility for the program of action is shared among all actors within the model regardless of which one carries out the action.

Figure 1

Second Meaning of Mediation: Composition



Note. Latour utilizes only three agents to simplify the composition of this model and showcase how the program of action is deployed. Here, he emphasizes that the action arises from the association among agents. From "On Technical Mediation – Philosophy, Sociology, Genealogy," by Bruno Latour, 1994, *Common Knowledge, 3(2),* p. 34. Copyright 1994 by Common Knowledge.

Although Latour emphasizes that the non-human carries a forceful agency, informed by their mediative potential to translate the actions of humans, some emerging technologies possess a form of agency that challenge his model by requiring little human mobilization. Latour's model was largely constructed under the assumption that non-human apparatuses could not carry out

programs of action of their own accord, in that they were largely rendered stagnant until a human intercedes. Thus, Latour claims that they are better defined as "actants" (Latour, 1994, p. 33) that are attributed with a role to then drive the program of action. My term "mediative agency" builds on Latour's original concept of a mediator to account for the potential of emerging technologies to act on their own accord after being programmed to do so, holding not just functions, but goals. After being programmed to respond, algorithms do not remain stagnant until put into action by a human actor, rather, they make programmed decisions based upon the information in the given environment. From these programmed decisions, they then generate outputs of information.

If both the user and the algorithm have the potential to act, this would entail that each agent can then hold different programs of action. In Figure 2, I recreate Latour's figure to showcase how this might function. Superseded by the algorithms' mediative output, the user agent's program of action does not become the final program of action. Rather, the final program of action in this model refers to how the information within the digital environment is granted value by being made visible within online ecologies. The algorithm enlists the user, drawing from their data and inputs to hierarchically present how the information is displayed, thus being granted the agency to mediate its value.[3] The user agent then takes on qualities that are akin to Latour's description of the non-human apparatus, in that they become the functional actants that drive the algorithm's goal. By providing the algorithm with both the input and the data necessary for it to produce outputs, the user "acts in a plot until the attribution of a figurative or non-figurative role" (Latour, 1994, p.33) is assigned to their data, as well as the data within the environment. As such, this model similarly de-anthropomorphizes our conception of agency as

[3] Though the quality of the output largely is contingent on the user's input, the machine-learning algorithm's ability to delimit the potential movement of a user within the ecology speaks to their mediative agency.

the non-human environmental factors remain key components by informing both the user-agent and the algorithm.

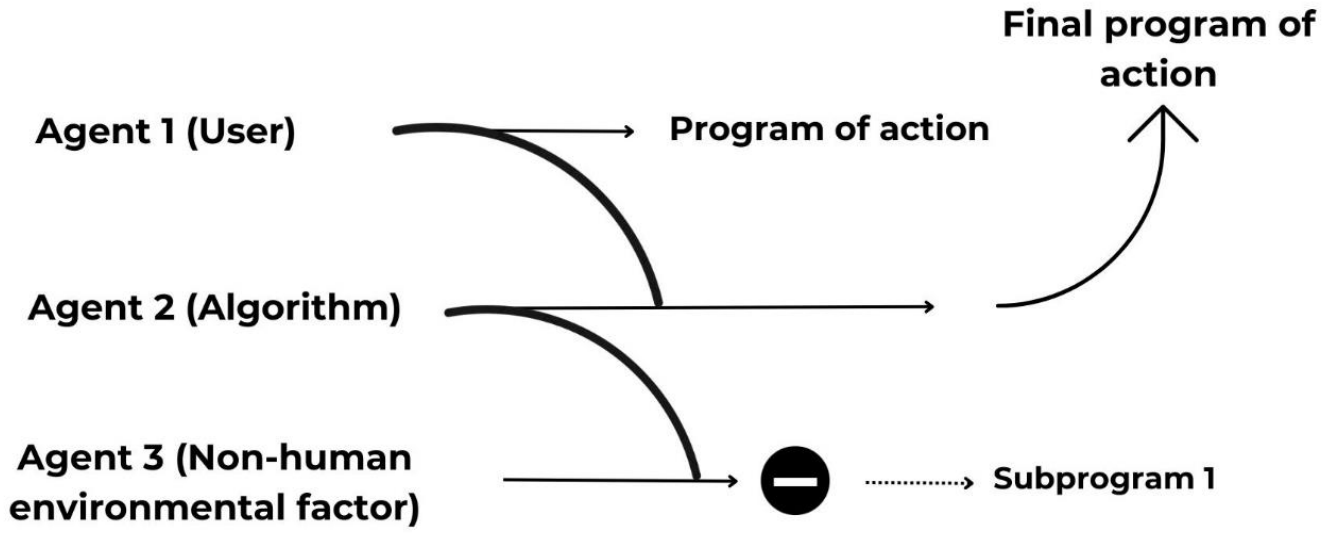
While both humans and non-humans could be considered actants within Latour's composition of mediation, the shift of the user taking on a more functional role by way of their input and data is a notable deviation from his original model. All agents contribute to the program of action in some manner, and yet, the algorithm still carries out the final program of action by determining which information is made visible to user agents, mediating between users and environmental data. Thus, the range of actions that users can take are largely delimited and dictated by the final action taken by the algorithm, which further influences how users take their own actions when provided information from the algorithm.

Algorithms are largely able to carry out these final programs of action unnoticed; however, when they fail to perform in accordance with the user's anticipated goals, users become more aware of their mediative presence. For example, users and Search Engine Optimization specialists have increasingly become discontented with the search results given by Google's PageRank algorithm (Montii, 2022). As such, users become critically aware of the final program of action taken by algorithms and how algorithms mediate this information. Users' inability to "expand" their range beyond that of the final program of action, even when altering the input that they provide the algorithm, leads to a frustrating web experience.[4] This further exemplifies the agential struggle involved in the interaction between user-algorithm, in which, the algorithm has the ability to dictate how information is hierarchically displayed to the user, thus delimiting what action they can take.

