Complexity, Diversity, and the Role of the Public Sphere on the Internet

**Abstract:** This paper explores the relationship between deliberative democracy, the internet, and systems theory’s thoughts on diversity. After introducing Habermas’s theory of deliberative democracy and how diversity fits into it, the paper discusses various ideas about if and how it could work on the internet. Next, the paper looks at research into diversity done in the field of complex adaptive systems, showing that diversity has both good and bad effects, but is clearly preferred for the purpose of survival. The paper concludes with an analysis of how the results of systems theory’s study of diversity can assist society in bringing democracy to the web.

**Keywords:** public sphere, internet, communication, diversity, complexity, systems theory, democracy, Habermas, complex adaptive systems, epistemology

 Aristotle speaks about the importance of the assembly for democracies,[[1]](#endnote-1) while Cicero defines the commonwealth as the “concern[s] of the people.”[[2]](#endnote-2) Rousseau calls his sovereign “a moral and collective body, composed of as many members as the assembly has voices,”[[3]](#endnote-3) and Hegel says “the people’s right to participate in public affairs” is something in the government’s interests.[[4]](#endnote-4) Arendt describes the public as the place where everything that appears there can be “seen and heard by everybody and has the widest possible publicity,”[[5]](#endnote-5) while Habermas sees it as a place of “free-floating issues, contributions, information, and arguments circulating in a civil society set apart from the state.”[[6]](#endnote-6) Clearly the necessity of debate for a healthy democracy is widely accepted. Because it is important, democratic discussion must be carefully coordinated. Unfortunately, how this can be done is not immediately obvious. Given the many complexities associated with holding public debate, finding healthy strategies is difficult and time-consuming.

 Recently, many have advocated for deliberative democracy, or collective decision making done through rational dialogue that is open, communicative, respectful, and engaged. Attempts at coercion, threats, abuse, control, and manipulation are rejected. The public sphere is a major part of deliberative democracy for it is where rational dialogue occurs. When it functions well, the public sphere is diverse, free, equal, open, and respectful. Yet a society as complex as ours must also examine how the public sphere functions in our concrete circumstances, and that includes the media where it takes place. In this paper I will take up the topic of diversity, asking how we should manage it on the internet. My claim is that theorists of deliberative democracy have not fully explored how diversity must be arranged in the complex society we encounter online.[[7]](#endnote-7) I will begin by discussing the public sphere as described by Habermas. Next, I will describe how, in the context of the internet, deliberative democracy faces numerous challenges, such as the fragmenting of discussion into numerous groups, hostile behavior, and the difficulty assessing the validity of information. Third, I will utilize complex system theory, in particular the work of Scott Page and John Holland, to show how diversity operates in such systems. Finally, I will conclude by combining systems theory with debates about democracy on the internet to develop ideas for creating a healthy and inclusive public sphere online.

**Deliberative Democracy**

 Diversity plays an important role in theories of deliberative democracy. It was first described in Jürgen Habermas’s theory of rationality. Unlike earlier philosophers who treated rationality as something to be discovered, Habermas feels that philosophy needs to give up the idea that one can capture absolute truth or totalize knowledge. Rationality arises from an attitude opposing deception and embracing reasons.[[8]](#endnote-8) One must be able to convey these reasons to others in order to build collective meaning, and evidence shows that reasoned discussion or argumentation allows for the building of such consensus. Rationality is the product of communicative practice which takes place in the context of everyone’s unique experiences. As Habermas says, “the rationality proper to the communicative practice of everyday life points to the practice of argumentation as a court of appeal that makes it possible to continue communicative action [when other means fail or are not appropriate].”[[9]](#endnote-9) Dialogue produces the outcome of rationality, rather than rationality determining the validity of dialogue. It is here that deliberative democracy’s engagement with diversity begins, for this theory of rationality admits there are numerous ways one can rationally conceive of the world depending on one’s experiences.

 Even though rationality begins in diverse experiences, it quickly makes an appeal to universality. While there are some types of speech which do not claim to be universal, types of speech that do make such claims—such as appeals to truth and moral norms— “are, by their very meaning, universal validity claims that can be tested in discourse.”[[10]](#endnote-10) Deliberative democracy admits there are diverse experience and beliefs, yet puts forth a path to determine which truth claims deserve to be considered universal. As Simone Chambers puts it, “To believe that we have good reasons [for something] entails the idea that given enough time, given interlocutors of goodwill, and given a constraint-free environment, everyone would come to the same conclusion as we have. Thus, impartial judgments are judgments that would gain universal agreement in an ideal communication community.”[[11]](#endnote-11)

 With this theory of rationality, the only necessity is that communicative actors adopt certain assumptions about the operation of language and the way things are best communicated.[[12]](#endnote-12) If society were small enough, or diversity predictable enough, this is all communicative rationality would need for “purely communicative social relations.”[[13]](#endnote-13) But because people come from different backgrounds, hold different jobs, occupy different classes, have different abilities, and are not equally qualified to discuss different topics, society contains some inertia that is unfavorable to true communicative rationality.[[14]](#endnote-14) People institute laws and establish a government to reduce the complexity of society. Institutions and formal procedures for governance limit public debate and help citizens focus on the issues of most concern to society. Deliberative democracy still allows rationality to arise from discussion, but it establishes laws, organizations, and a constitution to facilitate that discussion, making the decisions reached legitimate.[[15]](#endnote-15) Diversity is streamlined and facilitated by both a communicative procedure and by institutions.

 The addition of a government and legal system bring another level of complexity. To make sure they respond to the needs of a democratic people, society needs a public sphere. This sphere should detect problems, give them an identifiable character such that others can relate to them, and advocate for them with enough force that the government feels obligated to take them up.[[16]](#endnote-16) The public sphere is energized by a robust civil society, which is a grouping separate from the state, economy, and social structures that is characterized by plurality, privacy, legality, and publicity.[[17]](#endnote-17) Civil society is interconnected with the political and economic system, allowing each to influence each other. To fully energize the public sphere, civil society needs to be developed in a liberal society that allows for freedom of expression, prevents the development of political hierarchies, and foregoes notions of self-organization or radical change which undergird totalizing theories like Marxism.[[18]](#endnote-18) This will create a free and equal people capable of rational deliberation. This body will solve problems and communicate interests to the government, which in turn will enact policy to carry out those interests. Diversity is a central part of this public sphere, and through it has an impact on other systems. To the extent that our complex and changing society create challenges, Habermas says law should be deemed historically situated. As the public’s decisions and the government’s policies will always be endangered by forces that question their legitimacy, laws should be regularly reinterpreted as one’s context changes.[[19]](#endnote-19) This final point is relevant because it reveals how diversity manifests itself through history, and how the law must change to streamline and facilitate it.

