

Stanford University

From the Selected Works of Erez Reuveni

Spring April, 2013

Copyright, Neuroscience, and Creativity

Erez Reuveni



SELECTEDWORKS™

Available at: <http://works.bepress.com/erezreuveni/5/>

COPYRIGHT, NEUROSCIENCE, AND CREATIVITY

*Erez Reuveni**

It is said that copyright law's primary purpose is to encourage creativity by providing economic incentives to create. Accepting this premise, the primary disagreement among copyright stakeholders today concerns to what extent strong copyrights in fact provide efficient economic incentives. This focus on economic incentives obscures what is perhaps copyright doctrine's greatest weakness—although the primary purpose of copyright law is to encourage creativity, copyright doctrine lacks even a rudimentary understanding of how creativity functions on a neurobiological level. The absence of a cohesive understanding of the science of creativity means that much of copyright theory is premised on antiquated assumptions regarding the creative process that have no basis in cognitive neuroscience or psychology and therefore do not in fact encourage creativity effectively from a scientific perspective. This Article fills that void by developing a coherent narrative of how creativity functions on a neurobiological level and demonstrating how copyright law specifically and information policy generally play a largely unexplored role in determining how effectively the brain's creative process—what I term the cognitive architecture of creativity—functions both internally and when interacting with the Internet and other informational environments. Relying on this narrative, the Article argues that creativity is not an isolated singular moment of genius as theorized by contemporary copyright doctrine but rather the product of complex interactions between individuals within a larger cultural environment that, in turn, can trigger the brain's creative process in the right circumstances. Copyright's goal of encouraging creativity should therefore be understood as an environmental design question, with the brain's creative process as that environment's hub, and copyright law and information policy as design levers in engineering that environment. Relying on this framework, the Article concludes by suggesting modifications to copyright law and policy that

* Trial Attorney, United States Department of Justice; Fellow, Stanford Law School, Center for Internet and Society, 2010–2012. The views expressed here do not reflect the views of the United States Department of Justice. Special thanks to Jack Beermann, Melissa Bruno, Ryan Calo, Daniela Caruso, Jim Fleming, Hanny Hindi, Keith Hylton, Gary Lawson, Michael Meurer, Walter W. Miller, Jr., Abigail R. Moncrieff, Maureen O'Rourke, Stephen Rickard, David Seipp, Robert Volk, and the fellows at the Stanford Center for Internet and Society for helpful comments. Thank you also to the *Alabama Law Review* editors for their excellent editorial support and suggestions.

foster a system where the brain's cognitive architecture interfaces effectively with the Internet to achieve copyright's core goal of encouraging creativity.

INTRODUCTION	736
I. ENVIRONMENTAL DESIGN AND CREATIVITY	742
A. <i>The Authorship Account of Creativity</i>	742
B. <i>Cultural Environmentalism and Systems Design</i>	744
II. THE COGNITIVE ARCHITECTURE OF CREATIVITY	747
A. <i>The Neuroscience of Creativity</i>	748
B. <i>Optimal Environmental Design</i>	752
III. COPYRIGHT, INFORMATION POLICY, AND SYSTEMS DESIGN	756
A. <i>Copyright and the Internet</i>	756
B. <i>Neuroscience and the Internet</i>	763
IV. DESIGNING THE OPTIMAL COGNITIVE ARCHITECTURE.....	770
A. <i>Communications Channels</i>	772
1. <i>Network Neutrality</i>	772
2. <i>Data Caps</i>	777
3. <i>Graduated Response</i>	780
4. <i>Transparency</i>	782
B. <i>Fair Use and Cognitive Liberty</i>	784
C. <i>Content Layer</i>	791
1. <i>DMCA</i>	791
2. <i>Domain Seizures and Content Blocking</i>	794
D. <i>Peer Production</i>	798
CONCLUSION.....	800

INTRODUCTION

Copyright is traditionally theorized as a utilitarian system for encouraging authors to produce creative works for the benefit of the public. Copyright policy in this view is fundamentally about providing a balance of economic incentives for authors to create, which in turn effectuates one of several possible goals, including advancing knowledge,¹ channeling investment in creative fields and regulating competition among rival disseminators,² promoting democratic governance,³ or facilitating a system

1. Harper & Row, Publishers, Inc. v. Nation Enters., 471 U.S. 539, 545 (1985) (noting that “copyright is intended to increase and not to impede the harvest of knowledge”).

2. Timothy Wu, *Copyright's Communications Policy*, 103 MICH. L. REV. 278, 279–81 (2004).

3. Neil Weinstock Netanel, *Copyright and a Democratic Civic Society*, 106 YALE L.J. 283, 285–86 (1996).

of free expression.⁴ Generally accepting these goals, the primary disagreement among copyright stakeholders is over what means best achieve these ends. Although in recent years scholars critical of the utilitarian, author-centric model of copyright have challenged the notion that financial compensation serves the motivating function utilitarian theory assumes it does,⁵ the argument between utilitarians and their critics revolves around how to encourage creativity. Both views share an underlying assumption—copyright exists to encourage and manage the *output* of creativity.

A related scholarly literature offers theoretical and descriptive accounts of the importance of the public domain for creativity.⁶ In this view, the incidence of creative production depends on the availability of prior creativity from which creators can draw inspiration and build on. Because all creativity is influenced by what has come before, all new innovation builds incrementally on existing creativity. As the story goes, reducing the scope of exclusive rights in informational goods yields more information production, because increasing the availability of materials needed for creativity outweighs any theoretical reduction in economic incentives to create. This view of copyright complements both the utilitarians and their critics in that its central concern is ensuring an optimal level of external *inputs* to creativity, without which creative *output* cannot be effectively encouraged. As with the incentives story, the primary disagreement among stakeholders is not whether the public domain should exist, but rather to what extent strong copyrights advance or hinder the public domain's role as a source of inspiration.⁷

But what of the actual architecture of creativity—that is, the process by which creative inputs become creative outputs? While focusing on the beginnings and ends of creativity, the copyright literature offers little discussion on the mechanics of the middle—the creative processes that occur entirely within the human mind and function on a neurobiological level. Although this middle step in the creative process provides the pivotal

4. Jack M. Balkin, *Digital Speech and Democratic Culture: A Theory of Freedom of Expression for the Information Society*, 79 N.Y.U. L. REV. 1 (2004).

5. See, e.g., Diane Leenheer Zimmerman, *Copyrights as Incentives: Did We Just Imagine That?*, 12 THEORETICAL INQUIRIES L. 29 (2011); Gregory N. Mandel, *Left-Brain Versus Right-Brain: Competing Conceptions of Creativity in Intellectual Property Law*, 44 U.C. DAVIS L. REV. 283 (2010); Jeanne C. Fromer, *A Psychology of Intellectual Property*, 104 NW. U. L. REV. 1441 (2010); Yochai Benkler, *Law, Policy, and Cooperation*, in GOVERNMENT AND MARKETS: TOWARD A NEW THEORY OF REGULATION 299 (Edward J. Balleisen & David A. Moss eds., 2010).

6. See, e.g., Jessica Litman, *Real Copyright Reform*, 96 IOWA L. REV. 1 (2010); JAMES BOYLE, *THE PUBLIC DOMAIN: ENCLOSING THE COMMONS OF THE MIND* (2008); Julie E. Cohen, *Creativity and Culture in Copyright Theory*, 40 U.C. DAVIS L. REV. 1151 (2007).

7. See, e.g., Michael J. Madison et al., *Constructing Commons in the Cultural Environment*, 95 CORNELL L. REV. 657 (2010); Cohen, *supra* note 6, at 1180.

fulcrum by which cultural inputs become expressive outputs, it remains a black box in the scholarly literature. The absence of a cohesive understanding of the science of creativity means that much of copyright theory is premised on antiquated assumptions regarding authorship and the creative process that have no basis in biology, neuroscience, or psychology.⁸

However, recent developments in the field of cognitive neuroscience and psychology have begun to reveal how the human mind's neurobiological processes produce creativity. These discoveries have significant implications for copyright policy, regardless of what underlying theoretical rationale one subscribes to.⁹ The science of creativity reveals that creativity is a product of both the brain's internal environment and the brain's interaction with the external environment. Internally, creativity is a function of the environment of the human brain, a massive network of billions of neurons, or nodes, and even more synapses connecting those neurons.¹⁰ The brain's ability to produce creativity—what I term its “cognitive architecture of creativity”—is essentially a function of the breadth of these neural networks, the diversity of information housed in each individual node, and the immediacy with which the brain can access specific nodes.¹¹ The more neurons actually containing some bit of information, the richer the network, and the richer the network, the greater the network's ability to produce creativity.¹² Of course, the human brain doesn't function in a vacuum. As individuals we interact with our environment, with other individuals, with ideas and media, and with informational and cultural networks of varying scope and degree.¹³ As the brain's cognitive architecture interfaces with these external networks, it builds new long-term memories and new internal associations within the brain.¹⁴ The brain's effectiveness is thus in part a function of the external environment it is situated within and the ease of access to information within that environment.¹⁵

In theory the Internet should be a boon to this process, providing trillions of additional informational bits that the brain's creative architecture can interact with and incorporate into its internal networks.¹⁶

8. *See infra* Part I.B.

9. *See infra* Part I.

10. *See infra* Part I.

11. *See infra* Part I.

12. *See infra* Part I.

13. *See infra* Part I.

14. *See infra* Part I.

15. *See infra* Part I.

16. Today we create as much information in 48 hours—five billion gigabytes worth—as was created “between the dawn of civilization through 2003.” Dan Tynan, *Prepare for Data Tsunami, Warns Google CEO*, PCWORLD (Aug. 6, 2010, 2:09 PM), <http://www.pcworld.com/article/202817/>

But the present state of Internet law suggests less sanguinity. Intellectual property scholars are in near-universal agreement that the scope of copyright has grown tremendously, primarily as a concerted response to the rise of the Internet as the primary means of communication and dissemination of informational works.¹⁷ As the sources of creative inspiration move online, copyright sweeps that knowledge within its ambit.¹⁸ Copyright now reaches far beyond its traditional core of regulating the production and distribution of creative works, also touching industries responsible for producing and managing the infrastructure of the Internet and the hardware and software used to access information online. Not only content producers, but search engines, Internet Service Providers (ISPs), software producers, computer and mobile telephone manufacturers—the industries that are at the core of the digital economy—all act under the shadow of copyright law.¹⁹ In addition, telecommunications law and federal regulation, driven in part by an industry structure whose competition and regulatory issues are framed by copyright and are therefore affected by copyright, govern both Internet infrastructure and network operators' freedom to manage their networks.²⁰

This state of affairs suggests that copyright and related laws governing the Internet—collectively “information policy”²¹—bear directly on the architecture of creativity. In the digital age, these laws govern the scope of inputs would-be creators have access to as well the quality of that access. They also govern the various intellectual technologies used to access those inputs and to disseminate a creator's output to the world at large. As we shall see, how the human brain interacts with the Internet can affect the neural wiring and content of the brain's cognitive architecture, both influencing the content of information entering the neural network and increasing the brain's dependence on information it previously internalized but which now exists on the Internet.²² A set of laws which not only governs both access to informational inputs needed for the creative process and the means of disseminating creative outputs but also intellectual

prepare_for_data_tsunami_warns_google_ceo.html. The total may surpass the zettabyte mark this year (a “1” with twenty-one zeroes after it). Ann Blair, *Information Overload, the Early Years*, BOSTON GLOBE, Nov. 28, 2010 (Sunday).

17. See, e.g., NEIL WEINSTOCK NETANEL, COPYRIGHT'S PARADOX 54–80 (2008); Litman, *supra* note 6, at 24–25; Edward Lee, *Freedom of the Press 2.0*, 42 GA. L. REV. 309, 313 (2008); Yochai Benkler, *Coase's Penguin, or, Linux and The Nature of the Firm*, 112 YALE L.J. 369, 381–82 (2002).

18. See *infra* Parts III and IV.

19. NETANEL, *supra* note 17, at 78.

20. See *infra* Parts III and IV.

21. Professor Netanel calls this “paracopyright.” NETANEL, *supra* note 17, at 66. Others also note copyright's power over technological industries traditionally outside copyright's scope. See, e.g., Litman, *supra* note 6, at 24–25; Lee, *supra* note 17, at 313. On how copyright affects telecommunications law, see discussion *infra* Part III.

22. See *infra* Part III.B.

technologies which have the power to organize the mind on a neurobiological level functions as de facto cognitive policy, and as a result, functions as a guiding force behind coding the human brain's creative architecture. Given what we now know about the cognitive architecture of creativity, copyright can no longer theorize creativity in a scientific vacuum. Information policy that conflicts with the brain's creative architecture impedes creativity and innovation. Conversely, information policy that complements the brain's creative architecture encourages creativity and vindicates copyright's core concerns. As our understanding of cognitive organization grows, cognitive policy should join copyright's other theoretical concerns as a guiding polestar.

The Article proceeds in four parts. Part I situates the Article within contemporary copyright and innovation scholarship regarding cultural environmentalism and systems design. I argue that although utilitarian theory provides a simple explanatory baseline, any discussion of optimal creative environments, as opposed to products, cannot be limited to functionalist, property-based explanations for incentivizing creativity. That explanatory model fails to describe, much less theorize, many of the public and private institutions that produce cultural outputs outside the context of IP-based exclusion rights. Innovation and creativity are products not only of private rights to exclude, like copyrights, but also the interplay between public and private spheres by way of spillovers and interactions between many organizations and individuals. Because the narrow frame of "copyright" fails to encompass these larger environmental factors, this Part articulates a broader "information policy"-based view of creative environments, relying first on copyright, but also incorporating other bodies of law that affect the human brain's interactions with the Internet.

Part II canvasses the neuroscientific literature and presents a contemporary account of how the human brain's cognitive architecture for creativity functions. As we shall see, creativity depends not only on the richness of networked neurons within the brain, but also the brain's capacity to interact with the world around it and integrate new, useful information into the brain's cognitive architecture. That, in turn, is governed by how easily the brain can access and interact with disparate and diverse information sources external to it. However, the neuroscience literature also shows that in the age of the Internet the brain increasingly "outsources" the storage of information that it previously integrated into neural networks. The brain perceives this external information as part of its cognitive architecture but lacks the ability to access that information instantaneously as it does with internal networks. Creativity today is thus a function not only of the richness of the brain's cognitive architecture, but also the efficiency of its interface with networks external to it, particularly those that house outsourced information. Given this scientific evidence,

encouraging creativity should be understood as an environmental design question, with the brain's creative process as that environment's hub and copyright law specifically and information policy generally as design levers in engineering that environment. If these design levers are implemented in ways that complement the brain's cognitive architecture, that system will on the whole produce more creativity. If, however, these levers clash with that cognitive architecture or impede its access to outsourced information, it will undermine the brain's creative processes.

Next, Part III demonstrates that the present state of copyright and information law in fact implements these design levers suboptimally at two key chokepoints in the creative process external to the brain. First, these laws effectively govern the scope of inputs accessible to would-be creators and the quality and immediacy of that access. Likewise, they govern access to information that the brain used to integrate into internal networks but now externalizes onto the Internet. Second, they govern the intellectual technologies used to access inputs and to disseminate creative outputs, including those technologies that affect the brain's ability to integrate long-term memories and assist individuals in circumventing informational inputs that may impede the brain's cognitive architecture. Copyright's regulatory hand thus sits firmly on two key layers of the creative process—the content and infrastructure layers of the Internet. How these two layers, which can be understood as the external layer of the creative process, affect the internal layer, which I have termed the cognitive architecture of creativity, is the key question for environmental design purposes. Because copyright and information policy regulate the external layers of the system, they play a large and important role in optimizing the design of those layers, which in turn affect the fluidity of the creative process internally.