Figure 2

[4] For more information on how users react when an algorithm fails to function as anticipated, see Reyman's (2017) "The Rhetorical Agency of Algorithms."

Mediative Program of Action



Further, I argue, to be a mediative agent, an actor must have enough agency to have outsized effects on their ecologies. Algorithms take on a unique role in ecologies, possessing the qualities of mediative actants in that they "organize, shape, and limit our interactions" (Latour, 1994, p. 50) and the agency more typically associated with the human, in that they have encoded goals that drive the way they mediate information. While users can alter their inputs into algorithms to attempt to produce outputs that align with their goals, algorithms still possess encoded goals that allow them to dictate how information comes to be made visible to user agents, hence Figure 2 illustrates that they can have differing programs of action. Rhetorical trajectories are altered within the ecology by algorithms, with some users resorting to "gaming the algorithm" (Petre et al., 2019) to promote visibility of their own content. To "game" algorithms online, users alter and reconfigure the way their information is communicated to align with the goals of the algorithm to exploit its mediative agency. Bradshaw (2019) points to the intentional use of popular SEO keywords by "junk news" domains to spread disinformation online, to which she found that over time, Google adjusted their algorithm to prevent this

exploitation. This speaks to the algorithm's ability to alter not just the behavior of users by way of its mediation but to also be altered to accommodate for users who learn how to exploit their agential power. Thus, algorithms can reassert their agency by way of their design, further altering the flow of rhetoric based upon the programs of actions they are encoded to deploy. As ecological theorists have begun to shift their focus to the "flow" of rhetoric, or its disbursement (Shepley, 2013), velocity (Ridolfo & DeVoss, 2009), and re-composition (Gries, 2016), accounting for the emerging technologies, such as algorithms, that shape this flow on a large scale becomes integral. This analysis becomes especially pertinent given the growing presence of generative artificial intelligence (GenAI)[5], which utilizes machine learning algorithms to produce new forms of various media (text, images, audio, code). With the ability and agency to create original pieces of media (output) when fed a prompt (input), these aspects of technology raise many ethical and rhetorical concerns.

Mechanistic Mediative Agency

Some might assume that an algorithm's mechanistic proceduralism allows them to act objectively, free of human biases; however, this is not always the case. Algorithms are products of human design, meaning that before they are put into action, they are initially programmed by an individual or a team of individuals. Oftentimes, these individuals design the algorithm to be utilized for a large corporation, which greatly informs their programming decisions. This is especially prominent in algorithms utilized for social media sites where Kim (2015) finds that behind the algorithms general processes lies "the structures and dynamics of power" that we often overlook when simply analyzing the "function of technology" (p. 2). These power

[5] As GenAI is a relatively new technology, for now, GenAI is beyond the scope of this thesis. For more information on GenAI systems and their impact on writing studies see Sidney Dobrin's (2023) "Talking About Generative AI: A Guide for Educators."

dynamics can alter what the algorithm produces as an output and could potentially be utilized to bolster specific outputs to hold the user's attention (Deibert, 2019). This would entail that the mediative agency behind an algorithm's decision-making becomes further layered, informed not only by the environment it exists within, but also by the human agents who dictate how it responds to this environment.

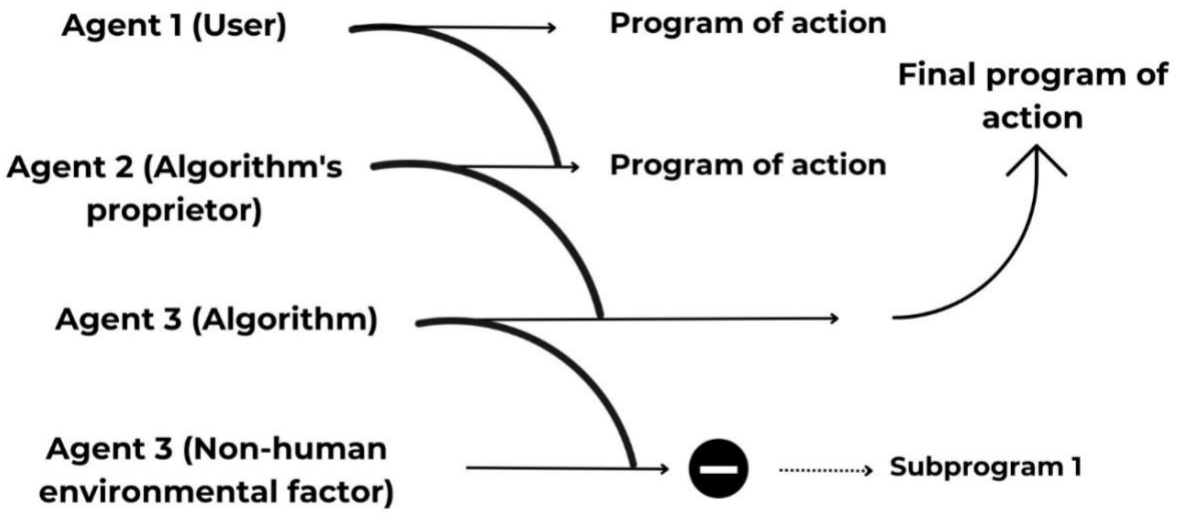
A growing concern that is tied to the layered agency behind algorithms is that developers and proprietors have begun to black-box, or purposefully obscure, the inner workings of algorithms so that we are unaware of how they reach an output. As previously noted, Google utilizes hundreds of algorithms behind their "Page Rank" system, all working in conjunction with one another to reach an output. Yet, we are not aware of all the exact algorithms that back their system or how they function, we have only garnered an understanding of how they rank websites based on the limited information that they provide to the public. The black boxing of algorithms has been justified as a "copyright protection mechanism" (Aiken et al., 2021), as corporations who own these algorithms have made a substantial investment in building and maintaining the algorithm. Although, in response to this claim, there has been a call for increased transparency regarding how algorithms carry out their automation as "the design values embedded in algorithms will inevitably become embedded in public behavior and consciousness" (Burk, 2019, p. 284). Thus, how algorithms interpret information and control the way information is dispersed is a public concern. As this black boxing has become commonplace, it is essential to ask what objectives lie behind commercialized algorithms' structures and understand how they are reflected in their enactment of mediative agency.