 Deliberative democracy thus is composed of a diverse social world as well as practices which ease the encounter between different perspectives in order to produce a stable political system. It is clearly a complex adaptive system defined by diversity. To clarify the role diversity plays in Habermas’s work, I will now summarize Antje Gimmler’s assessment of its value. Gimmler says one of the key values of Habermas’s version of deliberative democracy is its pluralism. Society is composed of many cultures, beliefs, and practices, all of which are valuable. Rather than institute society on pre-determined values, it is instituted on procedures that will bring about the goal of democracy. The public does not intentionally eliminate any interests or privilege one group over another. The aim of the public sphere is the creation of public opinion through the interaction of all the voices that compose society. Deliberative democracy doesn’t say that this is easy—Gimmler emphasizes it won’t be, given the heterogeneity of society—but the former does help to create the latter by funneling public opinion back into the legitimate means of governance. The diverse groups that create public opinion are encouraged to participate by being included in the public sphere and by virtue of the public sphere being filtered through structures of governance. As Gimmler says, “individuals are drawn back into the political process within the public sphere and with them a diversity of interests and preferences. The attitudes and interests, desires and motivations of individuals emerge from the process of interaction within the public sphere.”[[20]](#endnote-20) The public sphere thus handles diversity by incorporating all of it, and makes it useful through judiciously integrating it into constitutional democracy and State institutions.

 How does deliberative democracy incorporate so much diversity? Lincoln Dahlberg sets forth criteria for democratic debate which include exchange and critique of reasoned moral-practical validity claims, reflexivity, ideal role taking, sincerity, discursive inclusion and equality, and autonomy. The first, exchanging validity claims, is the idea that a healthy dialogue requires honestly stating one’s views and backing them up with reasons. The second, reflexivity, insists that members of the public sphere take the time to examine their background assumptions for validity and measure the assumptions against their social context. Third, ideal role taking requires members of the public to understand others’ arguments rather than dismissing them or refuting them through fallacious means. One should be generous and constructive when listening to interlocutors. Fourth, sincerity is the requirement of providing both honest information and all the necessary information that people need to make decisions about the problem under consideration. This includes biases, interests, and other personal factors influencing one’s decision. Fifth, inclusion and equality mean participants in dialogue are all equally entitled to participate in the dialogue, and everyone who is affected by the issue under discussion has the ability to participate. Inclusion can be limited by forces both inside and outside the discourse taking place. Finally, autonomy means that the dialogue taking place must be separated from economic or political interests held by those in positions of power. Within the dialogue, it is important that participants be able to treat each other equally.[[21]](#endnote-21)

**The Internet and Democracy**

 Let’s now turn to a discussion of how the theory of deliberative democracy has been applied to the internet. The advent of online communication has had both good and bad effects on the practice of democracy, and significant amounts of academic literature debate whether the internet is good, bad, or mixed with respect to democracy. Antje Gimmler believes the internet serves the ends of deliberative democracy because access to it is equal and unrestricted, which informs more people and contributes to their ability to deliberate.[[22]](#endnote-22) People from all parts of the world can get involved in decision making, overcoming geographic and logistic barriers to true deliberation. Because the internet is cheap and easy to use, it allows the lower class to participate. The fact that information can be sent and received quickly encourages informed debate among much larger segments of the population than before. The structure of the internet makes marginalization or repression of voices difficult since the internet is “rhizomatically constituted and not segmented or organized hierarchically.”[[23]](#endnote-23) The internet is constituted by many computers connected through numerous relationships which transcend traditional social, political, and economic categories, creating a net contribution to democracy.

 As an example, Gimmler describes to the Minnesota E-Democracy project, which hosts listserves that Lincoln Dahlberg also writes about. Both scholars believe that the project epitomizes deliberative democracy online. Dahlberg measures it against the criteria for democratic debate discussed earlier, finding that it meets the criteria as much as in-person forums. While it needs more diversity and independence from the state, the forum encourages responsible dialogue by encouraging members to follow guidelines, having moderators that monitor rather than closely manage discussion, asking participants to take responsibility for guiding others, and basing content on issues of concern to all.[[24]](#endnote-24) Other empirical data partly supports this conclusion, as a case study of online forums in Brazil during the 2010 election noted that “conversational responses” were the most common type of comments. While there was a notable lack of civility which prevented true deliberation, there was both “interactivity” and an “exchange of information and ideas.”[[25]](#endnote-25) The point of both Dahlberg’s and Gimmler’s reference is to show that the internet is as capable of democratic deliberation as any other forum. In some ways it can do more, since it offers new ways of consuming information (i.e. it is more accessible and can be shared through multiple platforms).[[26]](#endnote-26) To encourage democracy in all online forums, Gimmler and Dahlberg recommend public financing of deliberative spaces so that they are not co-opted by commercial interests, using easy to access software that is built with deliberative democratic principles in mind, cultivating a will towards civic participation in society, keeping nonprofits involved so that access remains affordable, and protecting the right to information gained through deliberation by referencing fundamental rights.[[27]](#endnote-27)

 The idea that design can encourage deliberation is confirmed by Scott Wright and John Street, whose study of online discussion forums discovered that the processes by which opinions are solicited and moderation is performed are correlated with the level of deliberation that occurs. Using Anthony Willhelm’s typology of online messages[[28]](#endnote-28) to study the Futurum online forum, they found that Futurum’s increased level of deliberation could be explained in part by its design.[[29]](#endnote-29) The final virtue that scholars see the internet bringing to democracy is the inclusion of the voices of those who would otherwise be marginalized. Both Dahlberg and Gimmler allude to this, but studies by Kerill Dunne and Ali Pirannejad use quantitative data analysis to prove this point. Dunne examines the types of discussions that occur on forums that either have a core group of contributors or lack one. Surprisingly, the discussions on both types of forums have many of the same features.[[30]](#endnote-30) Dunne concludes that the discussions found in online forums expose participants to differing political opinions and, when coupled with democracy, can transform private opinions into public ones.[[31]](#endnote-31) Pirannejad studies information from 122 countries from 2000 to 2014, using both the “Ordinary Least Squares” and “Dynamic Panel Data” models to check whether the introduction of the internet correlates with an increase in democracy in these countries. Assessments of how democratic countries were during this period came from the Freedom House, which analyzes factors like Electoral Process, Political Pluralism, Rule of Law, and Individual Rights.[[32]](#endnote-32) The study also looks at increases in education and Gross Domestic Product to gauge the countries’ health. Pirannejad concludes that “Internet extension has a significantly positive effect on democracy promotion,” probably because it promotes “political participation, empowerment, consultation of citizens” and reduces “poverty and illiteracy.”[[33]](#endnote-33) Because it includes more people, uses new methods for sharing information, and resists top-down domination, the internet arguably supports democracy.