Part IV then applies the environmental design and cognitive architecture principles developed in Parts II and III to several contemporary copyright and innovation issues that directly affect the external communication and content layers of this system. In particular, this Part argues that from a cognitive perspective, some form of network neutrality fosters greater creativity than its alternatives. Moreover, network management tools like data caps and so-called “graduated response programs” targeting copyright infringement can benefit creativity if they in fact alleviate network congestion, but should be more narrowly targeted, should provide greater transparency as to how they work, and should ensure more process before a user's Internet connection is degraded.²³ Also, copyright's fair use doctrine should be interpreted to privilege the personal use of software or hardware that facilitates a user's curation of

23. For a discussion of network neutrality, data caps, and graduated response, see *infra* Part IV.A.

their browsing experience to avoid disruptive external inputs that can harm the creative process.²⁴ Further, laws governing access to information and content, including the Digital Millennium Copyright Act²⁵ and the proposed Stop Online Piracy Act²⁶ and the Protect IP Act²⁷ should be more narrowly tailored and should provide greater procedural mechanisms to distinguish between copyright-infringing information and otherwise legitimate information stored on the Internet. These modifications ensure an efficient creative environment that complements the brain's process for developing long-term memories, expanding neural networks, and accessing information previously internalized by the brain. More generally, understanding creativity as an environmental design issue offers significant normative payoffs regardless of what rationale a copyright stakeholder relies on or what purpose he or she believes the copyright system is intended to achieve. Because the core of creativity is the brain's cognitive architecture, any conception of copyright benefits immensely from the environmental design model of creativity developed here.

I. ENVIRONMENTAL DESIGN AND CREATIVITY

A. *The Authorship Account of Creativity*

The Progress Clause of the United States Constitution grants Congress the power “[t]o promote the Progress of Science and useful Arts, by securing for limited Times to Authors and Inventors the exclusive Right to their respective Writings and Discoveries.”²⁸ Copyright law has generally assumed the production of creative works furthers that “progress”²⁹ and that such works are the products of singular moments of genius, springing fully formed from the creator's mind following flashes of inspiration.³⁰ Although this conception of authorship is anachronistic, it has served as a

24. See 17 U.S.C. § 107 (2006 & Supp. V 2011).

25. See 17 U.S.C. §§ 512, 1201–1205, 1301–1332 (2006 & Supp. V 2011).

26. See Stop Online Piracy Act of 2011, H.R. 3261, 112th Cong. (2011).

27. See Preventing Real Online Threats to Economic Creativity and Theft of Intellectual Property Act of 2011, S. 968, 112th Cong. (2011).

28. U.S. CONST. art. I, § 8, cl. 8.

29. See, e.g., *Feist Publ'ns, Inc. v. Rural Tel. Serv. Co.*, 499 U.S. 340, 349 (1991) (“The primary objective of copyright is not to reward the labor of authors, but ‘[t]o promote the Progress of Science and useful Arts.’”) (brackets in original).

30. E.g., Oren Bracha, *The Ideology of Authorship Revisited: Authors, Markets, and Liberal Values in Early American Copyright*, 118 YALE L.J. 186 (2008); Jeanne C. Fromer, *Expressive Incentives in Intellectual Property*, 98 VA. L. REV. 1745, 1754–55 (2012); Erez Reuveni, *Authorship in the Age of the Conducer*, 54 J. COPYRIGHT SOC'Y U.S.A. 285, 306–07 (2007). This is also true in the patent system. See Mark A. Lemley, *The Myth of the Sole Inventor*, 110 MICH. L. REV. 709 (2012).

convenient explanatory model for much of copyright's history.³¹ The prevailing utilitarian and economic account of copyright and progress is heavily contingent on this conception of authorship.³² As the story goes, singular creators need some mechanism for recouping the time and labor invested in their creative endeavors. Intellectual property protections provide this mechanism while simultaneously facilitating the production and distribution of creativity by larger organizational entities. Thus, singular creative geniuses and their organizational disseminators engage in a form of symbiosis: both earn a profit while the public benefits from the availability of creative works.³³ The public in turn may rely on these works for their own creative endeavors, within the confines of the copyright owner's limited monopoly over distribution.

Scholars have grown increasingly critical of this account. First, this "symbiosis" between singular author and corporate disseminator is premised on the assumption that the means of production and distribution are so expensive that only a few centrally organized and well-capitalized entities can deploy the means of distributing creative works to the public.³⁴ This assumption no longer carries much weight in the age of nearly zero-cost production and distribution of digital copies on the Internet.³⁵ Second, a growing body of psychological literature suggests that monetary recompense is not the motivator the economic rationale predicts it is, and in fact may hinder some forms of creativity.³⁶ Although one can hardly fault the prevailing explanation of authorship's failure to incorporate yet-unknown scientific insights, copyright's conception of the creative process is premised on the state of scientific, artistic, and corporate affairs over 300 years ago,³⁷ which even then was largely inaccurate.³⁸ That explanation, a simplified account that describes some set of cultural practices and some set of productive activities at some point in the past, leaves too many other

31. In the pre-industrial era, the singular, solitary genius conception of authorship was perhaps the norm. STEVEN JOHNSON, *WHERE GOOD IDEAS COME FROM: THE NATURAL HISTORY OF INNOVATION*, 226–28 (2010).

32. See, e.g., Reuveni, *supra* note 30, at 306–07. So too with the moral rights justifications for IP. See Fromer, *supra* note 30, at 6–22.

33. *Feist*, 499 U.S. at 349.

34. See Reuveni, *supra* note 30, at 290–92.

35. YOCHAI BENKLER, *THE WEALTH OF NETWORKS* 52 (2006); Reuveni, *supra* note 30, at 307–08.

36. See, e.g., Zimmerman, *supra* note 5; Gregory N. Mandel, *To Promote the Creative Process: Intellectual Property Law and the Psychology of Creativity*, 86 NOTRE DAME L. REV. 1999 (2011).

37. See, e.g., Zimmerman, *supra* note 5, at 22–30; Mandel, *supra* note 36.

38. See, e.g., JOHNSON, *supra* note 31, at 226–30; Lemley, *supra* note 30, at 712–15. To the extent this narrative retains substance, it is because individual creators often come up with new creations in total isolation through trial and error. JOHNSON, *supra* note 31, at 131–48.

variables unacknowledged and untheorized.³⁹ The model simply fails to account for the entire process of creativity.⁴⁰

B. Cultural Environmentalism and Systems Design

Copyright scholars have begun articulating a conception of creativity that views creativity as a function of the environment from which it arises.⁴¹ Although copyright provides a theoretical baseline, any discussion of optimal creative environments cannot be limited to functionalist, property-based explanations for incentivizing creativity.⁴² Innovation and creativity are products not only of private rights to exclude, but also public institutions and the interplay between public and private spheres by way of spillovers and interactions.⁴³ Many activities, practices, and intellectual resources involved in creativity remain outside the scope of intellectual property law.⁴⁴ Likewise, many market and non-market producers of information produce and exchange that information outside of IP-mediated markets.⁴⁵ Indeed, innovation and creativity are products of human relationships within complex systems and social environments that are significantly more nuanced and varied than those suggested by more traditional theories of information policy derived from the law and economics literature or antiquated notions of romantic authorship and inventorship.⁴⁶ Legal facilitation of innovation and creativity therefore cannot be confined to a simple set of property rules to incentivize individual innovative and creative efforts.⁴⁷ Thus, when discussing the design of creative *environments*, it makes little sense to focus exclusively on one specific variable of that environment, like private rights to exclude. For environmental design purposes, what is needed is a framework that

39. Madison et al., *supra* note 7, at 668.

40. *Id.* at 657–65.

41. *Id.*; Benkler, *supra* note 5, at 6; Brett M. Frischmann & Mark A. Lemley, *Spillovers*, 107 COLUM. L. REV. 257 (2007); Brett M. Frischmann, *Cultural Environmentalism and The Wealth of Networks*, 74 U. CHI. L. REV. 1083, 1136–37 (2007) (book review) [hereinafter *Cultural*]; Brett M. Frischmann, *An Economic Theory of Infrastructure and Commons Management*, 89 MINN. L. REV. 917, 1012–13 & n.370 (2005) [hereinafter *Economic*]; James Boyle, *A Politics of Intellectual Property: Environmentalism for the Net?*, 47 DUKE L.J. 87, 108–16 (1997).

42. Madison et al., *supra* note 7, at 668.

43. For excellent work highlighting non-IP-based institutional aspects of creativity, see Madison et al., *supra* note 7, at 668; *Cultural*, *supra* note 41, at 1094–96; Benkler, *supra* note 5, at 6.

44. Madison et al., *supra* note 7, at 684; *Cultural*, *supra* note 41, at 1104.

45. *Cultural*, *supra* note 41, at 1104.

46. Madison et al., *supra* note 7, at 669.

47. *Id.*

articulates a general set of variables relevant to any subsidiary question regarding design of that environment,⁴⁸ including private rights to exclude.

Accordingly, rather than focus on copyrights or patents narrowly, I focus more broadly on the framework of “information policy.” By information policy I refer not only to core IP entitlements like copyrights, but to other legal rules that govern information environments, including telecommunications law, contract and licensing regimes, FCC and FTC regulation, private ordering, Internet-governance institutions and norms, and informal cultural institutions and social practices.⁴⁹ I also refer to the structural realities of information industries that influence the scope and relevance of the legal rules that govern those industries.⁵⁰ Framing an analysis of “progress” through the lens of “information policy” provides a broader viewpoint through which to describe and theorize the structure of creative environments while nevertheless anchoring that discussion in the intellectual property literature’s core concern of promoting “science and the useful arts.”

Of course, how we define “progress” frames what sort of “creativity” or “invention” we incentivize through information policy design.⁵¹ The prevailing utilitarian model tends to incentivize observable and measureable outputs—copyrightable works and patentable inventions—at the expense of more inchoate outputs that may serve other important normative concerns. As a society, we might imagine “progress” as measuring the degree of participation in creative activities which not only yield monetizable outputs, but also educate, develop human capital, encourage civic participation, ensure threshold dignitary interests, and so on. I do not mean to articulate a new conception of progress. Rather I mean to point out that how we design any “system” intended to promote progress depends in large part on the designer’s preexisting assumptions and normative commitments. Those ideological or aspirational assumptions will influence what variables a framework’s designer will find relevant. Even so, the neurobiological process of creativity precedes these arguments. While any design choice regarding the external environment relies on assumptions and ideology, the neurobiology of creativity remains constant—its functions and structure remain the same, regardless of what policies and assumptions we layer on top of it. The cognitive architecture

48. See ELINOR OSTROM, UNDERSTANDING INSTITUTIONAL DIVERSITY 28–29 (2005) (discussing frameworks versus theories). No single theory explains information production, suggesting a framework, rather than a theory, is a wiser approach to systems design issues, pending further empirical work. See Michael J. Madison et al., *Reply: The Complexity of Commons*, 95 CORNELL L. REV. 839, 840 (2010).

49. See Madison et al., *supra* note 7, at 684; *Cultural*, *supra* note 41, at 1104

50. See Wu, *supra* note 2, at 340–41.

51. *Cultural*, *supra* note 41, at 1096.

of creativity is the hub of any system. Thus, regardless of what normative commitments we have or what explanatory theory for “progress” we adopt, an understanding of the cognitive processes underlying creativity provides the bedrock for any environmental view of creativity and any general framework for information policy. This bedrock provides the constant in any subsequent design choice that relies on variable assumptions. And while those assumptions may have been helpful in the past, cognitive science now allows copyright and innovation scholars to rely on a core of scientific empiricism as the center of any creative system.

Similarly, the neurobiological process of creativity precedes any argument regarding a specific theory of the individual, like the selfish actor,⁵² the rational actor,⁵³ or the collaborative actor.⁵⁴ Selfish, rational, and collaborative actors are variables within the system, but their internal cognitive architectures are constants. Thus, while much empirical work remains regarding theories of individual behavior and their interaction with specific institutional design choices, a cognitive view of information policy will facilitate better design for those systems regardless of what assumption we make about individuals in that system.⁵⁵ The cognitive explanation of creativity precedes all other assumptions about individuals, and therefore can be generalized across theories of the individual.

In sum, the utilitarian rationale and its critiques provide theoretical frameworks for explaining how creative outputs are incentivized and how subsequent creators benefit from a rich public domain which provides a diverse set of inputs for downstream creators. The environmental account pushes further, demanding an understanding not just of property-based conceptions of incentives, but also the myriad other variables that exist within and across complex systems. However, the environmental account as currently conceived remains concerned with environments external to the human brain and subject to normative commitments and behavioral assumptions about individual actors’ motives that are too context-specific to permit generalizations. Even so, contemporary advances in neuroscience permit scholars to begin understanding the crucial neurobiological fulcrum of creativity, a constant in any cultural environment external to the human brain. This descriptive account of the brain’s neural circuitry and how it interacts with external stimuli, particularly in the always-on Internet era, offers significant normative payoffs for copyright policy, regardless of

52. Benkler, *supra* note 5, at 1–23.

53. RICHARD A. POSNER, *ECONOMIC ANALYSIS OF LAW* 3–4 (5th ed. 1998).

54. Benkler, *supra* note 5, at 1–2.

55. Madison et al., *supra* note 7, at 846.

what explanatory lens we use to theorize creativity.⁵⁶ The cognitive architecture is the hub of the creative wheel, its spokes emanating out into any environment in which that hub is situated. We cannot begin to design an optimal system for creativity, let alone more specialized environments based on subsets of variables, without first understanding that hub. As Part II argues, the more robust the core of that system, the more robust all creativity depending on that core will be.

II. THE COGNITIVE ARCHITECTURE OF CREATIVITY

Before proceeding, it is important to define precisely what I mean by creativity. I use the term quite generally to encompass any idea that arises from the brain's cognitive architecture. By this I mean to encompass not only what copyright law deems original and what patent law views as novel and nonobvious, but all manner of creativity.⁵⁷ Thus, I mean to encompass any product of the brain's cognitive architecture, regardless of whether it results in copyrightable or patentable end products or whether those products are commercializable.⁵⁸ This definition is most appropriate because ideas that may yield copyrightable or patentable works do not themselves emerge copyrightable or patentable from the human mind. Any such creative or innovative product is a work of bricolage—although an idea may emerge whole from the human mind, most often such ideas coalesce only after snippet after snippet of creativity is finally assembled into an actual, tangible idea.⁵⁹ With this in mind I turn now to a discussion of how the cognitive architecture of creativity produces that creativity.

56. In this I disagree with those who argue that copyright cannot be used as a design tool to optimize creative outputs. *See, e.g.*, Cohen, *supra* note 6, at 1183. Although this may have previously been correct, the emergence of a neuroscientific consensus on the workings of the brain weakens this critique.

57. This avoids bogging down the following discussion in the legal distinctions between copyright and patent law or in debates on what constitutes artistic creativity as opposed to scientific or technical creativity. *See, e.g.*, Fromer, *supra* note 5, at 1446–56.

58. *See* JOHNSON, *supra* note 31, at 21–22; Peter Lee, *The Evolution of Intellectual Infrastructure*, 83 WASH. L. REV. 39, 43–45 (2008); *Economic*, *supra* note 41, 1012–13 & n.370; LAWRENCE LESSIG, *THE FUTURE OF IDEAS: THE FATE OF THE COMMONS IN A CONNECTED WORLD* 7, 10, 19 (2001). I also focus on copyright, rather than patents, because copyright concerns the production of knowledge, including the knowledge needed by inventors to invent, whereas patents focus more narrowly on the products of those inventions and commercial markets for them. *See* Lemley, *supra* note 30. The information ecology that creators and inventors rely on and exist in is primarily governed by copyright and communications law rather than patent law. *See infra* Part III. Indeed, the historical consensus is that as originally conceived, copyright was intended to promote creativity in order to promote innovation. *See, e.g.*, Greg Lastowka, *Innovative Copyright*, 109 MICH. L. REV. 1011, 1024 (2011) (collecting sources).