As Agosti (2022) claims, algorithms are not merely an extension of our will, though it can seem that way if we only consider the personalization systems that they enact to ensure that

outputs meet the needs of the user. The phrase “technology knows us better than we know ourselves” is largely made possible by algorithms that, beyond drawing from the data at large, draw from users’ personal data to make better predictions about what they want as an output. Without this personalization, users would feel as though the information they encounter this way is not as “accurate” and be met with information overload. However, this accuracy is not synonymous with “truth,” rather, algorithms are constructed to ensure that users are given the information that they want to see based on prior inputs. Geschke et al. (2018) argue that this locks users into “filter bubbles” (p. 10) so that they are only exposed to information that aligns with their own views. These filter bubbles can be thought of as the online ecologies in which users exist. We, then, are less likely to expand our relational scope, remaining locked into the ecologies that we are familiar with as a byproduct of the predictive outputs suggested by algorithms. Thus, we inevitably encounter rhetoric that we agree with more frequently, further embedding us in our rhetorical ecologies, whether intentional or not. Users delegate the decision-making involved in seeking out information to the algorithm, reliant on them to carry out this action. These algorithms are additionally at the whims of their proprietors, who have them designed with their own objectives in mind.

Figure 3

Proprietary Program of Action



To add on to my previous figure, I contend that accounting for the dynamics of power that underpin an algorithms design is essential to understanding the potential dangers of the mediative agency they possess. In Figure 3, I add an additional agent, the algorithm's proprietors, to illustrate that there are multiple layers that are involved in the final program of action. But unlike ecological disbursement of agency, my disbursement of agency contends that each separate agent involved can hold differing programs of action, potentially resulting in an agential struggle. These programs of action may not align, but all contribute to the final program of action that is carried out by the algorithm and then dispersed within the digital environment to be further reproduced. This reproduction allows for rhetoric to virally spread throughout the system, fostered by the algorithms initial program of action. Thus, those who program and own the algorithm play a huge role in dictating the movement of rhetoric throughout the ecology. They effectively control how the algorithm responds to the information, encoding them with the necessary decision-making features to carry out the final program of action. The mediative

agency of algorithms allows these technologies to potentially be modified to bolster information based on their proprietors' objectives. Thus, the question as to *why* certain information is granted visibility extends beyond an algorithms' encoded mechanisms and to external, proprietary influences that could potentially benefit from this information being made visible.

Mediative Agency and Innate Bias

Despite the ecological qualities of algorithms granting them an efficient and more accurate means of processing data, this does not mean that they are free of flaws. On the contrary, just as their ecological design carries benefits, it can also have detrimental impacts due to the mediative agency they carry. A machine learning algorithm's mediative agency, that arises from the ability to act and generate outputs that are predictive in nature, is greatly susceptible to bias because of this predictive component. This bias additionally arises from the fact that they develop their complex design by drawing on unfiltered data within the digital environment.

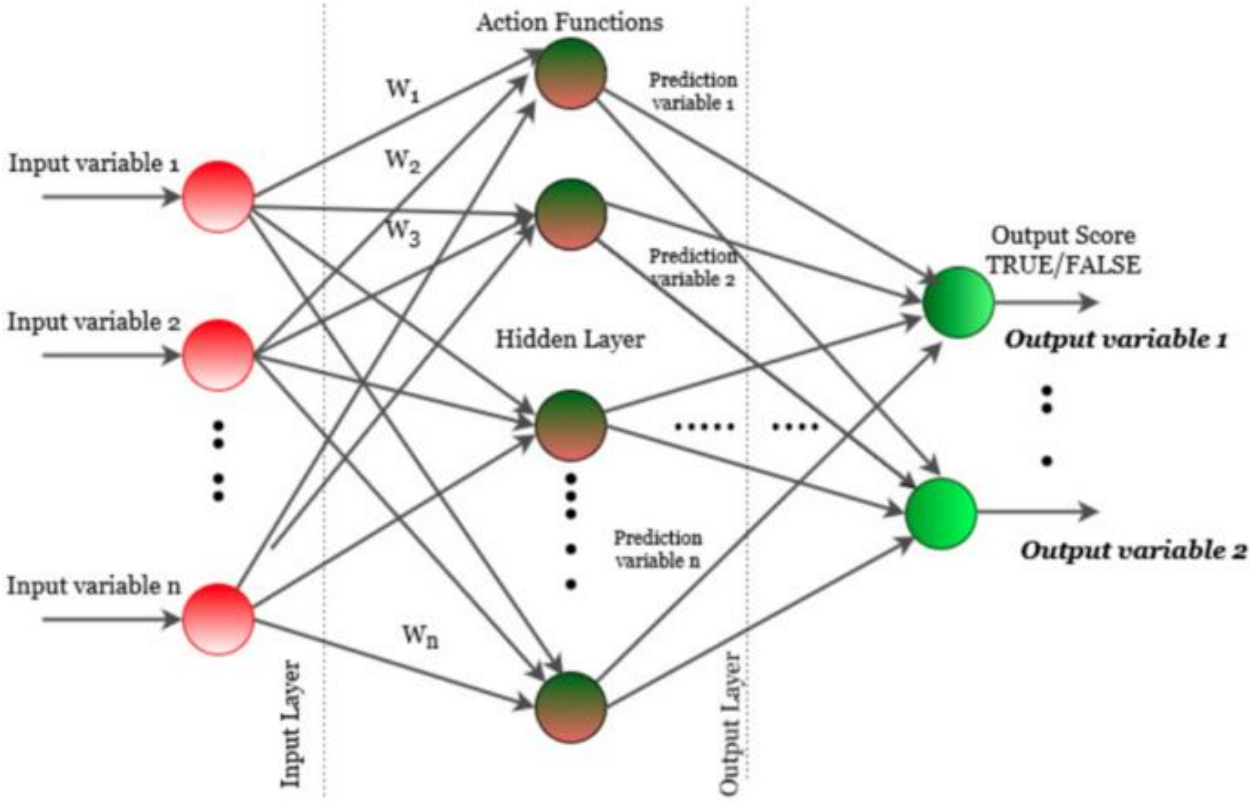
Machine learning algorithms innately carry biases because, in processing mass amounts of information, they often reproduce biases occurring in online discourse. Sun et al. (2020) find that the biases that are enacted through algorithms are "born from ingesting unchecked information" (p. 2), which occurs at a level beyond the input-output determinacy. Rather, it occurs as they move with the present flow of rhetoric: they become encoded with the knowledge to produce accurate, and ultimately predictive, outputs in analyzing the patterns of human activity. Because these patterns arise from the activity of humans without any verification to determine the accuracy of the information that the algorithms are fed, they are bound to contain layers of bias.