 Others claim the internet harms democracy. Matt Hern and Stu Chalk argue that internet participation is superficial, saying “genuinely participatory and direct democracies require the kinds of humanly-scaled social relationships that only face-to-face living, commitment and an unshakeable love of place can support.”[[34]](#endnote-34) Democracy thrives in communities where people know each other, work together for common goals, and feel the pull of responsibility that comes from personal encounters. These things are missing from the internet. Interactions don’t carry the same weight online, as one can ignore unpleasant people and discussions. Face-to-face communities also suffer when people spend so much time online that they ignore the hard work of building and maintaining relationships. Hern and Chaulk recommend returning to local, place-based democracy. The internet should be used with care, and democracy should not rest on it.[[35]](#endnote-35) Some empirical data supports this conclusion, as non-deliberative dogmatic (and sometimes insulting) claims are one of the most common type of comments found on Brazilian message boards (though the authors of the article posit that some such comments may be part of the ‘sociality’ necessary for maintaining participation and deliberation at other times).[[36]](#endnote-36)

 Peter Dahlgren describes multiple shortcomings found in online discussions, including a lack of reason and tolerance, the use of anonymity, and low levels of participation[[37]](#endnote-37) (that said, he does believe in the possibility of useful discussion online[[38]](#endnote-38)). Another downside of the internet as it pertains to the public sphere is the loss of expert knowledge. This idea is discussed by Nicola Mößner and Philip Kitcher in their paper “Knowledge, Democracy, and the Internet.” Mößner and Kitcher examine how the internet changes epistemological practices, concluding that there is a need for expert knowledge which the internet is not satisfying. They begin by saying that large amounts of information create a need to filter knowledge and differentiate right from wrong.[[39]](#endnote-39) In the environment of the internet, there are new ways of both producing and consuming information. Sources of information and ways of absorbing information have multiplied. Methods for filtering good knowledge from bad have not grown in response, and democracy is threatened without experts to clarify what is trustworthy. Through an analysis of Wikileaks and Wikipedia, Mößner and Kitcher show that the best way to check sites for accuracy is by evaluating their epistemic processes (the methods sites use to decide what to publish) and identifying those which are trustworthy.[[40]](#endnote-40) In a medium where anyone can call themselves an expert and publish findings online, deciding who to believe is very difficult. Many issues (e.g. climate change) require expertise to fully understand, and laypeople often encounter inaccurate information that sounds plausible.[[41]](#endnote-41) The result is a media landscape where information is produced and consumed in more democratic ways, but we cannot differentiate between truth and falsity. Online knowledge production encourages confirmation bias, personalization of internet searches, and the “partitioning” of the internet into many “niches.”[[42]](#endnote-42)

 If we want to use these new methods of knowledge consumption, we must retain old practices of knowledge production where experts are followed. Hana Grill echoes this concern, saying that social media undermines democracy since it cannot currently guarantee the accuracy of the information it hosts. Their platforms are prone to manipulation, censorship, and abuse for the purpose of propaganda.[[43]](#endnote-43) As many have noted, the internet can easily become a place of “systematically distorted communication” whereby someone only apparently adopts a position of openness and understanding, but is really deceiving themselves and acting strategically.[[44]](#endnote-44) Grill also says that the internet’s structure marginalizes certain voices (i.e. the opposite of Gimmler’s claim; I will address this difference later). As social media are commercial enterprises that offer advertisers an audience in exchange for money, they promote inequality by privileging those who can afford the infrastructure needed for social media use over those who can’t.

 This problem is echoed by Charles Ess, who describes the problems with the internet as “communicative capitalism” and “platform imperialism.” Social media platforms and other internet sites “work largely to reinforce existing beliefs and convictions, while undermining possibilities of challenging neoliberal capitalism.”[[45]](#endnote-45) They embed cultural and ideological values in their operations, and force themselves upon other populations by eliminating alternatives. The internet supports the corporate narrative via legal, political, and economic means. Dunne offers support for this claim, saying that surveys of local political online forums show that rational deliberation is absent while mixed discourse (dialogue that includes storytelling and personal experience in addition to some rational deliberation) is rare. The primary mode of discussion is non-consenual and non-rational.[[46]](#endnote-46) Though Dunne doesn’t address how much neoliberalism is reinforced, his evidence supports the claim that existing viewpoints are reinforced and rational deliberation nonexistent . Lastly, voices are marginalized online through the creation of an outside composed of ‘improper behavior.’ Rules about propriety become sedimented such that those who follow them become ‘rational’ and those who don’t ‘irrational’ or ‘extreme.’[[47]](#endnote-47) While these narratives can be contested, they are operate continually and currently are exercised by “corporate portals and mainstream media sites.”[[48]](#endnote-48) All voices are not treated equally.

 The authors suggest some solutions. The first is designing technology with the goal of human flourishing in mind. Technology’s relationships with humans should aim to make the latter excellent in all things. Designers should incorporate the things necessary for a good life, as well as ideals like environmental stability and fairness in labor, into the operations of the internet.[[49]](#endnote-49) This means teaching people to be comfortable without the internet, regulating when and where the internet can be accessed, and cultivating tech-free practices. The second solution is cultivating deliberative spaces online. This requires building easy to use technology, encouraging small and intimate dialogues, making sure people feel comfortable, fostering a culture of deliberation, and determining the best ways to facilitate complex dialogues. Use of public funding to create and improve these projects is necessary to avoid the corruption caused by corporate financing. A ‘will towards participation’ creates a healthy civic society online.[[50]](#endnote-50)

 The third solution is a more disciplined production and distribution of information. Democracy thrives with transparency, and requires trust in the information you receive. Standards that ensure accurate and detailed information are necessary for a healthy public sphere built on a common epistemological foundation. This is best brought about through a regulatory agency that can encourage transparency in how information is produced and maintain the proper qualifications of those producing it.[[51]](#endnote-51) Finally, Dahlberg suggests counter-publics, or alternative discursive sites that cultivate discussions opposed to the dominant one. The internet can encourage relationships and support identities marginalized by the prevailing narrative. It is easier for people supporting an alternative vision of the public to find each other, organize, and contest discourses using the internet. Through a back and forth between the dominant narrative and alternative ones, a more robust democracy can be brought about online.[[52]](#endnote-52)

**Complex Adaptive Systems**

 As my contribution to this debate comes from systems theory, the next step is to review its ideas about diversity. I will begin by addressing Habermas’s criticisms of systems theory.

 Habermas criticizes systems theory because it removes the normative dimension from democratic theory in the name of realism.[[53]](#endnote-53) Systems theory abandons notions of individual or collective agency, conceives of society as a network of autonomous subsystems, and focuses on how these subsystems work rather than considering intentions or interests.[[54]](#endnote-54) Because systems are closed, self-referential objects, unaffected by their environments,[[55]](#endnote-55) Habermas says systems theory can describe how democracy does work, but not how democracy should work.

 While the systems theory used in the social sciences of the 1990s (when Habermas wrote this critique) may have operated this way, current theory operates differently. Perhaps most important is systems theory’s incorporation of complexity and adaptive agents, such that the former arises from the interactions of the latter with each other and their environments.[[56]](#endnote-56) Intentions and interests, as well as the environment of systems, can be incorporated into the study of systems. John Holland, in his book *Hidden Order: How Adaptation Builds Complexity*, explains that complex adaptive systems are “composed of interacting agents described in terms of rules” where “agents adapt by changing their rules.”[[57]](#endnote-57) When many adaptive agents interact, nonlinearities flourish.[[58]](#endnote-58) Rick Davies echoes this claim, saying that the “Logical Framework” understanding of change (a model that starts with linear processes and treats the world as mechanistic and predictable) is inadequate, and argues for a networked understanding that treats the world as chaotic, complex, and unpredictable.[[59]](#endnote-59) Modeling no longer uses the deterministic, closed, and self-referential method Habermas criticized. Because Habermas’s criticism of systems theory is outdated, we should ask what systems theory can add to theories of democracy.