59. *See* JOHNSON, *supra* note 31, at 28–29; DANIEL KAHNEMAN, *THINKING, FAST AND SLOW* 54 (2011).

A. The Neuroscience of Creativity

Creativity is a product of both the brain's internal cognitive architecture of creativity and that architecture's interaction with the external environment. Internally, creativity is a function of the internal environment of the human brain,⁶⁰ which is a network of some 100 billion neurons connected by one quadrillion synapses.⁶¹ Over time, through education and experience, these neurons acquire informational bits that fix themselves in the network and expand the network, while also changing connections within the network.⁶² An idea is simply a specific constellation of neurons firing in sync with each other for the first time.⁶³ Such firing requires both that the neural network contain sufficient information from which an idea can arise and that each individual node in the network be connected to a minimal number of other nodes. The network's ability to produce a creative thought is entirely a function of the scope of these neural networks and the diversity of information housed in each individual node.⁶⁴ The more neurons actually containing some bit of information,⁶⁵ the richer the network, and the richer the network, the greater the network's ability to produce a creative thought when the brain's neurons fire.⁶⁶ Thus, at the moment the creative process fires up, that process draws upon knowledge

60. I assume genetics as a constant for this discussion.

61. See JOHNSON, *supra* note 31, at 46–47; Robert Lee Hotz, *Probing the Brain's Mysteries*, WALL ST. J., Jan. 24, 2012, at A3; Sebastian Seung, *I Am My Connectome*, TED.COM (Sept. 2010), http://www.ted.com/talks/sebastian_seung.html. Each synapse contains many vesicles, which contain neurotransmitters, the molecules responsible for communications between neurons. See Seung, *supra*.

62. JOHNSON, *supra* note 31, at 46–47; KAHNEMAN, *supra* note 59, at 54; Seung, *supra* note 61; Yasuyuki Kowatari et al., *Neural Networks Involved in Artistic Creativity*, 30 HUM. BRAIN MAPPING 1678, 1678 (2009). How easily information is integrated may in part depend on its relation to preexisting neural schema. See Penelope A. Lewis & Simon J. Durrant, *Overlapping Memory Replay During Sleep Builds Cognitive Schemata*, 15 TRENDS COGNITIVE SCI. 343, 344 (2011).

63. JOHNSON, *supra* note 31, at 45–46; KAHNEMAN, *supra* note 59, at 54.

64. Rex E. Jung et al., *Neuroanatomy of Creativity*, 31 HUM. BRAIN MAPPING 398, 398–409 (2010); Rosalind Arden et al., *Neuroimaging Creativity: A Psychometric View*, 214 BEHAVIOURAL BRAIN RES. 143, 143–56 (2010); Arne Dietrich, *The Cognitive Neuroscience of Creativity*, 11 PSYCHONOMIC BULL. & REV. 1101, 1101–26 (2004).

65. By information, I refer to any conceivable snippet of human experience that can be processed into the brain's neural circuitry. The brain is capable of storing any bit of information, be it words, sounds, images, experiences, feelings, smells, and anything else. OLIVER SACKS, *THE MIND'S EYE* 73–74 (2010); Seung, *supra* note 61.

66. See KAHNEMAN, *supra* note 59, at 54, 67 (“[C]reativity is associative memory that works exceptionally well.”); Seung, *supra* note 61; Jung et al., *supra* note 64, at 398, 401, 403; Sharon Begley, *I Can't Think!*, NEWSWEEK (Feb. 27, 2011, 10:00 AM), <http://www.newsweek.com/2011/02/27/i-can-t-think.html>. Also important is the efficiency of the connections. See Jung et al., *White Matter Integrity, Creativity, and Psychopathology: Disentangling Constructs with Diffusion Tensor Imaging*, PLOS ONE 5(3): e9818, at 4 (2010); Jung et al., *supra* note 64, at 398, 401, 403; Jung et al., *Biochemical Support for the “Threshold” Theory of Creativity: A Magnetic Resonance Spectroscopy Study*, 29 J. NEUROSCIENCE 5319, 5322 (2009) [hereinafter “Threshold” Theory].

both within the network and immediately accessible to it.⁶⁷ Neither condition alone will provide the necessary source materials. A node may contain a bit of information of fantastic import, but if that node is inaccessible to the network at the moment the network requires access to it, that node is essentially lost to the creative process.⁶⁸

The cognitive architecture produces the constellation of neural nodes that yields creativity by engaging in what neuroscientists call divergent and convergent neural processes. When facing a problem requiring creative thought, the brain first seeks easy answers, concentrating on obvious facts and familiar solutions.⁶⁹ This is mostly a left hemisphere function.⁷⁰ If that process fails, the left hemisphere begins working in tandem with the right hemisphere,⁷¹ which engages in what is called divergent thinking, scanning through nodes accessible to the neural network and searching for patterns and associations that may be relevant to the problem.⁷² The divergent process is largely unregulated and disinhibitory, meaning that this phase of the creative process scans through many nodes on the network the left hemisphere ignores, regardless of the contents of each individual node and their relevance to other nodes.⁷³ While the right hemisphere is engaged in its divergent process, the left hemisphere engages in what is termed convergent thinking, a top-down executive function.⁷⁴ As the right hemisphere searches through neural nodes seeking new patterns and connections, the left hemisphere synthesizes those nodes, filtering irrelevant information and constructing a bigger picture.⁷⁵ In a flash, so to

67. KAHNEMAN, *supra* note 59, at 54, 85; Jung et al., *supra* note 64, at 398, 401, 403; Carey K. Morewedge & Daniel Kahneman, *Associative Processes in Intuitive Judgment*, 14 TRENDS COGNITIVE SCI. 435, 435–36 (2010); Begley, *supra* note 66.

68. KAHNEMAN, *supra* note 59, at 85. This does not mean the node is lost, but only that it is inaccessible at that time. In the right circumstances, that specific node might be found again, perhaps after reading something vaguely related that sparks a memory. A good example is the sensation of something being on the tip of a person's tongue. Try as that person might, they can't recall the memory or thought in that moment, but manage to remember at some future date based on the serendipity of their circumstances.

69. Po Bronson & Ashley Merryman, *The Creativity Crisis*, NEWSWEEK (July 10, 2010, 4:00 AM), <http://www.newsweek.com/2010/07/10/the-creativity-crisis.html>.

70. *Id.*; Jonah Lehrer, *The Eureka Hunt*, NEW YORKER, July 28, 2008, at 40; Mandel, *supra* note 36, at 4–8 (collecting sources).

71. *See* sources cited *supra* note 70.

72. *See* sources cited *supra* note 70; KAHNEMAN, *supra* note 59, at 54, 69. The right hemisphere is uniquely suited to this task, as its dendrites—each neuron's branched projections that conduct the electrochemical stimulation received from other neurons in the network—are longer than the left hemisphere's, allowing the divergent process to cover more cranial geography, and therefore facilitating more effective scanning of nodes in separate networks that otherwise have no connection. *See* sources cited *supra* note 70.

73. *See* sources cited *supra* note 70; Arden et al., *supra* note 64, at 152. Here, too, density of grey matter affects how efficient the process is. *See* Jung et al., *supra* note 64, at 401.

74. *See* sources cited *supra* note 70; *see* KAHNEMAN, *supra* note 59, at 38.

75. *See* sources cited *supra* note 70; *see* KAHNEMAN, *supra* note 59, at 38, 47.

speak, the brain pulls together these disparate shreds of thought and binds them into a new constellation of neurons.⁷⁶ Once that happens, those neurons fire in unison, producing the so-called Eureka effect familiar to anyone who has suddenly registered an idea in their consciousness.⁷⁷

The cognitive architecture of creativity thrives in an environment where internal informational inputs are many, diverse, and immediate.⁷⁸ The greater the quantity and diversity of the nodes on the neural network, the better equipped the brain is to produce creative insights.⁷⁹ Of course, each individual neuron's bit of information must become a node in the neural network in the first place. That is accomplished over time by the building of long-term memory within the brain.⁸⁰ That in turn is a function of short-term memory—our immediate impressions, sensations, thoughts, observations, and so on existing in our consciousness at any given moment.⁸¹ These short-term memories exist ephemerally in what neuroscientists call “working memory.”⁸² The breadth of the cognitive architecture's nodal network is largely a function of the brain's ability to transfer information from working memory into long-term memory. The effectiveness of that transfer in turn is a function of working memory's “cognitive load.”⁸³ So long as the cognitive load remains manageable to the brain, such that the brain retains resources to distinguish signal from noise, transfer from short-term to long-term memory occurs fluidly and the brain's already existing neural networks integrate new information and

76. See sources cited *supra* note 70; see KAHNEMAN, *supra* note 59, at 52–54.

77. See sources cited *supra* note 70; see KAHNEMAN, *supra* note 59, at 54; see also KAHNEMAN, *supra* note 59, at 237 (“The situation has provided a cue; this cue has given the expert access to information stored in memory, and the information provides the answer.” (quoting Herbert A. Simon, *What Is an “Explanation” of Behavior?*, 3 PSYCHOL. SCI. 150, 155 (1992))).

78. See sources cited *supra* notes 64–67; JOHNSON, *supra* note 31, at 46–47. Creativity is not limited to any specific brain network or region, but rather stretches across many networks. See, e.g., Arne Dietrich & Riam Kanso, *A Review of EEG, ERP, and Neuroimaging Studies of Creativity and Insight*, 136 PSYCHOL. BULL. 822, 822–848 (2010); “Threshold” Theory, *supra* note 66, at 5322.

79. See sources cited *supra* notes 64–67; JOHNSON, *supra* note 31, at 46–47; NICHOLAS CARR, THE SHALLOWS 182–93 (2010); Lehrer, *supra* note 70; Adam Stevenson, Yann Le Du & Mariem El Afrit, *Running High-Performance Neural Networks on a “Gamer” GPU*, ARS TECHNICA (July 25, 2011, 11:48 AM), <http://arstechnica.com/science/news/2011/07/running-high-performance-neural-networks-on-a-gamer-gpu.ars>.

80. CARR, *supra* note 79, at 182–93; Begley, *supra* note 66; Morris Moscovitch et al., *Learning and Memory*, in COGNITION, BRAIN, AND CONSCIOUSNESS: INTRODUCTION TO COGNITIVE NEUROSCIENCE 255, 270 (Bernard J. Baars & Nicole M. Gage eds., 2007).

81. CARR, *supra* note 79, at 182–93; Begley, *supra* note 66; Santangelo et al., *The Contribution of Working Memory to Divided Attention*, 34 HUM. BRAIN MAPPING 158, 158–60 (2011).

82. See sources cited *supra* note 80; Santangelo et al., *supra* note 81, at 158–60, 169–71; Eyal Ophir et al., *Cognitive Control in Media Multitaskers*, 106 PROC. NAT'L ACAD. SCI. 15583 (2009), available at <http://www.pnas.org/content/106/37/15583.full.pdf>.

83. See sources cited *supra* note 80; Santangelo et al., *supra* note 81, at 158–60, 169–71; Ophir et al., *supra* note 82.

form new connections.⁸⁴ Conversely, where cognitive load overflows, the brain has difficulty distinguishing signal from noise. Information flows in and out of working memory regardless of its actual utility to long-term memory or to existing networks.⁸⁵ The overloaded mind simply loses the contents of working memory and loses its train of thought;⁸⁶ whatever information existed in working memory is lost to the neural network.⁸⁷

One additional observation is worth making here. So far as we currently know, the brain's storage capacity is virtually limitless.⁸⁸ The notion that one should "outsource" knowledge in order to make space for other things is therefore a false choice.⁸⁹ What's important is the depth, scope, and diversity of the neural networks the creative process is able to access with immediacy during its convergent and divergent sub-processes. Information that one may have learned through formal schooling, training, or otherwise engaging with media over a period of time is of no use to the cognitive architecture if it is somewhere on a book shelf or the Internet, untouched and unfamiliar to the brain.⁹⁰ That is not to say that the sum of all human knowledge must exist in the human brain. The important point is simply that the richer the network is inside the brain, the more likely that network will be able to draw new and valuable connections when encountering new information external to the network or when that information transfers from short- to long-term memory.⁹¹ That process itself associates the new information meaningfully and systematically

84. See sources cited *supra* note 80; Seung, *supra* note 61; Santangelo et al., *supra* note 81, at 158–60, 169–71; Ophir et al., *supra* note 82. The act of transferring information into long-term memory increases the number of synapses and connections in the network, as each new bit of information, once transferred and fixed, develops new connections and associations with preexisting networks and nodes. CARR, *supra* note 79, at 185; ERIC R. KANDEL, IN SEARCH OF MEMORY 214–21 (2006).

85. Santangelo et al., *supra* note 81, at 158–60, 169–71; Ophir et al., *supra* note 82; Begley, *supra* note 66; CARR, *supra* note 79, at 182–97.

86. Ophir et al., *supra* note 82. Working memory can hold roughly seven items at any given moment. Begley, *supra* note 66; CARR, *supra* note 79, at 182–97. Anything above that threshold must be processed into long-term memory or be lost to the brain. Begley, *supra* note 66; CARR, *supra* note 79, at 182–97; see also KAHNEMAN, *supra* note 59, at 31–37.

87. In rarer situations, the brain experiences what psychologists call "flow," or "a state of effortless concentration so deep that they lose their sense of time, of themselves, of their problems." KAHNEMAN, *supra* note 59, at 40. In a state of flow, maintaining focused attention on a task requires no exertion of mental executive function, thereby freeing up the brain's resources to focus on the creative task at hand. *Id.*

88. NELSON COWAN, WORKING MEMORY CAPACITY (2005); TORSEL KLINGBERG, THE OVERFLOWING BRAIN: INFORMATION OVERLOAD AND THE LIMITS OF WORKING MEMORY 36 (2009); CARR, *supra* note 79, at 192.

89. See CARR, note 79, at 191–97.

90. KAHNEMAN, *supra* note 59, at 54, 85. The psychological literature on creativity also supports this notion. As Professor Fromer observes, "creativity depends on internalizing knowledge about the relevant domain, frequently through formal schooling, a decade or thereabouts of learning the domain, and gaining access to the field." Fromer, *supra* note 5, at 1461 (footnotes omitted).

91. CARR, *supra* note 79, at 182–93 (collecting sources); KAHNEMAN, *supra* note 59, at 54, 69, 85.

within the networks already established in the brain.⁹² In other words, the richer our cognitive architecture is, the more likely we are to achieve creative insights when interacting with the world around us.⁹³

B. *Optimal Environmental Design*

The dynamics of the internal cognitive architecture are only half the story. Just as important is the external environment in which the cognitive architecture is situated. All the brilliant neural connections in the world are of marginal utility if they exist in isolation, particularly because so few great ideas emerge fully formed from the internal architecture of the brain. Rather, it is in exchanging information with others—in person, in school, in offices, on the Internet—that half-finished fragments of ideas interplay with similar fragments in other people’s minds. This “play” in the external network is crucial, as it permits half-formed ideas to develop into useful ideas over time.⁹⁴ A fertile cognitive architecture thus requires a similarly fertile external environment in which to interact, almost as if each individual were himself a node in a larger informational network.

What emerges from the scientific literature is a consistent trope—environments conducive to creativity, regardless of their size or scale, are fractal. By this I mean that optimal creative environments can scale, such that the same principles that render a cognitive architecture more or less creative apply similarly in any environment external to the brain, from prokaryotic cells to organizational entities, to cities, to the Internet.⁹⁵ These patterns recur throughout natural and human history, whether they are emergent and self-organizing or are deliberately constructed by human architects.⁹⁶

A baseline of these environments is the concept of the “adjacent possible.” First developed by the theoretical biologist Stuart Kauffman,⁹⁷ the concept posits that at any given moment only so many combinations of matter are possible but that each new combination itself serves to expand the number of possible combinations.⁹⁸ Understood more generally, the

92. CARR, *supra* note 79, at 182–93; KAHNEMAN, *supra* note 59, at 54, 85.

93. See CARR, *supra* note 79, at 182–93; JOHNSON, *supra* note 31, at 46–47; KAHNEMAN, *supra* note 59, at 54, 85. I mean creativity here as a thought arising from environmental interaction, not as a flash of genius as used in the copyright literature.