Previously, classical algorithms were trained on limited datasets that underwent several stages of validity-testing (Sun et al., 2020). In expanding this dataset to have the machine

learning algorithm draw from the digital environment to better optimize the capabilities of algorithms, biases were incorporated on a macro scale. These biases remain encoded when algorithms are left unsupervised, and thus, they are enacted through the outputs given to users. To provide an example, Microsoft released a chatbot named "Tay" that utilized machine learning algorithms to execute simulated conversations with users. The chatbot was meant to carry out dialogue like a teenage girl and would "learn" from the information garnered in conversations with previous users, using this data to "better" its responses. Fuchs' (2018) claims that the chatbot "went from resembling a normal teenage girl to displaying racist and sexist attitudes in a mere sixteen hours" and that this was emblematic of machine learning algorithm's ability to "take on human-like discriminatory biases" (p. 1). Since machine learning algorithms operate through reinforcement learning, the more a bias is fed through the input, the more it will be reflected within the output. Thus, the more an algorithm encounters an instance of rhetoric, the more it will be produced as an output to users. If these inputs are rife with bias, algorithms will reproduce this bias and will continue to introduce it into the environment. This is additionally emblematic of an algorithm's inability to discern accuracy or validity in the data that they are fed. Algorithms merely identify the patterns contained within the data and if these patterns are biased, they do not have the ability to understand it as a bias.

Figure 4

Architecture of Multi-Layer Perceptron



Note. The illustration above is of a Multi-Layer Perceptron neural network, in which the deep-learning algorithm utilizes multiple layers to find relationships within the dataset. These relationships are found both linearly and non-linearly, as indicated by the arrows. From "A Study on Different Deep Learning Algorithms Used in Deep Neural Nets: MLP, SOM, and DBN, by J. Naskath et al., 2022, *Wireless Personal Communication, 128,* p.2914. Copyright 2022 by Wireless Personal Communications.

Beyond the layers of subjectivity that are encoded into algorithms, a facet of their mediative agency also arises from their ecological complexity. Because the whole of the algorithm is comprised of a multitude of other algorithms that are made relational to arrive at the output, this complex process makes it difficult to pinpoint where in the network biases and errors

occur. In Figure 4, a deep-learning machine-learning algorithm that uses neural layers to arrive at an output is illustrated. The "hidden" neural layers are where the algorithm processes the data between the input and the output layer. Within these hidden layers, the 'neurons' are adjusted and work together non-linearly before producing a predictive output (as indicated by the arrows from each neuron). For example, to program a neural network to have the ability to identify pictures of forks, there could be two elements within the neurons in the hidden layer: one to identify the three-pronged shape, and one to identify the long stem. This would ensure that both elements must be identified to come to the output that the image is a fork. If both elements are not identified, the likelihood that the image is of a fork is decreased, and this will be reflected in the output. This example and the figure above are only simplifications of how neural networks function on a large-scale, and the realities are much more complex. Still, what occurs between the input and output of an algorithm is not easily traced because of the multitude of non-linear pathways carried out.

In essence, beyond the black boxing that the algorithms proprietors enforce, we have black-boxed ourselves from understanding these algorithms' inner organization by allowing them to learn[6] and develop from mass quantities of unfiltered data to develop their neural network. This black-boxing extends to experts in the field who assert that we have "no comprehensive theoretical understanding of learning with Deep Neural Networks or their inner organization" (Schwartz-Ziv & Tishby, 2017).[7] In many cases, we do not have full access to the ways that machine learning algorithms arrive at their outputs, such that we are reliant on them to

[6] Machine Learning Algorithms "learn" by observing patterns within data and prior user inputs. As such, what they "learn" largely becomes an issue of ingesting unchecked information that is then produced in future outputs.

[7] Deep Neural Networks (DNNs) are a form of machine-learning algorithms. Today, most machine-learning algorithms function using neural matching. For more information on DNNs see Schwartz-Ziv & Tishby's (2017) "Opening the Black Box of Deep Neural Networks via Information."

deliver predictions that align with our anticipated response without knowing how they reach this output. Their mediative agency then becomes increasingly difficult to pinpoint. The unsupervised learning techniques that underpin most of the algorithms online have come under criticism because of the prospect of unchecked agency (Rudin, 2019) in which creators of algorithms have difficulty in adjusting their algorithm's design to accommodate for biases encoded within, as well as for exploitations of its design. Thus, the algorithm potentially develops its own, unique mediative potential to "organize, shape, and limit our interactions" (Latour, 1994, p. 50) in learning from data to build on its existing design. The inaccessible innerworkings of algorithmic functions allows them to take on an agency that cannot be directly investigated because we are barred from how it is enacted within its complex structure. The growing reliance on algorithms to navigate the digital sphere and seek out information online makes this lack of understanding especially pressing, as users are oftentimes unaware of how information comes to be presented to them by way of algorithms. While we cannot feasibly "open" the black box of deep learning algorithms to understand how they innately function, analyzing the ecological impacts of their predictive outputs can give way to a better understanding of how they function as mediative agents. Thus, it is imperative we continue to analyze and identify the agential structures by which these non-human actors deploy their agency.