 John Holland argues that diversity is a characteristic of complex adaptive systems (or *cas*). As Holland says, “diversity is neither accidental or random. The persistence of any individual agent, whether organism, neuron, or firm, depends on the context provided by the other agents.”[[60]](#endnote-60) Many operations encourage diversity, such as the existence of mutator genes which allow for more rapid adaptation to changes in context, or how movements and migrations of species can create openings for new organisms to arise.[[61]](#endnote-61) “Perpetual novelty is the hallmark of *cas,*” Holland concludes.[[62]](#endnote-62) Diversity—the presence of many types of agents—is often encountered in highly interconnected systems featuring lots of agents—or complexity.

 These factors exist in social systems too (for one example, see Lansing, 2003).[[63]](#endnote-63) Holland describes how adaptation occurs in economic systems using the pin factory example from Adam Smith’s *Wealth of Nations*. The factory used specialization, efficient learning, and mass production as organisms in natural systems do (though Smith doesn’t fully explain how those traits created fitness in the factory’s society).[[64]](#endnote-64) These innovations diversified the system, and took hold because they filled a niche. Experiments conducted by Walker, Cowling, Lawton, and Ghilarov confirm that, as Smith’s example shows, diversity increases the likelihood that innovation will arise.[[65]](#endnote-65)

 Holland uses two-tiered *cas* model to describe some processes that produce diversity. The first tier is where flows of resources between agents occur and where agents respond to resource allocation in the short term. Looking at this tier, one can learn how fast resources travel, where they are located, and how agents are affected by resource distribution.[[66]](#endnote-66) For example, one can see how ‘bottleneck resources’ (i.e. limited resources) affect other parts of the system (i.e. the growth of populations), leading to large changes in the system. Tracking resources on the lower tier provides an understanding of the system’s short-term dynamics. The upper tier is where long-term adaptation and evolution happen. Long-term responses to the flows of resources, such as the shifts that occur in a species’ genome between generations and the evolution of new types of agents, are found here.

 The relevant point is that each tier affects the other. Movements on the lower tier alter how agents are organized on the upper tier, while changes on the upper tier affect how resources are allocated on the lower tier. The system produces diversity because the interactions and relationships among tiers are constantly changing. As Holland says, “a change in the definition of the agent-kinds (aggregations) used in the lower tier will result in different couplings to the upper tier”[[67]](#endnote-67) and “the upper tier has the effect of continually changing the flow network of the lower tier, as the agents evolve and adapt.”[[68]](#endnote-68) Diversity is an emergent feature of complex adaptive systems.

 Diversity does not necessarily mean unpredictability or unproductivity.[[69]](#endnote-69) By studying the role of diversity within complex systems it is possible to develop practices that produce sustainability. While not all theorists use Holland’s two-tiered model of change, it is common to study the development of systems at several levels, from the individual to the group to the ecosystem as a whole.[[70]](#endnote-70)

 Scott Page mentions several constraints on diversity in *Diversity and Complexity*, including the size of the possible, relative demand, interdependence/coordination, variation of selection, functionality/brittleness, and plasticity/rate of adaptation. The ‘size of the possible’ refers to the possible types of a thing; the smaller the number, the less diversity. ‘Relative demand’ refers to the need for something within the system, where a greater need produces more diversity. ‘Independence/coordination’ refers to how interconnected a thing is with other parts of the system. The more connected the more limited the ability to diversify, since the thing must respond to others. ‘Variation of selection’ refers to the forces that select for the types that can exist. If the pressures vary over time and space, diversity increases, whereas if the pressures are less varied and encourage a small number of forms, diversity decreases. (Page gives the example of oil tankers, which are constrained by the desire for more profit [thus bigger ships] and by physics and canal sizes [which limit how big ships can be] making oil tankers roughly one size). ‘Functionality/brittleness’ refers to whether a variation can survive and find a niche (the less functionality, the less diversity). Finally, ‘plasticity/rate of adaptation’ refers to how quickly a thing can adapt. Some things adapt quickly, other adapt slowly.[[71]](#endnote-71) The degree to which these constrains apply determines roughly how much diversity a system, or parts of it, will have.

 Changes in an agent’s traits or a system’s features are not axiomatically better. When a system is constant, there is less variation because forces generally push for a common outcome.[[72]](#endnote-72) Furthermore, variation can harm sustainability by reducing the system’s fitness. Systems can generate a balance of power where no agent is dominant. With lots of variation, it may be difficult to find such a balance, leading to unpredictable and potentially destabilizing actions. A balanced system where each being can correctly assess the powers of others contributes to long-term sustainability.[[73]](#endnote-73)

 Yet there are benefits to diversity. With a diversity of types, a system is more likely to have variations that aid adaptation. Systems inevitably change over time, often in ways that are outside any agent’s control. The amount of money a store makes daily and the local temperature are two examples.[[74]](#endnote-74) If a system is composed of diverse types, a change in one part of the system is less likely to substantially affect the whole system. For example, franchises set up stores in many locations so that events in one place will not preclude a profitable day. Similarly, diverse stock portfolios are more likely to yield stable returns in the long run since market fluctuations affecting one industry won’t affect the portfolio’s productivity.[[75]](#endnote-75) Finally, Barbara Cherry argues that the diversity within the telecommunications system is why an adaptive policy is needed to manage it.[[76]](#endnote-76) Because some changes influence numerous parts of the system at the same time, diversity does not prevent all variation, but manages it.[[77]](#endnote-77)

 The second benefit of diversity is diminishing returns to type. Diverse ecosystems fare better because there is a benefit of having many species and many types, particularly because conditions constantly change. As environments have multiple roles to fill, it helps to have different species fill those roles. And as conditions in environments change—perhaps as a result of seasonal change—new and diverse species emerge to fill the needs those changes create.[[78]](#endnote-78) The greater the diversity of species in an ecosystem, the better its performance and chance at survival will be.[[79]](#endnote-79) When there are many species, the good that one species does is lessened. The benefits that come from having a species in an ecosystem decrease when there are numerous others. If the benefit that a species provides can be sustained by a small number of the species, the ecosystem can make room for more diversity. As Page concludes, “We have seen that decreasing contributions from types imply that diverse collections perform best on average…We have also seen that diverse collections can perform best on average even when diversity creates harmful interactions.”[[80]](#endnote-80) Diversity contributes to survival.

 This last point is confirmed by the fact that mutator mechanisms are often found in organisms with a need to regularly adapt to new environments. Mutator mechanisms trigger changes in an organism’s mutation rate, making mutation either more or less likely. When mutators are activated or suppressed (depending on the type of mutator), diversity increases.[[81]](#endnote-81) What’s important is that mutators are selected for “when the normal mutation rate is the limiting factor in adaptation.”[[82]](#endnote-82) There are organisms that need to adapt quickly to survive, or processes that thrive through the production of genetic diversity. An example of the former is HIV-1 infections, while two examples of the latter are mammalian antibodies and antigenic trypanosomes.[[83]](#endnote-83) In each case, the organisms benefits from producing great diversity because it is more likely to create a variation that will survive. The organisms don’t constantly need great variety, but in certain situations (e.g. when HIV is spreading within a host’s body) it is preferable.