94. JOHNSON, *supra* note 31, at 22; see Cohen, *supra* note 6, at 1197.

95. JOHNSON, *supra* note 31, at 47; Jonah Lehrer, *A Physicist Solves the City*, N.Y. TIMES MAG., Dec. 17, 2010, at 50.

96. JOHNSON, *supra* note 31, at 47–65; BENKLER, *supra* note 35, at 1–18.

97. STUART A. KAUFFMAN, INVESTIGATIONS (2000) [hereinafter INVESTIGATIONS]; STUART KAUFFMAN, AT HOME IN THE UNIVERSE: THE SEARCH FOR THE LAWS OF SELF-ORGANIZATION AND COMPLEXITY (1995) [hereinafter AT HOME].

98. INVESTIGATIONS, *supra* note 97, at 142–47; AT HOME, *supra* note 97, at 106–07.

concept suggests an innovative environment is one that, by design or accident, facilitates interaction between its inhabitants and encourages those inhabitants to recombine preexisting components of that environment in new ways, which then expands the breadth of the adjacent possible.⁹⁹ Conversely, an environment that blocks or limits these new combinations, by punishing experimentation, obscuring pathways towards possible new branches, or rendering the edges of the environment inhospitable to exploration, will on average produce and circulate far fewer creative moments.¹⁰⁰ This feature appears time and again in the innovation literature, both among natural processes and human development.¹⁰¹

The important design principle that emerges from this literature is the concept of serendipity. By this I mean that random interactions between subunits of the environment are hardwired into the infrastructure of that environment. Professor Cass Sunstein has referred to this concept in a different context as the “architecture of serendipity.”¹⁰² An architecture of serendipity ensures that ideas can interface with and recombine with other ideas. Put another way, an architecture of serendipity facilitates environments that produce informational spillovers between subunits of the environment.¹⁰³ This is crucial because, as discussed, very few ideas actually emerge whole and complete from the singular mind of an individual. Most contain a kernel of something larger but lack all the elements needed to trigger their brains’ recognition of the full-fledged idea without interacting first with elements in the environment external to the

99. JOHNSON, *supra* note 31, at 29–42; *see also* Frischmann & Lemley, *supra* note 41, at 268–71, 282–84.

100. Frischmann & Lemley, *supra* note 41, at 268–71, 282–84. The phenomena of simultaneous invention can be explained in part by viewing the phenomena as a function of the adjacent possible. *See* Lemley, *supra* note 30, at 712–15. Inventors well-versed in the state of the art will be pushing against the same limitations of the adjacent possible and pursuing the same course of research in response to market demand or the needs of the moment. The same problems will need to be solved, and the adjacent possible places limits on any seeking to solve them.

101. JOHNSON, *supra* note 31, at 29–42 (collecting sources). Possibly the first of any innovative environments was the earth in its primordial state. The “network” as it existed then provided both a capacity for individual elements to make new connections with as many other elements as possible and a randomizing, chaotic quality that forced collisions between all the elements in the system. *Id.* at 30–33. The pattern was repeated when humanity first settled into cities. After millennia of nomadic life, cities provided the same two preconditions of innovation as the primordial ooze in the form of densely packed populations of humans interacting with each other in randomized encounters. As one would expect, an innovative golden age followed. *Id.* at 9–11, 33, 53–54.

102. CASS R. SUNSTEIN, GOING TO EXTREMES: HOW LIKE MINDS UNITE AND DIVIDE 80 (2009) (emphasis removed). Sunstein used the term in the context of critiquing the Internet’s potential for allowing people to filter out information they did not want to see, thus narrowing the breadth of information they were exposed to and potentially circumscribing the depth of their civic participation. In Sunstein’s telling, a paper newspaper exhibits a positive “architecture of serendipity” because it exposes readers to information they might not otherwise encounter, in turn facilitating new ideas and connections. *Id.*; *see also* CASS R. SUNSTEIN, REPUBLIC.COM 2.0, at 31 (2007).

103. *See* Frischmann & Lemley, *supra* note 41, at 268–71, 282–84.

brain. More often than not, the missing piece exists somewhere else, perhaps in the mind of another person, in a book, in an experience, or somewhere on the Internet. Thus, optimal creative environments view information spillover as a feature, not a flaw.¹⁰⁴ Information spillover within the brain permits disparate nodes to make connections that make no linear, logical sense. And information spillover in the external environment permits the products of an individual's cognitive architecture to interact with other individuals. The porousness of this external network helps otherwise isolated hunches and incomplete ideas interact and recombine into completed ideas.

Creativity thus requires two separate but interfacing networks, one internal to the human brain and one entirely external to it, both of similar design but at different scales. The internal cognitive architecture requires rich neural networks which themselves maximize the brain's access to the adjacent possible.¹⁰⁵ This network is hardwired for serendipity given the absence of internal constraints but is limited by how much information passes from the external network into the internal network through working memory.¹⁰⁶ That external network, in turn, maximizes the potential of the internal network when it provides that network access to an architecture of serendipity in which the ideas and fragmentary thoughts emerging from the individual brain can collide with other ideas and fragmentary thoughts produced by other individual brains.¹⁰⁷ The more porous but connected that external network is, which is to say, the more that network facilitates spillovers among members of the network, the more likely the external network will then feed back into an individual cognitive architecture and produce the sought after creative a-ha! Neither network can operate fully on its own and each benefits in an exponentially symbiotic fashion from the existence of the other network.¹⁰⁸

This yields a critical corollary. The efficiency of the internal and external networks' ability to work in tandem is contingent on the effectiveness of the two networks' mutual communications. Creativity is really a three-step process across these two networks. First, a fragment of an idea emerges from the individual's cognitive architecture.¹⁰⁹ Second, the

104. *See id.*

105. KAHNEMAN, *supra* note 31, at 47; KAHNEMAN, *supra* note 59, at 54, 85, 102.

106. KAHNEMAN, *supra* note 59, at 54, 85, 229; Santangelo et al., *supra* note 81, at 158–60, 169–71; Ophir et al., *supra* note 82.

107. JOHNSON, *supra* note 31, at 47.

108. KAHNEMAN, *supra* note 59, at 54, 85; Jung et al., *supra* note 64, at 398, 401, 403; Morewedge & Kahneman, *supra* note 67, at 435–36; JOHNSON, *supra* note 31, at 46–65; CARR, *supra* note 79, at 182–93; Begley, *supra* note 66.

109. *See* JOHNSON, *supra* note 31, at 28–29; KAHNEMAN, *supra* note 59, at 54.

individual interfaces with a larger, external network.¹¹⁰ Third, the individual's interaction with that external network feeds back into the cognitive architecture where, if the conditions are ripe, the convergent and divergent creative processes discussed above produce a creative thought which then wires itself into a constellation of neurons and emerges into the world.¹¹¹ But this assumes ideal communication conditions between step 1 and step 2 and again between step 2 and step 3. Thus, just as important as the structure of the internal cognitive architecture and the external network it interfaces with is the communications channel between the two. In the language of information theory, the channel between the two networks must be designed to facilitate their interface with sufficient redundancy that any signal lost will not cripple the thrust of the communication.¹¹² At the same time, a communications channel permitting too much redundancy will slow down the interfacing of the two networks.¹¹³ If internetwork communications are too slow, then both networks will suffer degradation in effectiveness. The point should be familiar to anyone who has felt the electricity of a good idea jumping into their mind, only to lose the idea before ever communicating it to another person or to paper or to memory due to external disruptions. The signal between the individual's brain and the external network was sufficiently degraded that no amount of redundancy could have saved it from communications failure.

No matter how well the internal and external layers of the network are designed, no matter how much they facilitate serendipity and encourage the exploration of the adjacent possible within and across their networks, creativity depends equally on the clarity and immediacy of the communications channel between the brain and the external network. The fractal nature of creative environments is relevant here. Just as the human mind's ability to produce creativity is largely a function of the number of networked nodes immediately accessible to it during the convergent and divergent thought processes, so must it be with internetwork communications. The more immediate and clear the brain circuitry's access to the external network is, the more likely the internal and external networks are to work symbiotically to produce creativity.

The real network for systems design purposes thus encompasses three components—the internal cognitive architecture, the external network, and the communications channel between them. Structural weakness in any one of these elements will compromise the effectiveness of the entire creative architecture. As I discuss in the next Part, it is the communications channel

110. See sources cited *supra* note 109.

111. KAHNEMAN, *supra* note 59, at 54; see also *id.* at 229.

112. JAMES GLEICK, *THE INFORMATION: A HISTORY, A THEORY, A FLOOD* 229–49 (2011).

113. *Id.*

between the internal and external networks and the content available on the external network that are the key issues for environmental design in the Internet era.

III. COPYRIGHT, INFORMATION POLICY, AND SYSTEMS DESIGN

A. Copyright and the Internet

Imagine if the cognitive architecture just discussed existed not as a biological construct within the human mind, but as a real world construct, owned piecemeal by various private network operators and subject to legal regulation. Each node within the network would still contain a specific bit of information, but the nodes' ability to network with other nodes with the level of immediacy provided by a neural network would be subject to various layers of disruption depending on each particular node's network provider. Each time the node sends a signal into the network seeking to communicate with another node, that signal would bounce around various intermediate layers of the communications infrastructure, perhaps routed directly, perhaps not, depending on the network load at that particular moment or whether that particular node and the node the first node sought to communicate with had both paid for priority access within each layer of the network. Before the node's communications reached its target, the contents of the communications would be checked against a background database of illicit communications. If the database turned up a hit, the communications might never reach the recipient. Or, perhaps less ominously, it would reach the recipient but at a degraded speed, given its contents. Once the recipient received the relevant bit, if at all, it too might seek out other nodes within its network, hoping to build those nodes into a larger "network" of nodes sufficient to produce an idea. Each step of the process, virtually immediate within the human mind, would now be subject to various layers of disruption in this external network, with each disruption degrading the effectiveness of this network's cognitive architecture.

One need not imagine very long at all, for what I have just described is the Internet at its worst, as governed by various existing and proposed copyright, paracopyright, and communications laws and regulations, each of which bear directly upon the scope of information available on the Internet and the speed that information is accessed and processed. If the brain were designed this way, we would rightly conclude the design was a failure. As the literature on creativity suggests, any system intended to promote creativity designed this way would severely under-produce creativity. Yet, the design of the greatest external network the world has ever seen can exhibit precisely those qualities.

The design failure is not a matter of engineering or hardware. Indeed, at its core, the Internet's infrastructure is designed to operate in an openly accessible, nondiscriminatory manner. The Internet is a series of physical networks interconnected with each other—its physical infrastructure—and the standards and protocols that facilitate the transmission of data across these networks—its logical infrastructure.¹¹⁴ As initially conceived under the so-called end-to-end principle,¹¹⁵ network owners would interconnect with other networks using a standard communications protocol and would not discriminate among users based on the applications used or content accessed by rival network's customers.¹¹⁶ The nondiscrimination ideal would promote open interconnection and focus development and innovation on end uses of the network. Essentially, the network was “dumb pipe,” intentionally oblivious to the information traversing it, thus precluding network providers from distinguishing between uses or users and basing access or pricing decisions on the identity of the user or use.

But end-to-end is only half of the design equation. Just as important are the laws governing the use of that infrastructure and the informational content layered on top of it. End-to-end is but a baseline. No law prevents network operators from discriminating among packets or end users or cutting off access to content.¹¹⁷ Quite the opposite is true. Currently, ISPs routinely degrade end users' Internet speeds, prioritize traffic, discriminate among devices, and censor informational content.¹¹⁸ The power to do so is justified as a matter of property rights. Because network operators own the physical pieces of their network, they should be free to use their property as they choose, including managing the finite capacity of the network to ensure sufficient bandwidth during peak hours¹¹⁹ and charging variable rates depending on usage in order to recoup investment in broadband expansion.¹²⁰ The capacious property impulse is a subset of a larger, worrisome trend in copyright law in the Internet age. Although at its core copyright has traditionally been concerned with encouraging the production and distribution of creative works, its edges have expanded considerably in the last twenty years. As many have observed, copyright now not only governs the individuals and organizations involved in the creation and dissemination of traditional media, like books, film, or music, but a wide range of technology industries involved in producing the hardware and

114. Frischmann & Lemley, *supra* note 41, at 294.

115. Brett M. Frischmann & Barbara van Schewick, *Network Neutrality and the Economics of an Information Superhighway: A Reply to Professor Yoo*, 47 JURIMETRICS J. 383, 385–86 (2007).

116. Frischmann & Lemley, *supra* note 41, at 294.

117. For a discussion of network neutrality, see *infra* Part IV.

118. See *infra* Part IV.

119. Excessive use of the network's finite resources would degrade the network for everyone.

120. Frischmann & Lemley, *supra* note 41, at 295.

software used to consume and deliver copyrighted content and individuals accessing that content over the Internet.¹²¹

A number of explanations for copyright's expansion have been offered,¹²² but the general narrative goes something like this. For most of its history, copyright applied to a narrow subsection of the American economic and cultural landscape, affecting only those directly involved in the production and dissemination of copyrighted works.¹²³ The "copyright" provided holders a narrow bundle of rights, leaving uses not directly specified by the statute beyond their reach. In effect, but not necessarily by law, a large range of private and even public uses of copyrighted materials that might in a technical sense violate copyright were permitted. In economic terms, copyright holders could not fully internalize the value of all externalities related to their copyrights. The Internet changed this by facilitating virtually cost-free duplication of creative works and providing a massive distribution network for digital copies. While in theory the Internet allowed for greater price discrimination such that specific uses previously unmonetizable could now be monetized, in practice, disseminators did not control the Internet as they had the means of distribution in the pre-Internet era. At the same time, the ease of copying and distribution on the Internet sounded alarm bells among disseminators who feared losing control over the distribution of their content.

The response was to seek protection from the Internet's perceived threat to pre-digital business models in Congress.¹²⁴ Invoking a robust conception of property rights, the old media industries successfully lobbied Congress to pass the Digital Millennium Copyright Act (DMCA).¹²⁵ For our purposes, two portions of the Act are relevant. First, the DMCA's anti-circumvention provisions made illegal the manufacture and distribution of software or hardware that circumvented technological access controls on digital copies of copyrighted works and the use of such software or hardware to circumvent such controls.¹²⁶ Second, the DMCA established a "grand bargain" of sorts between the operators of the Internet backbone and the media industries by establishing a safe harbor mechanism for web

121. See sources cited *supra* notes 2 and 17.

122. See, e.g., NETANEL, *supra* note 17, at 54–80; Wu, *supra* note 2, at 279–81; Litman, *supra* note 6, at 24–25.

123. Litman, *supra* note 6, at 24–25.

124. See, e.g., JESSICA LITMAN, DIGITAL COPYRIGHT 144–45 (2001).

125. See 17 U.S.C. §§ 512, 1201–1205 (2006 & Supp. V 2011); Wu, *supra* note 2, at 355–58; Pamela Samuelson, *Intellectual Property and the Digital Economy: Why the Anti-Circumvention Regulations Need to Be Revised*, 14 BERKELEY TECH. L.J. 519, 520–21 (1999); NETANEL, *supra* note 17, at 67–70.