Algorithms, though non-human, take on the role of mediative agents because they can carry out programs of action. By drawing on human data and employing users as functional actants, algorithms wield their own goals to effectively alter rhetorical trajectories within digital environments. Their structure additionally contributes to their mediative agency, making them both efficient and complex enough to work with raw, unstructured, and vast datasets to arrive at

a predictive output. However, their covert encoded subjectivity and black-boxed inaccessible innerworkings could potentially make this agency dangerous, as users are ultimately reliant on them to shape their understanding of data through the algorithm's predictive outputs. Algorithms and their applications in understanding big data then, have yielded both ethical, agential, and rhetorical problems that are not easily accounted for through our current ecological models of agency. The following section addresses how ecological theorists reconcile with the fluctuation brought about by big data, as well as proposes a speculatory framework to account for the mediation carried out by algorithms.

Accounting for Algorithms

Within a digital, networked reality all appears to be in flux: dispersing, flowing, and morphing before we can perceive the effects of these motions on us and our surrounding environment. This fluctuation is inextricably linked with technologies, such as algorithms, that grant us the rapid speed and limitless expanse of an unparameterized network. In conceptualizing rhetorical flow, flux, and using the word "unparameterized" to describe the inability to perceive boundaries, I borrow terminology from physics, as scholars of rhetoric often do. Such concepts complement ecological models of rhetoric because of the field's acute focus on examining the movement and materiality of our being—these concepts can guide our inquiry into the activity and responsivity of rhetoric itself. Thus, I adopt these terms to address some of the limitations of ecological models in examining the "fluctuating" state of digital rhetoric as it circulates within a digital sphere mediated by non-human actors. I further build on my concept of mediative agency and identify some of the ways that researchers can account for the mediation of algorithms by identifying the ways in which they parameterize data and act as a mediative agent.

Given the vast amount of potential that rhetoric holds to move, especially in the digital sphere, flux is the only certainty we can acknowledge. Physical boundaries are often imperceptible as rhetoric can move beyond the materiality of the text—it can be accessed on a multitude of devices, at any time, by almost anyone around the globe. This state leaves us with a limitless expanse of space and time seemingly without order, as nothing circulates linearly. Once temporal elements are disrupted, we cannot feasibly track the entire "lifecycle" of a text and what effects its rhetoric might spur. The text takes on a "life of its own" (Porter, 2009, p.11) post-delivery, thus informing the futurity and further circulation of not only the initial text, but texts that arise from it (Edwards, 2017). Rhetoric is dispersed and spilled, leaving in its wake spatters

and pathways that cannot easily be traced to any original source, especially as it mixes in with the existing data present. These pathways then influence the creation of new rhetoric, prompting further offshoots of data. To have rhetorical flux exist "unparameterized," then, means that we regard flux as the only stable state of rhetoric, which seems paradoxical, as existing in a state of flux is the antithesis of stability.

In response to this unparameterized state induced by technology, contemporary ecological theorists have developed new methodologies to account for the macro trajectories of digital rhetoric, foregoing the rigidity of classical paradigms that analyze a singular text in isolation. This process of looking at large datasets of texts or artifacts is often termed "distant reading" (Moretti, 2013) or "culturomics" (Michel et al., 2011) in which the goal is to garner a less localized perception of a text's lifecycle. These methods attend to the macro scale by utilizing large, raw data sets to track the circulation of rhetoric from a specific source, documenting the ways it is recomposed, reappropriated, and republished across time. Such studies are a means to address the certitude of fluctuation and change. These emerging research endeavors adopt data-mining techniques from fields such as computer science and physics to capitalize on the availability and accessibility of big data.

Emerging technologies with greater storage capacities allow us to access and extract data from the environment more easily, given that almost all aspects of our online activity can now be stored (Taylor, 2022), giving way to the rise of "big data," or data that exists exponentially. Thus, how we conceptualize digital ecologies has expanded, demanding scholars to enlarge their scope to meet the supply of big data to "stake out new terrains of objects, methods of knowing, and definitions of social life" (Kitchin, 2014, p. 2). We draw upon data to reflect on these emerging inquiries, examining how they circulate dynamically and contribute to building an understanding

of the movement of rhetoric. Although, the sheer number of actors involved in this relational process of disbursement has led some scholars to instead embrace "uncertainty" (Dush 2015; Gries 2016; Glotfelter, 2019) to reconcile the unknown impacts of big data and non-human actors that drive circulation. In response to this uncertainty, other scholars call for the reevaluation of "the role of nonhumans, as well as humans, in composing" (Reid, 2017, p. 37) to better understand what drives the conditions of circulation. If there is no feasible way to represent or examine the all-encompassing circulation of rhetoric because the spatiotemporal flow remains too large (Van Horn et al., 2016), then we must pay greater attention to how actors drive circulation, placing agency and the dynamics of power at the forefront of studying rhetorical ecologies.

An Agential Underpinning

In the age of datafication, where large proprietors collect and hold access to the data that shape our reality, the question of agency becomes even more pressing. In drawing from this data to mold our understanding of not only the movement of rhetoric, but the ways in which it reflects the "natural" context of discourse, rhetoricians potentially miss opportunities to interrogate how non-human actors are used to assign value to data. As information becomes mediated through non-human entities, like algorithms, acknowledging how these channels contribute to the manipulation of the flow centers questions that examine agency.