 The final point to discuss is how diversity works in complex adaptive systems. Holland’s discussion of *cas* revealed that diversity emerges in complex systems in response to changing extrinsic conditions and the changing rules of agents. Because the public sphere is a complex adaptive system, I will now discuss applications of *cas* to public discourse. First, complex systems benefit from allowing agents to specialize. When agents do all the work needed for their survival, they cannot produce as when everyone does work they are skilled at before trading their products for the things they need. Similarly, one can pick up one skill faster by focusing on it, whereas learning many skills simultaneously divides one’s attention. The faster one learns, the more one can contribute to the wellbeing of themselves and those around them.[[84]](#endnote-84) Also important are two of the interactions that Page terms synergies: superadditivity (i.e. emergence) and multiple landscapes. Superadditivity is the idea that variations can build on themselves such that they act as a third variation when combined. More comes out of the system than was put in when new phenomenon arise that are not simply the addition of two variations, but operate autonomously. Page gives an example, saying “suppose that one mutation procures stronger tree roots and a second mutation produces taller trees. The mutation alone would be nice, but probably unnecessary. The second mutation would lead to trees that fall down. The two mutations together produce a tall tree that won' t fall down.”[[85]](#endnote-85) Page summarizes, saying, “the whole exceeds the sum of its parts.”[[86]](#endnote-86)

 Multiple landscapes is the idea that certain perspectives can more easily solve some problems than others. Becoming stuck in a perspective can make problems appear insoluble, but a change of perspective can reveal previously unseen solutions. Diversity often uncovers solutions that unvaried systems miss. Similarly, by comparing diverse perspectives, we can develop optimal solutions which work best for all. Page says “with sufficient diversity in representations, the only common peak will be the optimal solution.”[[87]](#endnote-87) Next, collective knowledge is the idea that, on average, predictions from multiple agents yield better outcomes. While diversity will not produce complete accuracy, it reduces error more than trusting any one perspective does. The errors made by a collective are less than those made by individuals because they are reduced by “prediction variance.”[[88]](#endnote-88) This is similar to the idea of ‘response diversity,’ which says that having species which can respond to disruptions in a variety of ways creates more resilient systems.[[89]](#endnote-89)

Redundancy in systems provides backups in case one part of the system fails. While this reduces diversity in one way—there are several agents that play a similar or the same role—it also increases diversity, as there are now multiple ways of completing tasks that the system needs completed. Survival does not depend on one species or method.[[90]](#endnote-90) This increases robustness and prevents the degeneration of a system. It also separates the system such that the loss of one part does not lead to systemic failure or the loss of one type of agent.[[91]](#endnote-91) In addition, if one there is redundancy, one part can change without the system being affected. This is useful when the system needs to adapt without losing extant functionality. Finally, the idea of crosscutting cleavages says that when a system features diverse groups, each group is likely to identify and connect with other groups. When groups share similarities with others, they will be able to create partnerships and sustainable relationships. If they only identify with their own group, they will potentially want to separate, harming stability. A more holistic network forms when it is composed diverse groups; unvaried groups create a system inclined to collapse.[[92]](#endnote-92)

**Analysis**

 It is now time to compare the discussion of diversity in systems theory with the way it is described in analyses of democracy on the internet. The relationship between the internet and democracy bears numerous similarities with role of diversity in systems. As a complex system, democracy consistently produces diversity, which can have both good effects and bad. Building an effective democracy requires cultivating the good effects while minimizing the bad. Gimmler, Dahlberg, and Pirannejad describe the internet value for democracy, saying that it has a networked structure, can encourage true deliberation, and has contributed to freedom. Hern and Chaulk, Mößner and Kitcher, Ess, Grill, and Dahlberg say the internet harms democracy by increasing knowledge consumption and production without proper filtering, propagating a corporate narrative that marginalizes those who don’t fit, and preventing the in-depth relationships democracy needs. The internet’s networked structure parallels how systems encourage averaging and diminishing returns to type while incorporating firewalling and redundancy. The more people at more computers, and the more servers hosting material, the more interconnected the internet. Having different users, information, and terminals promotes the internet’s sustainability by incorporating many different agents capable of performing the tasks needed. To the extent that these voices deliberate online, this promotes democracy. Similarly, some purposes the internet has—like making decision among large groups—benefit from true deliberation, so sites like Minnesota E-Democracy do promote democracy. Third, the addition of everyone’s voice online yields something different than the sum of all the parts (i.e. superadditivity, multiple landscapes, and collective knowledge). There is often a net gain to true deliberation and the incorporation of diverse voices that is not found by simply adding individual views together. Given how the internet can benefit from having diverse agents involved, it is not a surprise that Pirannejad’s quantitative analysis saw political pluralism, rights, and freedoms in the places the internet went.

 Conversely, the problems the internet causes for democracy relate to the pressures that prevent diversity. There is a lack of experts because there is not much demand for them and they are not thoroughly interconnected with the internet. They are like a bottleneck resource limiting the production of verifiable knowledge, and without getting a bigger niche they will have trouble reducing misinformation. The widespread corporate narrative and marginalization of non-corporate voices exist because they are the types of things that can exist within the neoliberal world. There are strong selection pressures discouraging non-corporate mutations, and while they would have functionality in another system, within this one they have a small niche. The difference between Gimmler and Grill regarding the inclusion or marginalization of online voices makes sense using this analysis. Gimmer is right that more voices are included online, which demonstrates how diversity does not go hand in hand with stability. Without managing diversity properly (by ensuring accurate information, for example), there’s no guarantee of a healthy democracy. In addition, the plasticity of corporate narratives (a trait that many have commented on, including Jameson, Hardt, and Negri[[93]](#endnote-93)) allows capitalism’s elitisms and exclusions to persist. Finally, the lack of communal relationships on the internet comes from the types of relationships possible, the forces selecting for them over others, and the demand for such relationships online.

 This analysis doesn’t necessitate that these problems exist. Instead, it shows that we can identify where the problems come from. Systems theory readily admits that systems change, and that no features persist indefinitely. The outcome of this analysis is that democracy is possible on the internet with an intelligent approach that confronts the forces preventing it.

 The solutions described earlier (slow tech, cultivating a culture of deliberation, regulation, counter-publics) are worth trying. But except for counter-publics, they are all practices carried out locally or imposed on the system from above. Another avenue needs to be pursued, which is the systemic perspective. How can we, when examining the entire system, create a healthy public sphere on the internet? The first step is to forego the idea that the internet can act as one public sphere. It is far too complex and diverse to be counted as one public. It will never be possible to hear all voices equally or to consider them as they deserve. Voices speaking in other languages, with different idioms, and on different sites compound the problem. Currently, the practicalities of arranging the whole internet according to the principles of the public are insurmountable. What we can have are many public spheres produced at a manageable level, such as Minnesota E-Democracy. To some extent that is what the internet already is, since it hosts many sites capable of encouraging dialogue. The forces that foster diversity will operate on these publics the same way they do on other systems, meaning that they will develop variation over time. People within each public will adapt to one another, creating new and different perspectives that diverge from those encountered elsewhere. In other words, partitioning is an inevitable outcome of the internet’s complexity and the ongoing creation of diversity. Related to this is the loss of experts, since the partitioning of groups will inevitably lead to different groups becoming biased in favor of experts that support their perspective. While Mößner and Kitcher are right that overcoming the partition of knowledge requires experts, they omit that the partitioning of knowledge partially produces the lack of experts, since ideological biases make people distrust other perspectives. There is a clear connection between the irreducible complexity of the internet and the dangers it poses to deliberative democracy.