126. 17 U.S.C. § 1201 (2006 & Supp. V 2011); see *Chamberlain Group, Inc. v. Skylink Techs., Inc.*, 381 F.3d 1178 (Fed. Cir. 2004).

intermediaries, including ISPs and web-hosting services:¹²⁷ intermediaries would receive immunity from lawsuits based on their users' copyright infringement in exchange for establishing a mechanism by which copyright holders could seek the removal of infringing content from their networks.¹²⁸ As a result, Internet intermediaries are free to go about their affairs so long as they respond expeditiously to copyright holders' takedown requests.¹²⁹

Additional developments further expand copyright's influence over the content and structure of the Internet and the industries involved in producing the hardware and software used to access and store content on the Internet. Backed by the DMCA, content owners have incentive to overreach in seeking to remove content from the Internet, particularly in light of the forbidding cost of going to court to contest a DMCA takedown for all but the largest of corporate entities.¹³⁰ This is exacerbated by the lack of incentives for Internet intermediaries to push back against overclaiming, given their need to maintain their safe harbors.¹³¹ Indeed, the same intermediaries who bargained with old media over the provisions of the DMCA are now themselves both distributors and owners of content.¹³² These intermediaries now have greater incentive to cooperate with content owners because they seek to profit from distributing content through their own proprietary cable and Internet delivery mechanisms.¹³³ As of this writing, five of the largest ISPs in the United States had agreed to actively police their users' activity on their networks at the behest of the film and music industries, largely because these ISPs have made large capital investments in their broadband networks and hope to recoup that investment by delivering the media industries' content over their networks.¹³⁴ In this new broadband world, ISPs, dependent on media content to monetize networks, have all the incentive in the world to

127. Wu, *supra* note 2, at 355–58; 17 U.S.C. § 512 (2006 & Supp. V 2011).

128. Wu, *supra* note 2, at 355–58; 17 U.S.C. § 512 (2006 & Supp. V 2011).

129. See Wendy Seltzer, *Free Speech Unmoored in Copyright's Safe Harbor: Chilling Effects of the DMCA on the First Amendment*, 24 HARV. J.L. & TECH. 171, 203 (2010).

130. *Id.*

131. *Id.*; NETANEL, *supra* note 17, at 67–70.

132. TIM WU, THE MASTER SWITCH 302–10 (2010); Derek E. Bambauer, *Orwell's Armchair*, 79 U. CHI. L. REV. 863, 879–80 (2012); Jessica E. Vascellaro & Thomas Catan, *Comcast Cleared to Buy NBC*, WALL ST. J., Jan. 19, 2011, at B7.

133. Bambauer, *supra* note 132, at 879–80; Timothy B. Lee, *ISP Flip-Flops: Why Do They Now Support "Six Strikes" Plan?*, ARS TECHNICA (July 10, 2011, 6:30 PM), <http://arstechnica.com/telecom/news/2011/07/why-did-telcos-flip-flop-and-support-six-strikes-plan.ars>.

134. Ben Sisario, *Net Providers Plan Penalties to Slow Piracy*, N.Y. TIMES, July 8, 2011, at A1; Nate Anderson, *Major ISPs Agree to "Six Strikes" Copyright Enforcement Plan*, ARS TECHNICA (July 7, 2011, 10:06 AM), <http://arstechnica.com/tech-policy/news/2011/07/major-isps-agree-to-six-strikes-copyright-enforcement-plan.ars>.

cooperate with the media industries' invocation of a robust and all-encompassing copyright.¹³⁵

In reality, the structure of the content and delivery industries is such that whoever owns the relevant copyrights sets the nature of the competition and communications problems created and consequently drives the tenor of any legal response to those problems.¹³⁶ In economic parlance, copyrighted materials serve as a vertical bottleneck. The entity that controls the copyrighted materials disseminators wish to distribute and consumers wish to access can set the terms by which such (legal) dissemination occurs and access is permitted.¹³⁷ As Tim Wu has convincingly argued, given the structure of the industries involved in dissemination, copyright, despite not technically governing the communications industries, in fact creates the baseline for competition among disseminators and therefore by necessity creates and governs communications policy.¹³⁸ This continues to be the case even in the wireless era, as industry consolidation among disseminators and now between disseminators and infrastructure operators continues.¹³⁹

The takeaway for our purposes is that copyright now governs, by direct statutory mandate or indirect structural reality, anything on or connected to the Internet.¹⁴⁰ By direct statutory mandate, every word, sound, and pixel accessible on the Internet is governed by the Copyright Act,¹⁴¹ as is any software company or ISP that facilitates access to that material.¹⁴² By indirect structural reality and by virtue of telecommunications law and federal regulation, every industry even tangentially involved in producing the tools consumers use to access any bit on the Internet operates in copyright's shadow.¹⁴³ And any individual who accesses anything on the Internet using these tools, including computers or mobile devices, accesses

135. See sources cited *supra* notes 132–133.

136. Wu, *supra* note 2, at 325, 340–41.

137. *Id.*

138. *Id.* First, the Copyright Act includes voluminous sections devoted to governing various communications and media industries, including the DMCA. See *id.* at 341–56. Second, the FCC views one of its core functions as “copyright policy-making,” often intervening in copyright industries with regulations governing the technological hardware and software with which the net is accessed and content is distributed. *Id.* at 334–35. Regulation may not directly involve content owners’ copyrights, but it bears indirectly on those rights by governing the technological means by which end users consume content and creators produce and disseminate content. This too falls within the ambit of copyright. See, e.g., Molly Shaffer Van Houweling, *Communications’ Copyright Policy*, 4 J. TELECOMM. & HIGH TECH. L. 97 (2005).

139. See sources cited *supra* note 132; Lee, *supra* note 133; Shayndi Raice & Anupreet Das, *AT&T to Buy Rival in \$39 Billion Deal*, WALL ST. J., Mar. 21, 2011, at A1.

140. See sources cited *supra* note 17.

141. See 17 U.S.C. §§ 102, 103, 106 (2006).

142. See *MGM Studios, Inc. v. Grokster, Ltd.*, 545 U.S. 913, 930 (2005).

143. *Id.*; Wu, *supra* note 2, at 279–81; Wu, *supra* note 132, at 303–12.

such information at the mercy of copyright.¹⁴⁴ At the same time, the Internet as a communications medium is collectively embedded in our existence in a way unprecedented in the annals of human history.¹⁴⁵ As the sum of human knowledge increasingly moves online, copyright law sweeps that knowledge within its ambit. And because the present structure and scope of copyright establishes an Internet framework in which content owners can, with the aid of intermediaries, remove content from the Internet, copyright can also potentially degrade the depth and scope of that knowledge. Likewise, copyright and related information policy laws and regulations enable Internet intermediaries to pick and choose what sources of information end users have immediate access to and the speed at which that access occurs.¹⁴⁶ These laws, directly or indirectly, govern the entire span of the Internet and all its participants, including the breadth and content of the external network layer and the signal-to-noise ratio in the communications layer.

Accordingly, copyright and information policy are not just the tails that wag the technology industry dog. They are the legal and policy levers by which the very architecture of creativity, both internal and external to the human brain, is governed. To tease this point out, recall the earlier discussion of optimal systems design across layers.¹⁴⁷ All three components of an integrated cognitive architecture must be optimized such that the internal cognitive architecture can interface with the external network with minimal noise and efficient signal. This presents two chokepoints in the structure of the cognitive architecture/Internet interface. First, as we have seen, the breadth and scope of actual information available in the external network is subject to access restrictions, removal, or outright censorship. Second, the mechanism by which that network and the internal cognitive architecture interface is subject to the vicissitudes of “network management,” itself an indirect function of copyright law and policy.¹⁴⁸ That management can either degrade or improve the quality and speed with which bits are communicated while also degrading or improving the strength of the signal by slowing the connection, rerouting information, censoring outputs, and so on, thus injecting more noise into the relay and rendering the interface suboptimal.

144. See sources cited *supra* note 143.

145. Wu, *supra* note 132, at 301–18.

146. See, e.g., Stuart Minor Benjamin, *Transmitting, Editing, and Communicating: Determining What “The Freedom of Speech” Encompasses*, 60 DUKE L.J. 1673 (2011); Rob Frieden, *Invoking and Avoiding the First Amendment: How Internet Service Providers Leverage Their Status as Both Content Creators and Neutral Conduits*, 12 U. PA. J. CONST. L. 1279, 1321 (2010).

147. See discussion *supra* Part II.B.

148. See Wu, *supra* note 2, at 340–41.

These two chokepoints affect the inputs to and outputs of creativity. An individual accessing the web while chasing down an idea needs immediate and broad access to inputs that may, when interacting with the idea in its emergent state, provide the serendipitous connection that will produce the creative insight. The larger the input sources, and the more immediate the access, the greater the chance the emergent idea in fact coalesces into a tangible idea. Those inputs need not be information passively consumed while web browsing. They could be a conversation, a phone call, microblogging, or any other interaction. But so long as it is mediated through the Internet, it is functionally an input affected by copyright. Both chokepoints directly affect the breadth and immediacy of access to these inputs, and therefore both directly affect the optimal design of the cognitive architecture.

The same is true when we consider outputs—the dissemination of creativity and its constituent components. Taking this example further, individuals accessing the Internet seeking inputs to assist their creative process are also disseminating outputs. Every interaction they have with others is itself an output to be inputted to other individuals interfacing with the network. Those outputs may themselves yield the missing piece of the creative puzzle for other individuals, who may then disseminate creative output back into the network, completing the virtuous cycle. Here too, both chokepoints directly affect the breadth and immediacy of available information. First, the quality of outputs present in the content layer depends on the zeal with which content owners flag materials for removal. A capacious copyright enforcer will flag outputs deemed to violate the copyright grant, removing them from the network and decreasing the sum total of bits available to the creative process. Second, the quality of technological tools available for end users to disseminate and receive information affects the quality of information available to others once outputted. And the quality of the communications signal affects how quickly end users can access and process inputs. A poor communications signal will not only inhibit the uploading of new outputs to the network but the cognitive architecture's processing of those inputs back in to neural networks. Thus, how robust available informational outputs are is entirely a function of how the managers of the communications layer manage their networks and prioritize content.¹⁴⁹

149. I do not mean to suggest that the Internet, with all its legal and structural imperfections, provides a worse creative environment than what preceded it. The Internet provides far more opportunities for serendipity than any previous network. But because it is better does not mean it is optimal. Moreover, the Internet's structure and laws governing it are not etched in stone and are subject to change, as are rules governing market participants. My point is simply that information policy laws generally, and copyright in particular, affect the optimality of the brain/Internet interface.

Copyright's regulatory hand therefore sits firmly on the points of ingress and egress to the external network while simultaneously regulating the content of the external network. It governs the scope of inputs would-be creators have access to and the quality of that access while also governing the various intellectual technologies used to disseminate a creator's output to the world at large. A set of laws which governs the structure of the creative process external to the human mind that itself feeds back into the internal cognitive architecture and affects the breadth and depth of that internal network's ability to function, thus organizing the mind on a neurobiological level, functions as *de facto* cognitive policy, and, as a result, functions as a guiding force behind coding the human brain's creative architecture in both its interior and exterior dimensions.

B. Neuroscience and the Internet

When viewed in conjunction with the neuroscience literature, copyright's functional grip on the two chokepoints described above presents additional issues relevant to designing an optimal system for encouraging creativity. The process of accessing and consuming media on the Internet, more than any medium for media delivery and consumption before it, has the potential to alter the brain's neural networks. This is a consequence of the brain's essentially malleable structure, or its "neuroplasticity." As neuroscientists in recent years have learned, the brain changes the structure and function of its neural circuitry, growing new synaptic connections and closing old ones in response to input from external stimuli.¹⁵⁰ Until recently, this was thought to be limited to the pre-adolescent brain,¹⁵¹ such that upon reaching adulthood the structure of the brain became "set."¹⁵² Neuroscientists now agree that even in adulthood, the brain remains plastic, although not as plastic as the pre-adolescent brain.¹⁵³ This explains why a child can learn a new language more easily than an adult. But it also explains why an adult, even in late age, can learn a

150. NORMAN DOIDGE, *THE BRAIN THAT CHANGES ITSELF* 46–48, 97–98 (2007); CARR, *supra* note 79, at 182–97. Evidence suggests that the act of thinking or recalling changes the structure of a neural network by building new connections and changing existing connections. CARR, *supra* note 79, at 182–97; DOIDGE, *supra*; Seung, *supra* note 61. Underlying neural processes can also adaptively shift the default nodal network recruited for performing tasks. See Inbal Goshen et al., *Dynamics of Retrieval Strategies for Remote Memories*, 147 *CELL* 678, 687 (2011).

151. DOIDGE, *supra* note 150, at 51–53, 77–79.

152. *Id.*

153. CARR, *supra* note 79, at 182–97; DOIDGE, *supra* note 150, at 46–48, 97–98; Seung, *supra* note 61. Recent research shows that the human brain continues to mature well into the 30s. See Catherine Lebel & Christian Beaulieu, *Longitudinal Development of Human Brain Wiring Continues from Childhood into Adulthood*, 31 *J. NEUROSCIENCE* 10937 (2011); Zdravko Petanjek et al., *Extraordinary Neoteny of Synaptic Spines in the Human Prefrontal Cortex*, 108 *PROC. NAT'L ACAD. SCI.* 13281 (2011), available at <http://www.pnas.org/content/108/32/13281.full.pdf>.

new language or any other new habit or skill dependent on brain structure.¹⁵⁴ It just takes more time and discipline.¹⁵⁵

For environmental design purposes, neuroplasticity's effect on brain structure raises several concerns. First, it can affect the process by which new information enters long-term memory and is incorporated into existing nodal networks.¹⁵⁶ To see how, consider the difference between written media in the pre- and post-Internet era. Pre-Internet, the act of consuming media, like reading, listening to music, or watching films, was generally a linear experience. For example, engaging text as a reader involved a slow drip of information, line-by-line, and page-by-page. This linear process mirrored the structure of the brain's process for transferring short-term memory into long-term memory.¹⁵⁷ While distractions were possible, and by no means was all information consumed incorporated into long-term memory, the process was generally less prone to fragmentation and distraction given its linear nature.¹⁵⁸

The Internet doesn't necessarily change this, but it amplifies it. Unlike the linear experience of consuming pre-Internet media, the Internet itself is a teeming bazaar, filled with millions and millions of media materials, some relevant, some not, each vying for our limited attention. The structure of this "bazaar" is such that fragmentation and disruption are features, not bugs. Every source of information links to others, calling out like a siren through hyperlinks and search results. Advertisements interrupt a stream of thought while social media feeds and email routinely pull us away from other activities. Each new instant of disruption diminishes focus and fragments attention, making it more likely we lose our train of thought or the contents of short-term memory.¹⁵⁹

Perhaps the more disciplined among us can mitigate the effect of distraction or disruption. But the important point for design purposes is that the structure of the Internet amplifies the potential consequences of distraction and fragmented attention beyond anything that existed in the pre-digital world.¹⁶⁰ That amplification, delivering a flood of constant and new stimuli through web browsing and media feeds, is precisely the kind of cognitive stimulation that can produce rapid alterations in brain circuitry

154. DOIDGE, *supra* note 150, at 47, 52, 59–60, 69, 87.

155. *See id.*

156. *See* KAHNEMAN, *supra* note 59, at 31, 42, 151; Santangelo et al., *supra* note 81, at 158–60, 169–71; Ophir et al., *supra* note 82.

157. CARR, *supra* note 79, at 192–97; KANDEL, *supra* note 84, at 210.

158. *See* sources cited *supra* note 157; Ophir et al., *supra* note 82.

159. *See* sources cited *supra* note 157; Ophir et al., *supra* note 82.