Researchers largely remain reliant on sourcing data from easily accessible environments to showcase the dynamic nature of the digital network. This is especially common in socio-ecological studies that examine social networking sites to represent the flow of information. Social media provides prime ground to source large amounts of information that are publicly available and have the potential to represent the social alterations that technology makes.

Although sourcing data from these locations also results in skewed representations of ecologies, as models often cannot not account for potential manipulations of the flow by non-human technologies. Wang (2022) claims that "our public construction and interpretation of who we/they are rely on little more than immediately accessible hypermediated data that we produce and circulate via digital media" (p. 382). Speaking to the mediated nature of the digital social sphere, the information drawn from its bounds is mediated through and by technology, such as algorithms. This means that the data drawn from these digital social ecologies are inevitably altered by the initial mediation of the environment that then later impacts the representations made of the network, which cannot account for this mediation. Wang (2023) later proposes that "turning our focus to the infrastructural and geopolitical conditions for transnational circulation" (p. 3) will aid in our reconceptualizing of how networks function within the digital sphere. Wang's (2023) call for a turn to examining the power structures that underpin the circulation of rhetoric is echoed in Jones' (2021) sentiment that methodologies employed by ecological researchers "emphasizes flux but elides material histories" (p. 1). Thus, the ecological tendency to focus purely on the interconnected nature of networks and the rapid disbursement of rhetoric could potentially allow researchers to neglect the analysis of agency and power that drives this interconnectedness.

In expanding on Wang (2023) and Jones's (2021) assertions of a gap in the study of material powers and the conditions of ecological constructions, there must additionally be an acknowledgement of the underlying agency of the non-humans that fuel rhetoric's fluctuations. These agential pursuits do not deemphasize the fluctuating nature of agency, rhetoric, or the digital sphere at large. Rather, these efforts suggest that critical examinations of the non-human actors that exist within ecologies can better aid in our understanding of how the digital network

functions. Critically examining how algorithms make sense of the world around them through the interpretation of data is an important endeavor for rhetoric scholars. With the digital sphere consisting of an exponential volume of interlinked artifacts that make up "big data," the spillage of rhetoric remains far too fragmented and large to ever capture it accurately as it exists. Thus, ecological models remain somewhat limited in pursuing their examinations of the "fluctuating" nature of digital rhetoric as it circulates across time and space and could potentially learn more about the network in interrogating the actors that drive such occurrences.

Outlining Parameters

Looking at flux and movement alone leaves us with flow without boundaries—something incalculable. In this scenario, flux is present, but there is no feasible way to calculate the extent of the "spillage" (or rhetorical trajectories) without any sort of parameterization. As the digital network that we exist in remains unparameterized, for an agent to make sense of it, they must parameterize. To parametrize something is to bestow it with set boundaries. These boundaries are necessary to calculate the flux in any capacity as a surface must be present for the flux to spill upon. Flux, in mathematics and physics, is defined as the amount of x (x denoting anything) passing through a surface (Martin et al., 2019), this "surface" is often dictated by algorithms when they carry out their layered, mediative agency. When the algorithm enlists human data to carry out a program of action, they utilize their encoded mechanisms to parameterize the flux and alter rhetorical trajectories.

The black-boxed opacity of machine learning algorithms makes it difficult to outline the ways in which they parameterize data and flux but that does not necessitate that accounting for their agency is a futile effort. Laurie Gries (2016) acknowledges that circulatory endeavors often fall short and that "we also need to work hard to identify those nonhuman entities…that play

such an important role in an image's rhetorical transformation" to fundamentally understand the ways in which digital rhetorics circulate. For circulation studies that draw upon data to trace rhetoric, analyzing and speculating on the parameters whereby programs of action are taken by technology will give way to a deeper understanding of how spatiotemporal flow is altered by mediative, agential powers.

Regarding digital delivery, Gallagher (2017) turns to the concept of an "algorithm audience" to allow authors to tactically anticipate how one might alter the composition of their text to better promote the visibility of their work online. Taking and modifying this idea to account for mediative agency could potentially aid scholars in better accounting for the parameters set by algorithms and their impacts on rhetorical trajectories. To begin to identify the "algorithm audience" Gallager (2017) asserts that writers start by thinking of the algorithms "processes and procedures as their audience" (p. 27). Thus, writers must then start by understanding the primary functions of the algorithm, requiring them to understand the parameters algorithms set in place to grant visibility. Since humans are not entirely aware of these exact parameters, there is a degree of speculation required to identify them for strategic use. Accounting for the mediative agents, like algorithms, that fuel the circulation of rhetoric uses these same principles. Researchers, when sourcing data from digital environments to showcase the macro trajectories of digital rhetoric, can begin to account for non-human agents that contribute to this circulation in firstly identifying the ways they carry out programs of action through their parameterization and mediation.

Considering algorithmic parameterization allows us to understand the agency fostered by algorithms' mediation of data and users. Because algorithms shape and limit how we engage with information based on encoded goals and parameters we might develop a speculative model that

anticipates how they arrive at final programs of action. Latour's conceptualization of non-human agency largely attended to objects that were black boxed in a manner that required abstraction to identify the relational impact of their mediation. Latour's example of a speed bump as a shifting enunciator that "stands in for an actor" (Latour, 1994, p. 40) to prompt drivers to slow down demonstrates the abstractness necessary in analyzing how they carry out agency. The speed bump has an inscribed program of action that is assigned through layers of association and technical entanglements. In contrast, the mediative agency of algorithms operates on encoded parameters that dictate their decision-making, which then is reflected within their tangible outputs. As algorithms produce predictive outputs, researchers can speculatively trace the parameters that algorithms use to assign value to data. For example, we better understand Google's PageRank algorithm not because we have full access to its innerworkings, but rather, because researcher's acquired large amounts of data dispersed from them to approximately calculate the factors that play a role in its design (Joshi & Patel, 2018). Thus, with these tangible outputs at our disposal, accounting for the mediative agency of algorithms in driving circulation becomes a more feasible endeavor for ecological theorists who wish to uncover the agential underpinnings of a network.