 Regulation and developing cultural practices consistent with deliberative democracy are important, but there’s another solution. Complex adaptive systems theory says that diverse systems work best when they are interconnected such that each part can respond to others. Online public spheres are not networked in this way. Individual public spheres can grow without relying on others. This freedom granted by social media platforms enables the harmful partitioning on the internet. (This is not to say that oppression is preferable, but that without interconnectedness freedom won’t work as it should.) We need a more interconnected set of public spheres, such that no one public sphere becomes autonomous. Right now online forums, most of which do not qualify as public spheres, depend on platforms where individuals can interact and information can be shared. Specific forums may have unique needs, such as a relationship with a celebrity, fund-raising, or secret ways to communicate. The platforms themselves lack diversity as they are controlled by elites. One way of avoiding the problems described above is to have social media platforms controlled (e.g. how they work, where they are hosted, etc.) by those using them.

 The other things forums need don’t necessarily connect them together. Content is often produced by institutions (which Habermas says restrict complexity[[94]](#endnote-94)), while individuals don’t have to be part of different forums. To build a network of public spheres, forums following the deliberative democracy model must engage more with others when seeking information and participants. Information should be sought both from outlets and other places for deliberation. Public spheres should not wait for participants but advertise themselves responsibly, seeking out participants that could better inform their discussion. Engaging in participation across several forums should be a part of one’s civic life (for which one may deserve compensation).

 Diversity flourishes when there are many roles for members and groups to fill. While not all online forums can contribute to all discussions equally, groups become alienated and more autonomous when they are not included. The climate change discussion is a good example. While the evidence clearly backs one side, the refusal of some climatologists to engage climate-change deniers fuels conspiracy theories. The argument that engaging deniers legitimates them and provides them a platform is valid if experts are supposed to only talk with individuals of a similar status and if their discussions are widely broadcast. But if experts are expected to encourage diversity and interconnectedness, they should be willing to talk with many others. Their discussions don’t need to be hosted on large media platforms or by prestigious institutions. The groups experts interact with must forego pre-made conclusions and engage openly. Diverse systems work best when the various agents can predict the behavior of others. These changes will make the internet’s public spheres more transparent and predictable, allowing other groups and agents to adapt better. In sum, the internet will inevitably lead to some level of partitioning in its attempts to hold public dialogue. The response is not simply more regulation, but a holistic and healthier networking of these public spheres.

 In addition to networked public spheres, we should try to overcome the forces constraining diversity. Given how much corporations circumscribes democracy, removing their influence will do a lot. Corporations don’t just obscure some voices while privileging others, they both produce and constrain communication. Sound bites, easily communicable phrases, and entertaining content are the most commonly transmitted messages found on social media.[[95]](#endnote-95) Substantive dialogue, open and honest debate, and complex arguments are rare. Much of what passes for debate online is done in addition to one’s job and is not seen as part of one’s duty. More sites need to be created which produce diverse relationships, content, and dialogues. These are roughly equivalent to mutator mechanisms. Just as mutators are activated in certain situations when diversity is of great help, online forums can increase diversity when it will be stimulating. Keeping in mind that diversity itself is not a solution, there are times when embracing a plurality of opinions will lead to healthy outcomes. Social and political institutions could create a demand for such practices and encourage their growth. Most of the interactions institutions currently have with the public are short, but they could work to create a demand for longer, more diverse ones. Giving more control over the development of the internet to local places would help to produce diversity by increasing the variation of selection pressures. Finally, there are several actions that can address the problem of experts as a bottleneck resource. The first one is to produce more experts. The focus on vocational education harms this goal, for it doesn’t create agents capable of engaging with diverse viewpoints. Next, more effort can be made to spread experts throughout the internet. While it makes sense for experts to interact, and thus to follow the model of academia, it is also important to make experts available online where the public can interact with them. Having major websites work with experts who can help the public is one way of spreading the resource throughout society. Additionally, seeding experts in many online institutions, and making their methods and resources widely available will foster a more informed public.

**Conclusion**

 Diversity is a virtue, but not universally so. There are times it harms our goals or promotes repulsive views. Its advantages are mitigated by the challenges of organizing it properly. Democracy recognizes this virtue, and its advocates have described ways to make it work for the best. The challenge comes from how complex societies are, and their many possibilities. As we cannot create contingencies for every danger, we must make society adaptable so that it can respond without endangering its goals. The internet offers many possibilities for this, but also brings threats. Analyzing it as a complex system can help us use the internet more effectively. We can create a network of adaptive public spheres which, together, will take the place of the public sphere that earlier theorists described. Complexity and diversity would work for, rather than against, democracy.