160. *See* Ophir et al., *supra* note 82.

and function.¹⁶¹ This works in two related ways. First, it taps into the brain's reward circuitry. The human brain's default state is to notice change over stasis¹⁶² and to prefer the immediate over delayed reward.¹⁶³ New stimuli present the brain with a choice of paying attention to that stimuli or retaining focus on previous stimuli.¹⁶⁴ Because the brain favors the new and the immediate, the brain is predisposed to favor the new stimuli, which in turn triggers the reward function of the brain.¹⁶⁵ Quite rapidly, the brain can be conditioned to seek the pleasurable reward found in consumption of new information, regardless of its objective importance, such that the consumption of new information takes precedence over the consumption of relevant information.¹⁶⁶ This restructuring of the brain affects an individual's capacity for attention and more specifically their capacity for distinguishing relevant and irrelevant informational streams.¹⁶⁷ That in turn affects the quality of information that passes from short-term to long-term memory.¹⁶⁸

Related to this is the Internet's effect on working memory's cognitive load. Recall that the process of creating long-term memories integrated into the brain's neural circuitry requires that working memory's cognitive load not be overwhelmed.¹⁶⁹ The Internet's amplified data stream not only overwhelms working memory with information both relevant and irrelevant, but it forces the brain to confront each new bit of information in real time and determine whether it is worth retaining or discarding.¹⁷⁰ This

161. Gary W. Small et al., *Your Brain on Google: Patterns of Cerebral Activation During Internet Searching*, 17 AM. J. GERIATRIC PSYCHIATRY 116, 120–21, 124 (2009); GARY SMALL & GIGI VORGAN, *iBRAIN: SURVIVING THE TECHNOLOGICAL ALTERATION OF THE MODERN MIND* (2008).

162. KAHNEMAN, *supra* note 59 at 31, 42, 151; Santangelo et al., *supra* note 81, at 158–60, 169–71; Ophir et al., *supra* note 82; Begley, *supra* note 66.

163. See Jan Peters & Christian Büchel, *The Neural Mechanisms of Inter-temporal Decision-Making: Understanding Variability*, 15 TRENDS COGNITIVE SCI. 227, 227 (2011); Todd L. McKeerchar et al., *A Comparison of Four Models of Delay Discounting in Humans*, 81 BEHAV. PROCESSES 256 (2009).

164. See sources cited *supra* note 162.

165. See sources cited *supra* note 162; Sharon Begley, *Can You Build a Better Brain?*, NEWSWEEK, Jan 3, 2011, at 41; Matt Richtel, *Your Brain on Computers: Growing Up Digital, Wired for Distraction*, N.Y. TIMES, Nov. 21, 2010, at A1; CARR, *supra* note 79, at 117–26.

166. See sources cited *supra* note 165. This can also recruit new neural networks previously used for more productive uses. See Goshen et al., *supra* note 150, at 687.

167. As Santangelo and Macaluso write, working memory “load results in a reduced capability to filter out task-irrelevant information” and reduces “the brain's capability to maintain stimulus-processing priorities.” Santangelo et al., *supra* note 81, at 158, 159; see KAHNEMAN, *supra* note 59 at 31, 42, 151; sources cited *supra* note 165; KLINGBERG, *supra* note 88, at 72–75.

168. Santangelo et al., *supra* note 81, at 158, 159; see KAHNEMAN, *supra* note 59 at 31, 42, 151; sources cited note 165 *supra*; KLINGBERG, *supra* note 88, at 72–75.

169. See *supra* notes 84–88 and accompanying text.

170. KAHNEMAN, *supra* note 59, at 31, 42, 151; Santangelo et al., *supra* note 81, at 158–60, 169–71; Ophir et al., *supra* note 82.

presents a form of “switching costs”,¹⁷¹ each time the brain shifts its focus to make an executive decision regarding whether to pay attention to specific stimuli, the brain must then reorient itself back to its previous state.¹⁷² This additional cognitive function adds to working memory’s cognitive load, which, when overburdened, increases distractedness and weakens the brain’s ability to retain and integrate information into long-term memory.¹⁷³ That over-taxation of working memory overburdens the executive process of distinguishing signal from noise from the data stream, further degrading the brain’s ability to discern the relevant from the irrelevant.¹⁷⁴ The end result is that, lacking sufficient mental capacity and stamina to filter irrelevant information and maintain stimulus processing priorities, the brain’s processing efficiency is compromised, causing the brain to process that irrelevant information as though it was relevant and useful when integrating into long-term memory¹⁷⁵ and then relying on that information once internalized.¹⁷⁶

The shift online also creates greater incentive for the brain to outsource the process of memory back into the cloud. This is the flip side of the Internet’s potential effect on working memory and cognitive load—the Internet provides a vast storehouse of information, including information that until now many internalized into memory. Why memorize that when

171. Switching costs refer to the cognitive impairment caused by each momentary deployment of mental resources in response to interruption. Ophir et al., *supra* note 82; CARR, *supra* note 79; *see also* J. Gregory Trafton & Christopher A. Monk, *Task Interruptions*, 3 REVS. HUM. FACTORS & ERGONOMICS 111 (2007); Karin Foerde et al., *Modulation of Competing Memory Systems by Distraction*, 103 PROC. NAT’L ACAD. SCI. 11778 (2006). Research suggests that the impairment arises in part because the brain’s information processing capacity is not compartmentalized by task. *See* Santangelo et al., *supra* note 81, at 158–60, 169–71; Michael N. Tombu et al., *A Unified Attentional Bottleneck in the Human Brain*, 108 PROC. NAT’L ACAD. SCI. 13426 (2011); Joshua S. Rubinstein et al., *Executive Control of Cognitive Processes in Task Switching*, 27 J. EXPERIMENTAL PSYCHOL.: HUM. PERCEPTION & PERFORMANCE 763 (2001). For example, the act of driving and the act of typing rely on many of the same processing networks, such that doing both at once degrades the efficacy of both. Only where tasks rely on truly independent processing channels can they be done simultaneously with no switching costs. *See* Santangelo et al., *supra* note 81, at 158–60, 169–71; Tombu et al., *supra*; Rubinstein et al., *supra*.

172. *See* Santangelo et al., *supra* note 81, at 158–60, 169–71; Ophir et al., *supra* note 82.

173. *See* sources cited *supra* note 171.

174. *See* KAHNEMAN, *supra* note 59, at 31, 42, 151; Santangelo et al., *supra* note 81, at 158–60, 169–71; Ophir et al., *supra* note 82. This is particularly important in pre-adolescent youth, who are more susceptible to noise and disruption, degrading the efficacy of their sense processing functions on a neural level. Michael Mezernich, *Growing Evidence of Brain Plasticity*, TED.COM (Apr. 2009), http://www.ted.com/talks/michael_merzenich_on_the_elastic_brain.html.

175. *See* KAHNEMAN, *supra* note 59, at 31, 42, 151; Santangelo et al., *supra* note 81, at 158–60, 169–71.

176. Ophir et al., *supra* note 82, at 15585. This can then cascade into a domino effect, with the brain focusing on, so to speak, what’s on its mind in that particular moment, which in turn focuses attention further and deployment of working memory further. *See* KAHNEMAN, *supra* note 59, at 31, 42, 102, 151; Santangelo et al., *supra* note 81, at 1–3, 12–14; Christian N.L. Olivers et al., *Different States in Visual Working Memory: When It Guides Attention and When It Does Not*, 15 TRENDS COGNITIVE SCI. 327, 327 (2011).

you can search for it in Google or look it up on Wikipedia? The ready availability of every conceivable bit of information online means that the brain can wire itself to favor transactive memory rather than actual memory. Actual memory is developed by the process discussed above, whereby working memory is absorbed into the brain's internal neural circuitry so long as working memory's cognitive load isn't overburdened.¹⁷⁷ Once inside the neural network, however, the relevant information is within the network. Unlike actual memory, transactive memory tells the brain where to find actual information.¹⁷⁸ While entering the neural network the same way actual memory does, transactive memory is not the information itself but information regarding the location of the information.

The concept of transactive memory, developed by the psychologist Daniel Wegner in the context of small group dynamics, explains relationships where individuals remember specific things while others remember not the thing itself, but that their companion remembers it.¹⁷⁹ The theory is an example of the opportunity costs of memory within a cohesive unit. A recent series of experiments by Wegner suggests that transactive memory is not limited to small group dynamics but applies to the Internet as well. These studies suggest that in the age of search engines, the Internet has become a primary form of external or transactive memory.¹⁸⁰ People increasingly recall not the information itself but the transactive memory of where they might find the answer to a question or problem on the Internet.¹⁸¹ Moreover, as the Internet pervades ever more people's lives with its constantly on and constantly available nature, people expect computerized information to be continuously available and consequently remember less actual information given that they know they will have access to the Internet later.¹⁸² The end result is that the more we rely on the Internet for information, the more the information that enters our neural networks through working memory is transactive, rather than actual, information. In other words, we are building internal neural

177. See *supra* notes 84–88 and accompanying text.

178. See, e.g., Betsy Sparrow et al., *Google Effects on Memory: Cognitive Consequences of Having Information at Our Fingertips*, 333 *SCL.* 776 (2011).

179. Daniel M. Wegner et al., *Transactive Memory in Close Relationships*, 61 *J. PERSONALITY & SOC. PSYCHOL.* 923 (1991); Daniel M. Wegner et al., *Cognitive Interdependence in Close Relationships*, in *COMPATIBLE AND INCOMPATIBLE RELATIONSHIPS* 253 (William J. Ickes ed., 1985). In subsequent work, Wegner and others expanded the concept to group dynamics, where each member of the group has their own area of expertise. Daniel M. Wegner, *A Computer Network Model of Human Transactive Memory*, 13 *SOC. COGNITION* 319 (1995). Within the group, just as within the relationship, individuals possessed only certain actual information but retained information regarding who had actual information. *Id.*

180. See Sparrow et al., *supra* note 178, at 776–78.

181. *Id.*

182. *Id.*

networks that increasingly include the location of where we can find information instead of the information itself.¹⁸³

This alone is not necessarily a bad thing. The problem is that remembering where to find information is not the same thing as knowing that information. This has two related components. First, it affects what neuroscientists refer to as “embodied cognition.”¹⁸⁴ Embodied cognition describes the reality that the brain does not exist in isolation but instead interacts with its immediate surroundings, in particular the human body, to produce cognition.¹⁸⁵ As Daniel Kahneman notes, “you think with your body, not only with your brain.”¹⁸⁶ But given the realities of transactive memory, we now think not only with our brains and bodies but also with information on the Internet. That external information, a sort of “data ring” of information outside the brain but mapped within the brain as transactive memory, pushes the range of information the brain believes it has ready access to beyond what its embodied cognition can in fact immediately access. This disconnect between what the brain believes it can access and the reality of that access can hinder any creative cognitive process not entirely embodied within the human mind.¹⁸⁷

Second, when our neural circuitry fires up and divergent and convergent processes go to work, knowing where the information is rather than having the information stored internally adds an additional step to the cognitive architecture’s processes. Perhaps the thread of an idea materializes in your mind and simultaneously the *location* of the final piece of information that your brain suspects it needs to crystallize the idea also materializes. Chasing down the thread, you jump on your computer or mobile device, head straight to Google, and enter the information your brain is telling you to enter in order to find the last piece of your creative puzzle. Every second here is crucial. While the nodes within your mind fire at the speed of electricity, your search on the Internet occurs at the far more

183. *Id.* at 778.

184. KAHNEMAN, *supra* note 59, at 51; *see generally* ANDY CLARK, *SUPERSIZING THE MIND: EMBODIMENT, ACTION, AND COGNITIVE EXTENSION* (2008).

185. KAHNEMAN, *supra* note 59, at 51.

186. *Id.* A similar concept, derived from Martin Heidegger’s idea “ready to hand,” views tools as an extension of the human self. *See* Dobromir G. Dotov et al., *A Demonstration of the Transition from Ready-to-Hand to Unready-to-Hand*, PLoS ONE 5(3): e9433 (2010). Experiments conducted to test this theory found that disruptions to an individual’s use of a computer disrupted that person’s cognition as well, suggesting that the tools we use are in part an extension of our internal cognition and that interruptions to those tools disrupt that cognition. *Id.*; *see also* CARR, *supra* note 79, at 44–45.

187. Consider as an example an athlete whose athletic intelligence is embodied in both mind and body, but who one day wakes up and must access a third-party for information relevant to his or her mind’s instantaneous coordination of its body’s reactions to external stimuli and opposing athletes. *See, e.g.*, John Sutton, *Batting, Habit and Memory: The Embodied Mind and the Nature of Skill*, 10 SPORT SOC’Y 763, 778–79 (2007). The act of contemplating this external source of previously internalized information places a break on the athlete’s performance.

pedestrian speed of your ISP's network connection. Unfortunately, your ISP is suffering a network outage. As you scramble to find another path to the information, the thread of your idea dissipates into nothing. Unable to access the information your transactive memory told you to access, you lose the idea.¹⁸⁸

My point here is not that transactive memory in the Internet age is so pernicious that we must strive to jam as much actual memory into our collective heads so that we do not end up staring at screens wondering where our ideas went. Transactive memory has its benefits and works well in settings where the source of the actual information your transactive memory refers you to is readily available. But therein lies the rub—we do not control our access to the Internet and there is no guarantee that the specific information we need to find will be available to us in the specific moment we need to find it. All things being equal, two bits of actual memory inside the brain are better than one bit of actual memory and one bit of transactional memory referring the brain to an external source.¹⁸⁹ The more we outsource our actual memory and replace it with transactive memory, the more dependent we become on the perfectibility of our communications conduit from our brains to the Internet. Barring the perfect integration of the Internet into our brains—something that remains in the realm of science fiction—our dependence on transactive memory serves as yet another brake on our creative processes.¹⁹⁰ As we have seen, the brain's cognitive architecture is the fulcrum of the entire system. As a baseline, the richer the networks of informational nodes within this hub, the greater an individual's ability to think critically and creatively is. While the range of external inputs and the ability to convert those inputs into outputs is certainly critical, if the hub of this process does not contain sufficient core, internal information immediately accessible to it, no manner of optimal design of the external parts of the system will render the hub more effective. Simply put, a transactive memory that could have been an actual memory is no memory at all if it is not accessible when the brain needs to access it.¹⁹¹

This is not to say that the literature is unequivocal about the risks the Internet poses to the brain's ability to integrate new information into its

188. The problem is generalizable. An index is only useful if it comes attached to a book.

189. See KAHNEMAN, *supra* note 59, at 85. For a particularly dramatic example, see Lehrer, *supra* note 70.

190. This is not to say that disruption is always problematic. The same communications disruption between an individual's brain and external memory stored within the brain as transactive memory that disrupts that specific thought may simultaneously lead to some other source of information which itself might spark an idea. See JOHNSON, *supra* note 31, at 131–48.

191. See KAHNEMAN, *supra* note 59, at 85.

internal networks, and this is not the place to offer a definitive account.¹⁹² For our purposes, we need only understand that the structure of the Internet can both feed back into neural networks through neuroplastic change and serve to disrupt the process of long-term memory development. The most disciplined among us may mitigate any neurobiological consequences, but our collective experience over the past decade suggests many cannot. The design of any cognitive architecture across layers should therefore anticipate the possibility and design a set of mechanisms to mitigate it. Distractibility is not a problem per se,¹⁹³ but can become one when we fail to curate our browsing experience so that we are better able to block out irrelevant information from working memory. Conversely, the optimal system should not block out everything but a narrow band of filtered content. We know that this would run counter to the ideal creative environment, which encourages our thoughts to interact with disparate and possibly unrelated threads of information.¹⁹⁴ Finally, given that the Internet facilitates the integration of transactive, rather than actual, memory into neural networks, an optimal system will minimize any disruption along the communications channel between the brain's neural circuitry of actual memories and the online information which that neural circuitry's transactive memory tracks. The goal should be to facilitate the browsing experience in a manner that mirrors the structure of our cognitive architecture while accounting for the hard- and soft-wired characteristics of the neuroplastic brain.