To provide a theoretical approach to how we might attribute the effectiveness of a viral disbursement of rhetoric to an algorithm's mediation, I expand on Van Horn et al. (2016) who proposes that "a theory of 'trend integration' might be developed to track the movement of trends and determine the various cues that help spread a trend from one location to the next." By speculatively identifying the cues, or parameters, that algorithms have in place to grant visibility to content, researchers can integrate an acknowledgement of the mediative agent when analyzing the data set. This acknowledgement entails considering the data points selected to determine the

cues that aligned with the parameters that the algorithm sets in place when fabricating a surface to process and alter the flux of rhetoric. This speculation can work both ways, in which, the researcher first draws on outside sources to inform the outlined parameters of the algorithm to identify their effectiveness, or they analyze the dataset for larger commonalities to identify what parameters potentially contributed to the disbursement of specific artifacts. The first method utilizes a model-matching approach, where researchers interested in the agential mediation of algorithms can assess how texts and artifacts that attend to or defy their parameters fare in the digital sphere. The artifacts' increased or decreased circulation, in being read through the algorithms' parameterization factors, allows for us to better understand to what degree algorithms play a role in contributing to the artifact's rhetorical velocity and circulation. The second method relies on producing a model of tentative parameters based upon the data gathered, which could foster additional speculation as to what parameters algorithms have set in place to alter rhetorical trajectories. We see this work primarily used outside of rhetorical studies to better understand how algorithms come to produce predictive outputs, yet the integration of rhetorical theory in developing these models could potentially enrich the understanding as to what implications algorithm's agency and parameters might pose to the social sphere at large.

Of course, the identification and assessment of algorithmic parameters remains the most difficult endeavor within this approach. Since conceptually, no two algorithms set the same parameters in place given their differing internal structures, especially on larger social media platforms that researchers utilize to source data for circulation studies, it becomes essential to adjust for the specific algorithm. Further, as machine learning algorithmic design is modifiable, and thus their parameters can be changed by their designers, as well as their own ability to "learn" and adjust from the data that they equip, this poses challenging problems in identifying

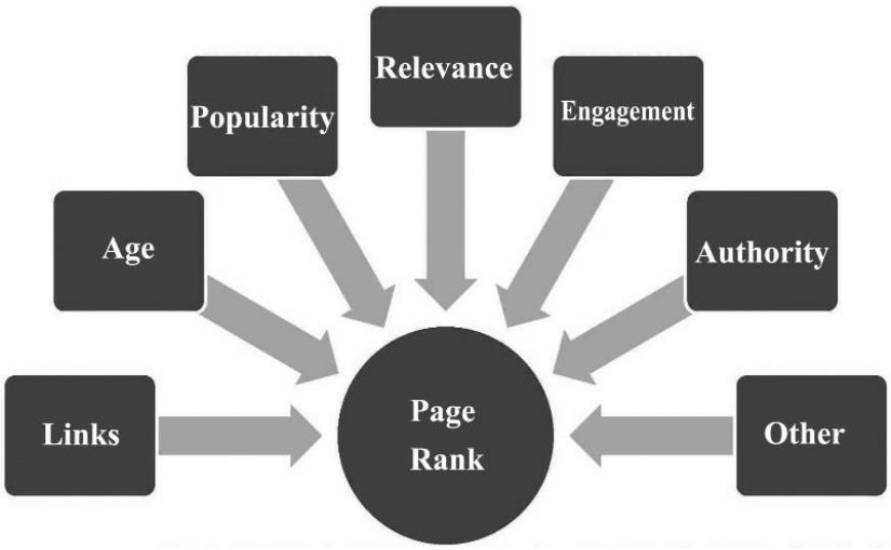
what drives their decision-making. Gallager (2017) turns to encouraging writers to construct "algorithm narratives" to identify and outline the "values and ideologies of a chosen algorithm" (p. 34) when composing for an algorithmic audience. These narratives largely take into consideration the "different rhetorical and compositional pressures" (Reid, 2017, p. 38) that arise because of the fluctuating nature of big data. The identification of emerging pressures, or parameters, that algorithms have on the circulation of rhetorics within the digital sphere, then, remains a crucial step. In tentatively expanding coding techniques to begin to identify and weigh the parameters by which algorithms function, we potentially better understand how their non-human agency is enacted.

Turning again to Google's PageRank algorithm, Joshi & Patel (2018) note several factors to determine how the algorithm assigns weight to different variables (see Figure 5). These factors can be perceived as a constructed "algorithm narrative" that helps the authors come to understand the parameterization that the algorithm enacts when granting visibility. Coding methodologies within circulation studies largely attend to the canonical rhetorical features of the datapoint or its temporal situatedness within the ecology. Though, with new rhetorical pressures emerging that widely contribute to the "effectiveness" (Seas, 2012) of rhetoric within the digital sphere, integrating these factors within our macroscopic tracings of circulation can assist in understanding the mediation of data by non-human agents. Joshi & Patel (2018) note in Figure 5 that "relevance," which is attributed to the overall webpage's quality of content and the usability/interoperability of the interface, is an important factor to "score higher" within the search. In utilizing this as a measure within a dataset, rhetoricians can assess if a webpage's "relevance" factored into the effectiveness of the rhetoric. If so, did all data points note a demonstrated effectiveness when webpage "relevance" was accounted for? Tracing these factors

in isolation may not offer any notable observations regarding an algorithm's impact on the disbursement of an artifact. But, in observing repeated patterns, we can potentially begin to assess how they have an impact on rhetorical trajectories. Thus, perceiving the mediation performed by technologies within the scope of the network broadens our understanding of the ways in which non-human actors contribute to the circulation of rhetoric and perhaps become the drivers of rhetorical trajectories. While my proposal to address algorithmic mediation is in its nascent stages, it points to what speculation can offer to the study of non-human agencies digital and rhetorical ecologies.