1. Aristotle, “Politics”, in *Complete Works, Vol. 2* (Princeton: Princeton University Press, 1991), 29. [↑](#endnote-ref-1)
2. Cicero, “On the Commonwealth,” in *On the Commonwealth and On the Laws* (Cambridge: Cambridge University Press, 1999), 75. [↑](#endnote-ref-2)
3. Jean-Jacques Rousseau, “The Social Contract,” in *The Social Contract and First and Second Discourses* (New Haven: Yale University Press, 2002), 164 [↑](#endnote-ref-3)
4. G.W.F. Hegel, “On the English Reform Bill,” in *Political Writings* (Cambridge: Cambridge University Press, 2004), 257 [↑](#endnote-ref-4)
5. Hannah Arendt, *The Human Condition* (Chicago: University of Chicago Press, 1958), 50. [↑](#endnote-ref-5)
6. Jürgen Habermas, *Between Facts and Norms: Contributions to a Discourse Theory of Law and Democracy* (Cambridge: MIT Press, 1996),183-184 [↑](#endnote-ref-6)
7. Though interrelated, diversity and complexity are different phenomena. Diversity occurs when a wide variety of agents or objects exist, while complexity occurs when the agents or objects in a system are highly interconnected such that the actions of one can impact the behavior of many others. [↑](#endnote-ref-7)
8. Jürgen Habermas, *The Theory of Communicative Action Vol. 1: Reason and the Rationalization of Society* (Boston: Beacon Press, 1981), 22 [↑](#endnote-ref-8)
9. Habermas, *The Theory of Communicative Action Vol. 1*, 17 [↑](#endnote-ref-9)
10. Habermas, *The Theory of Communicative Action Vol. 1*, 42. Types of speech that don’t make such claims are such as cultural values or aesthetic experience, which take place within the ‘lifeworld’ of a particular group. [↑](#endnote-ref-10)
11. Simone Chambers, “Discourse and Democratic Practices,” in *The Cambridge Companion to Habermas* (Cambridge; Cambridge University Press, 2005), 233 [↑](#endnote-ref-11)
12. Habermas, *Between Facts and Norms*, 4-5 [↑](#endnote-ref-12)
13. Habermas, *Between Facts and Norms*, 326 [↑](#endnote-ref-13)
14. Habermas, *Between Facts and Norms*, 325-6 [↑](#endnote-ref-14)
15. Habermas, *Between Facts and Norms*, 326, 356 [↑](#endnote-ref-15)
16. Habermas, *Between Facts and Norms*, 359 [↑](#endnote-ref-16)
17. Habermas, *Between Facts and Norms*, 368 [↑](#endnote-ref-17)
18. Habermas, *Between Facts and Norms*, 372 [↑](#endnote-ref-18)
19. Habermas, *Between Facts and Norms*, 386-7 [↑](#endnote-ref-19)
20. Antje Gimmler, “Deliberative democracy, the public sphere and the internet,” *Philosophy and Social Criticism* (2001): 28 [↑](#endnote-ref-20)
21. Lincoln Dalhberg, “The Internet and Democratic Discourse: Exploring the prospects of online deliberative forums extending the public sphere,” *Information, Communication & Society* (2001): 623 [↑](#endnote-ref-21)
22. Gimmler, “Deliberative democracy, the public sphere and the internet,” 31-32 [↑](#endnote-ref-22)
23. Gimmler, “Deliberative democracy, the public sphere and the internet,” 33 [↑](#endnote-ref-23)
24. Dahlberg, “The Internet and Democratic Discourse: Exploring the prospects of online deliberative forums extending the public sphere,” 624 [↑](#endnote-ref-24)
25. Marisa Torres Da Silva, “Online forums, audience participation and modes of political discussion: readers’ comments on the Brazilian presidential election as a case study,” *Communication and Society* (2013): 188 [↑](#endnote-ref-25)
26. Gimmler, “Deliberative democracy, the public sphere and the internet,” 32 [↑](#endnote-ref-26)
27. Dahlberg, “The Internet and Democratic Discourse: Exploring the prospects of online deliberative forums extending the public sphere,” 629-630; Gimmler, “Deliberative democracy, the public sphere and the internet,” 34 [↑](#endnote-ref-27)
28. Anthony Willhelm, *Democracy in the Digital Age: Challenges to Political Life in Cyberspace* (New York: Routledge, 2000). [↑](#endnote-ref-28)
29. Scott Wright and John Street, “Democracy, deliberation and design: the case of online discussion forums,” *New Media and Society* (2007): 863 [↑](#endnote-ref-29)
30. Kerill Dunne, “Cross Cutting Discussion: A form of online discussion discovered within local political online forums,” *Information Polity* (2009): 230. Some of the features Dunne identifies are heterogeny, conflict, digression, rationality, reciprocity, reflectivity, inclusivity of personal experience, and a lack of equality of opportunity. [↑](#endnote-ref-30)
31. Dunne, “Cross Cutting Discussion: A form of online discussion discovered within local political online forums,” 231 [↑](#endnote-ref-31)
32. “Methodology,” in *Freedom in the world* (Washington DC: Freedom House, 2016). Accessed January 17, 2019, <https://freedomhouse.org/report/freedom-world-2016/methodology> [↑](#endnote-ref-32)
33. Ali Pirannejad, “Can the internet promote democracy? A cross-country study based on dynamic panel data models,” *Information Technology for Development* (2017), 291-292 [↑](#endnote-ref-33)
34. Matt Hern and Stu Chaulk, “Roadgrading Community Culture: Why the Internet is so Dangerous to Real Democracy,” *Democracy & Nature* (2000), 115. [↑](#endnote-ref-34)
35. Hern and Chaulk, “Roadgrading Community Culture: Why the Internet is so Dangerous to Real Democracy,” 116-117 [↑](#endnote-ref-35)
36. Marisa Torres Da Silva, “Online forums, audience participation and modes of political discussion: readers’ comments on the Brazilian presidential election as a case study,” 186 & 190. [↑](#endnote-ref-36)
37. Peter Dahlgren, “The Internet, Public Spheres, and Political Communication: Dispersion and Deliberation,” *Political Communication* (2005), 156. [↑](#endnote-ref-37)
38. Peter Dahlgren, “The Internet, Public Spheres, and Political Communication: Dispersion and Deliberation,” 159-160 [↑](#endnote-ref-38)
39. Nicola Mößner and Philip Kitcher, “Knowledge, Democracy, and the Internet,” *Minerva* (2017): 5 [↑](#endnote-ref-39)
40. Nicola Mößner and Philip Kitcher, “Knowledge, Democracy, and the Internet,” 13-14 [↑](#endnote-ref-40)
41. Nicola Mößner and Philip Kitcher, “Knowledge, Democracy, and the Internet,” 15 [↑](#endnote-ref-41)
42. Nicola Mößner and Philip Kitcher, “Knowledge, Democracy, and the Internet,” 15-18 [↑](#endnote-ref-42)
43. Hana Grill, “Does Social Media Technology Promote Democracy?”, *New Presence: The Prague Journal of Central European Affairs* (2011): 28 [↑](#endnote-ref-43)
44. Jürgen Habermas, *The Structural Transformation of the Public Sphere: An Inquiry into a Category of Bourgeois Society*, Trans. Thomas Burger (Cambridge: MIT Press, 1996), 205-6; John Thompson and David Held, eds. *Habermas: The Critical Debates* (Cambridge: MIT Press, 1982), 264; Alan Gross, “Habermas, Systematically Distorted Communication, and the Public Sphere,” *Rhetoric Society Quarterly* (Summer, 2006), 309-330, 320-1. [↑](#endnote-ref-44)
45. Charles Ess, “Democracy and the Internet: A Retrospective,” *Javnost - The Public* (2018), 95 [↑](#endnote-ref-45)
46. Dunne, “Cross Cutting Discussion: A form of online discussion discovered within local political online forums,” 229. [↑](#endnote-ref-46)