IV. DESIGNING THE OPTIMAL COGNITIVE ARCHITECTURE

As discussed, designing an optimal cognitive architecture across internal and external layers specific to every conceivable environment requires a great deal of further empirical work. But given what we now know about the brain's neurocircuitry and how it interacts with the Internet, we can establish a set of baseline principles applicable across all aspects of the information economy. My goal here is not to establish an exhaustive list; nor do I aim to apply this set of principles to every aspect of contemporary copyright or information policy. Rather, my goal is to provide a blueprint based on cognitive science that policymakers and

192. Some examples of benefits include improved visual-spatial skills, see Patricia M. Greenfield, *Technology and Informal Education*, 323 SCI. 69, 69–71 (2009); search efficiency and visual acuity, see Matt Richtel, *Hooked on Gadgets, and Paying a Mental Price*, N.Y. TIMES, June 7, 2010, at A1; hand-eye coordination and reflex response, CARR, *supra* note 79, at 139; and even an expansion of working memory. *Id.* What remains unknown and requires further research is what effect the replacement of written literacy with visual literacy will have on neural infrastructure.

193. Indeed, it may yield serendipitous encounters that can yield creative results.

194. See *supra* Part II.

systems designers can look to when designing the legal structure of the information economy. Because I aim to articulate design principles applicable to all copyright stakeholders, these principles will be general rather than industry or individual specific.

At base, these design principles need to support an environment that complements the realities of long-term memory construction, neuroplastic change, and transactive memory in the Internet age. The system should strive to complement the process by which the brain builds its network of internal nodes by minimizing short-term memory failures and cognitive overload. The system should also promote efficient interface between the brain's neural network and the external Internet network by facilitating a clean and immediate communications signal between the two. As we have seen, the more disruptive the communications channel between internal and external layers of the system, the more likely information will fail to enter long-term memory. Likewise, the system should account for the fact that the brain increasingly outsources information previously internalized through transactive memory and therefore increasingly relies on external sources of information as an extension of the brain's nodal networks. The system should therefore facilitate access to external sources of information stored within the brain as transactive memory to the extent necessary to allow the brain's cognitive architecture to translate transactive memory into actual information useful to the creative process. Finally, the system should provide access to sufficient external content with which the brain's cognitive architecture can interact, even where that information is not necessarily information stored as transactive memory. As we have seen, the interaction between the brain's internal networks and external informational environments is more likely to trigger creativity where the interplay between the two facilitates serendipitous encounters and information spillovers. It is this interplay that can then activate connections between unrelated neural networks, thereby sparking creative insights. As a separate matter, the system should account for the empirical realities of incentive structures across creative industries, such that the principles are general enough to apply uniformly. At the same time, these realities do not require that we assume such incentives must be property-based rights to exclude at various layers of the infrastructure. As discussed, incentivizing creativity cannot simply be confined to a rigid set of property rules. Likewise systems design cannot focus single-mindedly on any one layer, device, or moment in time in the system. Rather, we need to look at the system as a whole, across layers, devices, and time.¹⁹⁵ Incentives at the

195. James Grimmelmann & Paul Ohm, *Dr. Generative or: How I Learned to Stop Worrying and Love the iPhone*, 69 MD. L. REV. 910, 943–48 (2010) (book review); see also Oliver R. Goodenough,

physical infrastructure layer are but one of many variables. To the extent that tradeoffs within physical infrastructure and network design are necessary to facilitate an efficient and uncongested network, design choices that impact the cognitive architecture should be transparent, so that end users retain some ability to design their own user experience in light of infrastructure design that has cognitive effects.

Here, I focus on a few contemporary issues that touch directly on the three layers of the cognitive architecture I have described above—the internal cognitive architecture, the content layer on the Internet, and the communications channel between these two networks.¹⁹⁶ As to the communications channel, the scientific evidence discussed supports some form of network neutrality, which fosters greater creativity than its alternatives, and suggests that network management tools like data caps and so-called graduated response programs targeting copyright infringement should be more narrowly targeted to alleviate actual congestion issues and provide greater transparency and more process before a user’s Internet connection is degraded. As to cognitive architecture, the neuroscience literature supports reading copyright’s fair use doctrine to privilege the personal use of software or hardware that facilitates a user’s curation of their browsing experience to avoid cognitive inputs that can harm the creative process.¹⁹⁷ Further, as to the content layer, the scientific literature suggests that laws governing access to information and content, including the Digital Millennium Copyright Act, the proposed Stop Online Piracy Act, and the Protect IP Act should be more narrowly tailored and should require content owners to satisfy a higher initial burden of proof when seeking to block content or seize allegedly infringing websites. They also should provide website operators greater procedural safeguards in order to distinguish between copyright infringing information and otherwise legitimate information stored on the Internet. Finally, the scientific literature offers support for both for-profit and peer-production models of creative production.

A. Communications Channels

1. Network Neutrality

“Network neutrality” is the notion that network operators should not be permitted to discriminate in their treatment of unaffiliated content, devices,

Institutions, Emotions, and Law: A Goldilocks Problem for Mechanism Design, 33 VT. L. REV. 395, 402 (2009).

196. I will flag areas for further research where relevant.

197. See 17 U.S.C. § 107 (2006 & Supp. V 2011).

and services. The key questions in the network neutrality debate are whether (1) the Internet should retain the end-to-end architecture discussed above and continue to be managed in an openly accessible, nondiscriminatory manner or (2) the owners of the networks that comprise the physical infrastructure of the Internet—what I have termed the communications channel between the internal cognitive architecture and the content layer of the Internet—can discriminate among Internet users in pricing and access decisions.¹⁹⁸ As discussed, end-to-end design insulates users at the ends of the network from market-driven restrictions on access and use.¹⁹⁹ As Professors Frischman and Lemley have suggested, end-to-end design acts as a limitation on the property rights of network owners, much like fair use operates as a limitation on the rights of copyright owners.²⁰⁰

Network neutrality opponents argue that the Internet’s “dumb,” open architecture is unsustainable, and that network providers need to differentiate and discriminate among users and uses.²⁰¹ They argue that the network is a finite resource that requires effective management in order to optimize traffic, particularly at peak usage hours. This is so because of the growth of bandwidth-heavy applications, which require expanding broadband and wireless infrastructure to supply sufficient capacity for those applications.²⁰² If network operators cannot discriminate based on user and use, they will lack sufficient incentive to invest in infrastructure improvements, and all participants in the Internet’s ecosystem will suffer as a result.²⁰³ In essence, network owners argue that the freedom to manage their property as they see fit will best incentivize expanding and improving broadband and wireless access.²⁰⁴

It is not my intent to solve the debate.²⁰⁵ Rather, I would like to highlight how the two competing conceptions of Internet architecture would reflect the systems design principles discussed earlier. In a legal regime reflecting some version of network neutrality principles, end users would have ready, non-discriminatory access to the inputs and outputs necessary to fire the brain’s creative process. As we have seen, this is particularly important in light of the brain’s increasing incorporation of

198. Frischman & Lemley, *supra* note 41, at 293.

199. See discussion *supra* Part III.A.

200. Frischman & Lemley, *supra* note 41, at 286–88.

201. *Id.* at 295–96.

202. *Id.*

203. *Id.*

204. See *id.*

205. If incentives to invest in infrastructure become suboptimal, they can be improved without network discrimination. *Id.* at 297 n.147. However, there is little reason to believe that telecoms will not expand their infrastructure without the rights they now demand in light of their past history of doing just that. *Id.*

transactive memory in place of actual memory. But more fundamentally, network neutrality-like design appears to parallel the brain's cognitive architecture. Both facilitate access to a breadth of information without instituting blocks between nodes of information or closing off some subset of information to those who can afford to pay for it. As within the cognitive architecture, a network premised on end-to-end legal design facilitates access to disparate nodes at the content layer, pushing the adjacent possible and hard-wiring the system for serendipity.²⁰⁶ Similarly, network neutrality principles minimize noise on the communications layer, setting as a default a rule that all individuals accessing the Internet are entitled to a baseline level of speed and quality in terms of the content they access and send. So long as that baseline does not degrade the entire network during peak use, that baseline will benefit cognitive wiring.

Of course, should this baseline of non-discriminatory access and speed overwhelm the network, all would suffer. In that situation, the cognitive argument for network neutrality is less compelling. But there is reason to doubt the argument made by network neutrality opponents that network neutrality will lead to congestion because network providers will be unable to combat bandwidth scarcity and will lack incentives to invest in infrastructure. First, the argument is a species of the general property impulse we have already seen pervading contemporary copyright law—because some property rights facilitate some level of investment in creative infrastructure, therefore more property rights, and the ability to capture all value arising from that property, will necessarily yield more creative infrastructure. There is considerable reason to doubt this account. Recouping the cost of expanding network infrastructure and earning a profit are not the same thing as internalizing all externalities the network produces.²⁰⁷ At some point, there are decreasing returns in terms of improved incentives to allowing property owners to capture more of the value realized by users.²⁰⁸ Indeed, shifting to a system where access to and use of the Internet are allocated and prioritized according to a person's willingness and ability to pay—the basic objective of network discrimination—prioritizes activities that generate observable and appropriable financial benefits over activities that may not produce immediately monetizable benefits, but that nevertheless generate spillovers that an individual's cognitive architecture can benefit from. Similarly, network discrimination can reduce innovation at the non-network level, given that more of the innovation's value will be transferred to network

206. See discussion *supra* Part II.B.

207. Frischman & Lemley, *supra* note 41, at 297–98.

208. *Id.*

owners.²⁰⁹ That sort of non-network level innovation in the form of new content and applications is precisely the innovation that creativity depends on, as it is interactions with this information in the form of content-layer applications that facilitates the serendipitous interactions that produce creativity in the first place.²¹⁰

But more critically, the argument regarding congestion is based on a false premise. The latest empirical data addressing congestion shows that congestion is a problem, if at all, only during peak usage periods lasting roughly four to five hours during the evening.²¹¹ Content discrimination does nothing to solve that problem that does not also degrade access to content for all users that otherwise would be available on equal terms. That solution is therefore far too overinclusive and produces cognitive harms for all Internet users regardless of their level of bandwidth consumption. A more narrowly tailored solution targeting the largest bandwidth users at peak hours avoids this problem by degrading the Internet speeds of only those consuming bandwidth at some relevant threshold.²¹² Such congestion-based pricing is not discriminatory and actually solves the congestion problem without degrading every Internet user's access to content.²¹³ In short, under some versions of a network neutrality regime, users retain non-discriminatory access to content, thus facilitating access to information that the brain needs to develop long-term nodes within its neural circuitry and information stored within the brain as transactive memory, while network providers can manage congestion in a way that ensures that most users continue to have an efficient communications channel with that information.²¹⁴

209. *Id.* at 298.

210. The social opportunity costs of allowing network owners to implement network discrimination is difficult to measure precisely because so much of the value generated by the Internet is not fully captured in market transactions. *Id.*

211. BENOÎT FELTEN, DO DATA CAPS PUNISH THE WRONG USERS? A BANDWIDTH USAGE REALITY CHECK, DIFFRACTION ANALYSIS (2011), available at <http://www.diffractionanalysis.com/blog/2011/11/29/report-do-data-caps-punish-the-wrong-users-a-bandwidth-usage-reality-check.html>; see also Nate Anderson, *Data Caps a "Crude and Unfair Tool" for Easing Online Congestion*, ARS TECHNICA (Dec. 2, 2011, 12:29 PM), <http://arstechnica.com/tech-policy/news/2011/12/data-caps-a-crude-and-unfair-tool-for-easing-online-congestion.ars>.

212. For an example of such a system, see Nate Anderson & Eric Bangeman, *Comcast Loses P2P Religion, Goes Agnostic on Throttling*, ARS TECHNICA (Sept. 19, 2008, 5:27 PM), <http://arstechnica.com/old/content/2008/09/comcast-loses-p2p-religion-goes-agnostic-on-throttling.ars>.

213. Frischman & Lemley, *supra* note 41, at 295 & n.144; Felten, *supra* note 211.

214. In December 2010, the FCC adopted rules that address aspects of network neutrality. The regulations apply primarily to broadband. See *In re Preserving the Open Internet, Broadband Industry Practices*, 25 FCC Rcd. 17,905 (Dec. 21, 2010) (report and order). They ban content blocking and require a modicum of transparency from ISPs but allow network management and packet discrimination so long as "reasonable." *Id.* at 17,906. Wireless providers may continue to manage their networks and discriminate by packet. The regulations also permit "specialized services" over a last-mile broadband pipe, in effect permitting content prioritizing on the last mile, despite the ban on such prioritizing elsewhere in the broadband network. *Id.* at 17,965; see Matthew Lasar, *It's Here: FCC Adopts Net*

Conversely, a discriminatory access regime clashes with the design principles discussed above. Shifting from essentially an Internet infrastructure commons to a tiered Internet, where access and use are allocated and prioritized according to a user's ability and willingness to pay, entails significant cognitive costs. First, only a subset of end users would have access to both a clean communications signal and the full breadth of information on the network. By definition this will narrow the range of individuals able to rely on the Internet to complement their internal cognitive architecture and narrow the range of serendipitous encounters the Internet can engender through the adjacent possible.²¹⁵ Second, such limitations would clash with the realities of transactive memory, degrading the communications channel between the brain's neural circuitry and information stored in the cloud.²¹⁶ Moreover, as noted, prioritizing access based on ability to pay would favor monetizable uses over nonmonetizable uses. Only observable and appropriable benefits would be given "priority" access. For example, consider ISPs who either own content or serve up other people's content through licensing.²¹⁷ Presently, some ISPs favor their own content over competitors' content.²¹⁸ Such priority access is easily measurable and therefore monetizable. Profit-maximizing ISPs naturally would encourage such access instead of non-

Neutrality (Lite), ARS TECHNICA (Dec. 21, 2010, 12:05 PM), <http://arstechnica.com/tech-policy/2010/12/its-here-fcc-adopts-net-neutrality-lite>. The regulations also rely on jurisdictional grounds previously rejected by the D.C. Circuit, and their viability is thus seriously in doubt. See *Comcast Corp. v. FCC*, 600 F.3d 642, 644 (D.C. Cir. 2010) (holding that FCC lacks authority to regulate an ISP's network). All in all, these regulations are not the network neutrality discussed here.

215. As an example, an ISP might provide "free" search engines at non-discriminatory speeds but require additional payments for priority access to competing search engines at similar speeds. Or, an ISP might favor content whose owners have paid for "premium" speed, thus making such content more accessible than content whose owners cannot afford to pay for priority access. See Anton Troianovski, *AT&T May Try Billing App Makers*, WALL ST. J., Feb. 28, 2012, at B4.

216. This is so even for free public domain content accessible through Google or Wikipedia. The availability of such information is only half the issue. The other half is the speed with which that information is accessed. If paid-for packets are prioritized over public domain content, we can reasonably expect a loss in speed for that un-prioritized content.

217. See sources cited *supra* notes 132–137; David Hyman, *Why Bandwidth Pricing Is Anti-Competitive*, WALL ST. J., July 8, 2011, at A15.