Figure 5

Google PageRank Factors



Note. The figure above details the tentative factors outlined by the authors to interrogate their weightage within Google's PageRank Algorithm. From "Google Page Rank Algorithm and It's[8] *[sic]* Updates," by A. Joshi & P. Patel, 2018, *International Journal of Management,*

[8] The published article includes this typo.

Technology, and Engineering, 8, p.1109. Copyright 2017 by International Journal of Management, Technology, and Engineering.

Algorithms deploy their mediative agency in parameterizing data to assign value and grant visibility within ecologies. By undertaking more critical examinations of the ways in which non-human agents, such as algorithms, alter rhetorical trajectories and by locating and speculating on these emerging rhetorical constraints, we can better account for the agency of algorithms. Additionally, this work can foster broader understandings of our networked relationality, as we garner a deeper comprehension of the ideologies that proprietors put forth within their design of algorithms. When attempting to trace the pathways that rhetoric takes, it is easy to attribute the accelerated flow to an accelerated social sphere that is innately chaotic (Dobrin, 2011), unstable (Brooke, 2009), and uncertain (Dush, 2015; Gries, 2016; Glotfelter, 2019). Turning to interrogating how prominent actors interpret and assign value to the given information within the environment and how they consequently make representations and produce outputs based on this information, allows us to trace the agency that underlies our digital and material reality. Thus, examining the layered parameters of agency that the network is built upon can help elucidate how the flow comes to be constructed by non-human actors within the ecology. Further, this approach also acts as a "speculative modeling" (Sundvall, 2019) technique, in that, pursuing questions of agency allows us to wholistically and critically understand what parameters non-human actors use to carry out programs of action. This perspective better equips rhetoricians to predict how these actors might develop and how they might further alter the production and disbursement of rhetoric.

Conclusion

The exponential volume of complex information that exists as a byproduct of our online activity fuels the "antirhetorical notion of the Web as an inherently decentralized, liberatory, and randomizing media platform" (Reeves, 2013, p.325). Big data and its immeasurable size and rapid speed suggests that the digital sphere is innately chaotic and expansive in incomprehensible ways, thus allowing for the perception that this expansiveness is indicative of a freedom from agential powers. Humans, however, have become increasingly reliant on emerging technologies that can store, comprehend, and analyze data for meaning at speeds that surpass human abilities. These conditions allow these technologies to take on a greater role in our lives and in turn, establish a complex agency.

The machine learning algorithms developed to aid in processing vast amounts of data enact agency in that their specific operations remain partially obscured from users by design. Humans and algorithms exist interconnectedly in the digital sphere, both contributing to making meaning of the world around them through data and contributing to the spread of data. The emerging potential of technologies to carry out programs of action that alter the digital ecologies they share with humans begs for more analysis into how they function rhetorically. Algorithms' ability to act, in that they generate outputs that are foregrounded to users, allows them to shape the very flow of rhetoric. My thesis accounts for the complex design of algorithms, the biases encoded within, and their proprietary status to display how their mediative agency takes form.

While much of my thesis discusses the "digital sphere" as if it is isolated from our lived reality, it is necessary to remember that just as rhetoric is spilled, data and technology spills. Machine learning algorithms have increasingly become utilized in many aspects of our everyday lives: in healthcare sectors to help diagnose mental illnesses (Cho et al., 2019), for screening

potential re-offending rates in legal cases (Skeem & Lowenkamp, 2020), in calculations for self-driving vehicles (Manoharan, 2019), and these are only a few of many examples. Further, this technology contributes to the datafication of our lives where this data might be examined to make further inquiries into our actions, prompting further examinations of our social and material realities and analyses of how they function and change over time. These new utilizations of technology and the rapid advancement of the technology itself opens potential for further investigations into how their mediative agency functions as well as what effects it might have on our perception of our ecologies and our world broadly.

Big data has additionally allowed researchers to better conceptualize the social dynamics that occur within our ecologies in providing us access to the information that was rarely stored prior to its allowance. The vastness of this data gives way to our understanding that everything remains interconnected, dynamic, and ever-changing. Yet, in accepting this unstable underpinning, rhetoric scholars greatly underestimate the major actors that play a large role in our conceptualization of this data. If how we come to understand data contributes to how we conceive of the world around us, the non-human actors that imbue this data with meaning through their parameterization have the agency to construct our world. Thus, defining these actors as mediative agents, as well as continuing to interrogate their evolving agency as they make meaning from the data and contribute to its spread, remains an important endeavor for ecological theorists who wish to uncover how networks function on both a macro and micro scale.

The technologies utilized to analyze and assign value to big data and the rhetoric contained within are increasingly complex and innately agential. In identifying major non-human actors that contribute to our understanding of information and critically examining how they

mediate and parameterize, rhetoric scholars can better understand how reality is crafted through these actors' alterations of rhetorical trajectories. Interrogating agency further serves as a method of "speculative modeling" (Sundvall, 2019) in that it allows us to theorize the functions of agency and anticipate how it might further develop as environments change over time. Developing new means of interrogating agency, as I have done in constructing my conceptualization of mediative agency, allows us to address the growing complexity of our dynamic reality. Thus, my thesis is a call for the re-centering of agency within our ecological models that gravitate towards conflating the complexity of our networked social sphere with chaos. The central question of my thesis remains: "who or what holds the power to analyze information and how do they go about doing so?" and I acknowledge that the answer will fluctuate as new actors come to the fore. Thus, it is imperative that rhetoric scholars continue to investigate the actors that contribute to making meaning and critically analyzing how they do so.

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