47. Lincoln Dahlberg, “The Internet, deliberative democracy, and power: Radicalizing the public sphere,” *International Journal of Media and Cultural Politics* (2007), 54. [↑](#endnote-ref-47)
48. Dahlberg, “The Internet, deliberative democracy, and power: Radicalizing the public sphere,” 56 [↑](#endnote-ref-48)
49. Ess, “Cross Cutting Discussion: A form of online discussion discovered within local political online forums,” 98-99 [↑](#endnote-ref-49)
50. Dahlberg, “The Internet, deliberative democracy, and power: Radicalizing the public sphere,” 629-630. [↑](#endnote-ref-50)
51. Nicola Mößner and Philip Kitcher, “Knowledge, Democracy, and the Internet,” 20 [↑](#endnote-ref-51)
52. Dahlberg, “The Internet, deliberative democracy, and power: Radicalizing the public sphere,” 56-57 [↑](#endnote-ref-52)
53. Habermas, *Between Facts and Norms*, 2 [↑](#endnote-ref-53)
54. Habermas, *Between Facts and Norms*, 334 [↑](#endnote-ref-54)
55. Habermas, *Between Facts and Norms*, 335-6 [↑](#endnote-ref-55)
56. That said, systems theory can incorporate problematic assumptions when researchers model a relationship that doesn’t actually exist, when they don’t have a good grasp of the question they are trying to answer, or when they don’t know about something they need to include. This is still a fair critique of systems theory. [↑](#endnote-ref-56)
57. John Holland, *Hidden Order: How Adaptation Builds Complexity* (Redding: Helix Books, 1995), 10 [↑](#endnote-ref-57)
58. Holland, *Hidden Order*, 5 [↑](#endnote-ref-58)
59. Rick Davies, “Scale, Complexity and the Representation of Theories of Change,” *Evaluation* (2004): 104 [↑](#endnote-ref-59)
60. Holland, *Hidden Order*, 27 [↑](#endnote-ref-60)
61. Several other scholars have emphasized this part of complex adaptive systems, including Ahmed et al. (Ahmed, Elgazzar, and Hegazi, “An overview of complex adaptive systems”, *arXiv* [2005]) and Rammel et al. (Rammel, Stagl, and Wilfing, “Managing complex adaptive systems – a co-evolutionary perspective on natural resource management”, *Ecological Economics* [2007]) [↑](#endnote-ref-61)
62. Holland, *Hidden Order*, 31 [↑](#endnote-ref-62)
63. J.S. Lansing. “Complex adaptive systems,” *Annual Review of Anthropology* (2003). [↑](#endnote-ref-63)
64. Holland, *Hidden Order*, 97-98 [↑](#endnote-ref-64)
65. For examples, see B.H. Walker, “Biodiversity and ecological redundancy,” *Conservation Biology* (1992.); Cowling, Mustart, Laurie, and Richards, “Species diversity, functional diversity and functional redundancy in fynbos communities,” *South African Journal of Science* (1994); Lawton and Brown, “Redundancy in ecosystems,”. in *Biodiversity and Ecosystem Function*, (Springer, 1994); and Ghilarov “Ecosystem functioning and intrinsic value of biodiversity,” *Oikos* (2000). [↑](#endnote-ref-65)
66. Holland, *Hidden Order*, 164-5 [↑](#endnote-ref-66)
67. Holland, *Hidden Order*, 166 [↑](#endnote-ref-67)
68. Holland, *Hidden Order*, 167 [↑](#endnote-ref-68)
69. Holland, *Hidden Order*, 168 [↑](#endnote-ref-69)
70. For one example, see Simon Levin, “Complex Adaptive Systems: Exploring the Known, the Unknown, and the Unknowable,” *American Mathematical Society* (2003),11. [↑](#endnote-ref-70)
71. Scott Page, *Diversity and Complexity* (Princeton: Princeton University Press, 2010), 130-144 [↑](#endnote-ref-71)
72. Page, *Diversity and Complexity*, 163-4 [↑](#endnote-ref-72)
73. Page, *Diversity and Complexity*, 165 [↑](#endnote-ref-73)
74. Page, *Diversity and Complexity*, 169 [↑](#endnote-ref-74)
75. Page, *Diversity and Complexity*, 172-3 [↑](#endnote-ref-75)
76. Barbara Cherry, “The Telecommunications Economy and Regulation as Coevolving Complex Adaptive Systems: Applications for Federalism,” *The Federal Communications Law Journal* (2007), 390-391 [↑](#endnote-ref-76)
77. Page, *Diversity and Complexity*, 179-180 [↑](#endnote-ref-77)
78. This is not to say that variation makes a system more stable. There are ecosystems with lots of diversity that are unstable and others with comparatively little variation that are stable. The value of variation is not axiomatic, though it does exist. [↑](#endnote-ref-78)
79. Page, *Diversity and Complexity*, 185-192 [↑](#endnote-ref-79)
80. Page, *Diversity and Complexity*, 194 [↑](#endnote-ref-80)
81. David Metzgar and Christopher Wills, “Evidence for the Adaptive Evolution of Mutation Rates,” *Cell* (June 2000): 581 [↑](#endnote-ref-81)
82. Metzgar and Willis, “Evidence for the Adaptive Evolution of Mutation Rates,” 582 [↑](#endnote-ref-82)
83. Metzgar and Willis, “Evidence for the Adaptive Evolution of Mutation Rates,” 584 [↑](#endnote-ref-83)
84. Page, *Diversity and Complexity*, 197-202 [↑](#endnote-ref-84)
85. Page, *Diversity and Complexity*, 217-218. [↑](#endnote-ref-85)
86. Page, *Diversity and Complexity*, 217. [↑](#endnote-ref-86)
87. Page, *Diversity and Complexity*, 223. [↑](#endnote-ref-87)
88. Page, *Diversity and Complexity*, 227 [↑](#endnote-ref-88)
89. See Naeem and Wright, “Disentangling biodiversity effects on ecosystem functioning: deriving solutions to a seemingly insurmountable problem,” *Ecology Letters* (2003); Griffin, O’Gorman, Emmerson, Jenkins, Klein, Loreau, and Symstad, “Biodiversity and the stability of ecosystem functioning,” in *Biodiversity, Ecosystem Functioning, and Human Wellbeing: An Ecological and Economic Perspective*, edited by S. Naeem, D. E. Bunker, A. Hector, M. Loreau, and C. Perrings (Oxford: Oxford University Press, 2009); and Mori, Furukawa, and Sasaki, “Response diversity determines the resilience of ecosystems to environmental change,” *Biological Reviews* (2013). [↑](#endnote-ref-89)
90. See Webb and Bodin, “A network perspective on modularity and control of flow in robust systems,” in *Complexity Theory for a Sustainable Future*, edited by J. Norberg and G. S. Cumming (New York: Columbia University Press, 2008). [↑](#endnote-ref-90)
91. Page, *Diversity and Complexity*, 227-245. [↑](#endnote-ref-91)
92. Page, *Diversity and Complexity*, 246. [↑](#endnote-ref-92)
93. See Frederic Jameson, *Postmodernism: or the Cultural Logic of Late Capitalism* (Durham: Duke University Press, 1991), 34-5, 75; and Antonio Negri and Michael Hardt, *Empire* (Cambridge: Harvard University Press, 2000), 326. [↑](#endnote-ref-93)
94. Habermas, *Between Facts and Norms*, 326-7 [↑](#endnote-ref-94)
95. See Disha Dinesh, “7 Types of Social Media Content That Drive Most Engagement – What Experts Say (& Real Life Examples),” accessed January 17, 2019, <https://blog.drumup.io/blog/7-types-of-social-media-content-that-drive-most-engagement/>; “15 Types of Content That Will Drive You More Traffic,” accessed January 17, 2019 at <https://www.quicksprout.com/2014/04/14/how-these-15-types-of-content-will-drive-you-more-traffic/>; and Alfred Lua, “2018 Social Media Trends Report: 10 Key Insights Into the Present and Future of Social Media,” accessed January 17, 2019 at <https://blog.bufferapp.com/social-media-trends-2018>. [↑](#endnote-ref-95)