218. Hyman, *supra* note 217. Most recently, Comcast announced a streaming video service, Xfinity TV, that favors Comcast-owned media over other sources by not counting use of Comcast media against existing data caps. See Eduardo Porter, *Keeping the Internet Neutral*, N.Y. TIMES, May 9, 2012, at B1. Companies may also discriminate by content as to "last-mile" services, see Lasar, *supra* note 113, or by offering mobile services that boost bandwidth for specific uses or content, see Mark Hachman, *Verizon API to Give Apps 'Turbo' Bandwidth Boost*, PC MAG. (Nov. 1, 2011, 11:36 PM), <http://www.pcmag.com/article2/0,2817,2395728,00.asp>. Likewise, companies like Comcast use data caps to ensure that users either use Comcast's media on the Internet, or refrain from cancelling cable services in order to use Internet-based alternatives like Netflix. See Timothy B. Lee, *Why Bandwidth Caps Could Be a Threat to Competition*, ARS TECHNICA (Apr. 29, 2012, 4:00 PM), <http://arstechnica.com/tech-policy/2012/04/why-we-should-worry-about-the-decline-of-the-unmetered-internet/>.

monetizable uses that the ISP's infrastructure subsidizes but that cannot be easily valued and priced. Creativity falls into this latter category. Creativity benefits society as a whole, but the subsidiary components of creativity that arise half formed from an individual's brain and then grow into full-fledged, useful ideas after that individual accesses the Internet are not easily appropriated by infrastructure operators. A system favoring identifiably profitable uses would underproduce these inchoate, positive externalities.²¹⁹ But the system should encourage precisely these externalities, as they are the spillover creativity depends on.²²⁰

This is not to say that network operators must serve the needs of the ideal system for encouraging creativity absolutely. As for-profit, market entities, they should be able to recoup investment sufficient to at least encourage investment in the first place. But there are ways to do so that do not depend on discriminatory Internet access.²²¹ Given a range of options for encouraging infrastructure investment, all but one of which lacks demonstrable negative effects on the brain's cognitive architecture, it makes little sense to insist that discriminatory access provisions are the only means of achieving this end. Given what we now know about cognitive organization and creativity, it makes little sense to discuss network neutrality without also discussing the cognitive implications of any alternative to network neutrality, particularly where some form of network neutrality as a baseline complements the brain's cognitive architecture. All things being equal, more access to more content on quality communications signals will yield more creativity than the alternative.

2. *Data Caps*

Related to network neutrality is the emerging trend in network management towards data caps and metering. Until recently, the predominant Internet pricing model was based on download and upload speeds, without reference to actual data downloaded and uploaded. With the rise of mobile computing,²²² ISPs increasingly use metered billing

219. So-called "walled gardens," where ISPs might provide access to certain content free, but other content on a premium basis, would achieve the same negative result.

220. See discussion *supra* Part II.

221. Options include direct subsidization of infrastructure expansion, tax incentives to support the same, cooperative research and development projects, and joint ventures. Frischman & Lemley, *supra* note 41, at 297 & n.147. France has managed to encourage broadband innovation simply by fostering robust competition among providers. BERKMAN CTR. FOR INTERNET AND SOC'Y, NEXT GENERATION CONNECTIVITY REPORT 13–14 (2010), https://cyber.law.harvard.edu/sites/cyber.law.harvard.edu/files/Berkman_Center_Broadband_Final_Report_15Feb2010.pdf.

222. Currently, 35% of American adults own a smartphone and access the Internet through it. See AARON SMITH, PEW RESEARCH CTR., SMARTPHONE ADOPTION AND USAGE 1 (2011), available at http://pewinternet.org/~media/Files/Reports/2011/PIP_Smartphones.pdf.

whereby users purchase a set amount of download and upload capacity and once exceeding that capacity, pay for additional capacity based on some pricing plan. Three of the four major U.S. wireless companies use this,²²³ as do many American ISPs.²²⁴ As with network neutrality, network operators argue that data caps are necessary network management tools and help ease congestion caused by heavy use during peak-use hours.²²⁵ Even some network neutrality proponents suggest that metering is an acceptable network management tool, so long as it is not used to discriminate based on packet content.²²⁶

As a baseline, metering establishes transaction costs for all involved. First, ISPs must deploy sophisticated tracking equipment to manage the various levels of service and differential billing.²²⁷ Metering also forces Internet users to consider each specific Internet use, and balance its utility against the data costs. Although ISPs generally claim that roughly 2%–5% of their users actually exceed data caps,²²⁸ that is today. As more people rely on bandwidth heavy services (think Netflix, iCloud, or Amazon cloud services), that number will surely rise.²²⁹ This is a demand-driven virtuous cycle. As bandwidth increases, new innovative services arise to utilize that bandwidth, which drives users to those services, which then drives further infrastructure investment, driving more innovative uses. By metering, ISPs slow down diffusion and adoption of these new services, in turn slowing down the innovation of useful services that require more bandwidth.²³⁰ This is particularly problematic when we view the Internet as a platform, with significant network effects as its scale expands. The more users the Internet has, the more developers will respond to that market. And the more apps and services developers build on the Internet's infrastructure, the more follow-on innovation, building on those prior developments, will occur.²³¹

223. This includes Verizon, AT&T and T-Mobile. Jenna Wortham, *As Networks Speed Up, Data Hits a Wall*, N.Y. TIMES, Aug 15, 2011, at B1.

224. Comcast caps users at 250 gigabytes, AT&T at 150 gigabytes, and Time Warner uses a nebulous “acceptable use policy” which states abuses of bandwidth usages will result in degradation of speed. See Matthew Lasar, *It Could Be Worse: Data Caps Around the World*, ARS TECHNICA (Apr. 4, 2011, 6:45 AM), <http://arstechnica.com/tech-policy/news/2011/04/how-internet-users-are-disciplined-around-the-world.ars>. In Canada, such caps are the norm and are increasingly becoming so in the United Kingdom and Australia, among other places. *Id.*

225. Frischmann & Schewick, *supra* note 115, at 392–408.

226. *Id.*

227. See Wortham, *supra* note 223. Costs in dealing with customer confusion may also arise.

228. *Id.*

229. *Id.*

230. On the importance of diffusion, see Gaia Bernstein, *In the Shadow of Innovation*, 31 CARDOZO L. REV. 2257, 2259 (2010).

231. Imagine the state of the Internet today if metered bandwidth existed during the rise of YouTube, Netflix, and iTunes. These services would not exist in their present form, and the body politic would be culturally poorer for it.

Moreover, data caps may not even ease congestion because they target the wrong users at the wrong time.²³² The most recent empirical data shows that data caps are far more overinclusive than they need to be, capturing many users that cannot possibly be responsible for congestion.²³³ When viewed through a cognitive lens these issues become more concerning. The act of considering whether to use data allotments is a mental transaction cost akin to the switching costs that disrupt the process of converting working memory into long-term memory and overtax cognitive load. Data caps also shut off access to information for those that cannot afford to pay the overage fees to ensure full access. That information may be housed in transactive memory. Or it could be some serendipitous snippet required to turn a yet unrealized notion into a full-fledged idea. Or it might be the video chat or Netflix film that provides the visual cue that sparks an insight. As increasingly more people rely on cloud services and large transfers of data to and from cloud storage locations, that information might also be the information that once sat on an individual's hard drive or bookshelf, where it would be readily accessible.²³⁴

Even so, data caps, when implemented to alleviate actual congestion, can have their benefits. Recent data suggests that data caps can be most effective during peak congestion hours when on average 48% of active Internet users are among the top 10% of bandwidth users at some point or another.²³⁵ By targeting data usage during peak hours, data caps can more effectively combat congestion without overinclusively degrading nonpeak browsing that does not in fact impact the network.²³⁶ So long as such caps are targeted to peak hours and combined with some form of metering, they can be effective where blanket data caps are not.²³⁷ The absence of such congestion benefits all users by ensuring access to content housed within the brain as transactive memory during nonpeak hours and ensuring a minimum guarantee of access during peak hours. Similarly, data caps are

232. See sources cited *supra* note 211.

233. See sources cited *supra* note 211.

234. Cloud computing, which involves remote network-based applications and storage, is increasingly becoming the norm. Kevin Werbach, *The Network Utility*, 60 DUKE L.J. 1761, 1792 (2011). Many cloud-based services involve transferring significant amounts of data back and forth between a user and a remote server. Data caps therefore can serve as a significant disincentive to utilize cloud services. Data caps also encourage vertically integrated ISPs to favor their own content over competitors' content. For example, various Canadian ISPs cap their customers data consumption at anywhere between two and fifteen gigabytes, including Netflix streaming, but do not cap use of their own video streaming services. See Nate Anderson, *Data Caps Claim a Victim: Netflix Cuts Streaming Video Quality*, ARS TECHNICA (Mar. 29, 2011, 9:41 AM), <http://arstechnica.com/tech-policy/news/2011/03/data-caps-claim-a-victim-netflix-streaming-video.ars>. Indeed, data caps can be used to "encourage" users to utilize a provider's preferred video service over other services. *Id.*

235. Anderson, *supra* note 234.

236. *Id.*

237. *Id.*; see also Frischman & Lemley, *supra* note 41, at 295 n.144.

less problematic when the types of information to which they apply is limited. For example, there is a very real cognitive difference between caps that degrade access to an individual's cloud-based storage of personal information on the one hand, and information in the form of very large video files found while browsing the Internet. The former is the type of information previously housed on a person's local hard drive and more likely to be the sort of information housed in transactive memory. The latter has likely not yet been integrated into transactive memory, and therefore using data caps to limit access poses fewer cognitive risks. Of course, data caps do establish another layer of disruption in the communications channel between the brain and the Internet's content layer, and have the potential to diminish the Internet's capacity to facilitate serendipitous informational encounters.²³⁸ But if such caps are targeted to specific problem areas and nonessential information that is not otherwise stored in transactive memory, they can be a useful tool in degrading congestion, where congestion is in fact shown to be an issue.²³⁹

In sum, while across the board data caps have significant cognitive drawbacks, more narrowly tailored data caps targeting specific types of information that is not related to transactive memory, coupled with some amount of peak-usage metering, can complement the brain's cognitive architecture where the alternative is degraded browsing speeds and limitations on content access for all users.

3. *Graduated Response*

Related to both data caps and network neutrality is the implementation of private graduated response systems in the United States and abroad.²⁴⁰ These systems target alleged copyright infringers with a set of mitigation measures whose impact increases with each alleged violation.²⁴¹ The American model is a "six strikes" system, a voluntary agreement between

238. Perhaps a distinction can be drawn between active producers and passive consumers in terms of what activities are capped. But even then, the act of consuming, watching, reading, or listening to media can provide the serendipitous penultimate spark that yields a creative thought.

239. See sources cited *supra* note 211.

240. See Peter K. Yu, *The Graduated Response*, 62 FLA. L. REV. 1373, 1374-79 (2010).

241. See *id.*; Anderson, *supra* note 134; Corynne McSherry & Eric Goldman, *The "Graduated Response" Deal: What If Users Had Been at the Table?*, ELECTRONIC FRONTIER FOUND. (July 18, 2011), <https://www.eff.org/deeplinks/2011/07/graduated-response-deal-what-if-users-had-been>. Both AT&T and Verizon already do this for their non-infringing customers using the most bandwidth. See Jacqui Cheng, *AT&T to Begin Throttling Heaviest Data Users on October 1*, ARS TECHNICA (July 29, 2011, 10:50 AM), <http://arstechnica.com/gadgets/news/2011/07/att-expected-to-follow-verizon-and-begin-throttling-heavy-data-users.ars>; Jacqui Cheng, *Verizon Quietly Begins Throttling Data as iPhone Launch Looms*, ARS TECHNICA (Feb. 3, 2011, 11:41 AM), <http://arstechnica.com/gadgets/news/2011/02/verizon-quietly-begins-throttling-data-as-iphone-launch-looms.ars>.

the large media industries and ISPs to police infringing activity.²⁴² Content owners monitor net traffic for infringing activity and provide ISPs the alleged infringer's IP address.²⁴³ ISPs then issue warnings to subscribers.²⁴⁴ Should these warnings fail, ISPs initiate more serious measures, including temporary reductions in Internet speeds, redirection of web use to specific sites until the subscriber contacts the ISP or agrees to undergo "copyright education," restricting web access temporarily, or cutting off Internet access entirely.²⁴⁵ If measures are taken, the subscriber bears the burden of proving they did not infringe.²⁴⁶ To do so, the subscriber must pay a \$35 fee, which is refunded if the subscriber is successful.²⁴⁷

The system suffers several shortcomings. Mitigation measures degrading access or speed require no judicial process.²⁴⁸ Rather, ISPs can impose mitigation on the say-so of content owners, without any determination, judicial or otherwise, that the subscriber did anything wrong.²⁴⁹ This reverses traditional procedural norms, establishing a principle of presumptive guilt in the infringement context. Second, alleged infringers cannot invoke the full range of copyright defenses. The agreement establishes only six narrowly defined defenses, only two of which reflect copyright defenses in litigation—a cabined version of fair use, and a limited public domain defense.²⁵⁰ The fair use defense requires the accused infringer to demonstrate that wholesale distribution of a copyrighted work over the Internet is fair use, and the public domain defense is limited to works published before 1923, even though works can be in the public domain even if published after 1923.²⁵¹ Review by a neutral party is not guaranteed.²⁵²

242. Currently, the five biggest ISPs in the United States, AT&T, Verizon, Comcast, Cablevision, and Time Warner Cable, participate. Memorandum of Understanding Between ISPs (SBC Internet Services, Inc. et al.) and Content Owners (RIAA et al.) (July 6, 2011), <http://www.copyrightinformation.org/wp-content/uploads/2013/02/Memorandum-of-Understanding.pdf> [hereinafter MOU]; Anderson, *supra* note 134.

243. See Yu, *supra* note 240, at 1374–75; see sources cited *supra* notes 241–242.

244. See Yu, *supra* note 240, at 1379.

245. *Id.* at 1390–96. Many ISPs already claim the right to take these measures in their terms of service. *Id.* at 1418

246. See MOU, *supra* note 242, at 26 (Attachment C).

247. *Id.* at 30 (Attachment C).

248. See Yu, *supra* note 240, at 1395.

249. *Id.*

250. The defenses are misidentification of the relevant account, unauthorized use of the account, authorized distribution, fair use distribution, incorrect identification of a file, and work published before 1923. See MOU, *supra* note 242, at 26 (Attachment C).

251. See sources cited *supra* notes 241–242. These "understandings" by private actors, which in effect alter the delicate balance the Copyright Act establishes, might be preempted under federal law. See, e.g., Reuveni, *supra* note 30, at 329–30.

252. See sources cited *supra* notes 241–242.

The structural problems portend cognitive consequences similar to those that arise from non-network neutrality regimes and data caps. False positives resulting in Internet speed degradation or access limits will disrupt both the process of developing long-term memories, and the cognitive load of working memory. Depending on what is cut off, these restrictions may also eliminate access to information that is stored in the brain as transactive memory. Conversely, limiting bandwidth-hogging infringing uses that decrease network efficiency could provide cognitive benefits by decreasing lag on the network for others, but only where congestion is in fact shown to be a problem and mitigation measures are shown to in fact decrease congestion. More fundamentally, graduated response systems place additional layers of potential disruption on the brain's creative processes. To mitigate that potential, more robust procedural safeguards should be implemented in order to ensure that only individuals actually proven to repeatedly infringe are blocked from accessing the Internet. Moreover, a more targeted approach to blocking will avoid many of these problems. ISPs might degrade access to a subset of sites proven to facilitate copyright infringement. Or, they might implement a species of data caps and metering, essentially degrading repeat offenders' download speeds for media files to a trickle, while leaving access to the content layer of the Internet intact. The graduated response system currently in place fails to do this, and therefore sweeps far more content within its ambit than necessary.

4. *Transparency*

From the perspective of network operators, the issues raised by network neutrality, data caps, and graduated response regimes all are specific examples of the more general problem of managing infrastructure to provide effective access and alleviate congestion issues. These concerns are not unwarranted. Any design choice in the legal framework governing the communications channel that favors more access and more speed may entail tradeoffs in the form of slower speeds during congested peak hours. Unlike information itself, which is both nonrivalrous and nonexcludable, the communications layer of the Internet is in fact semi-rivalrous, given that capacity is limited.²⁵³ If, during peak hours, every user on the network is streaming movies, each user's experience will be degraded, as compared to if only a few people on a specific ISP out of millions are streaming at that moment.

253. Frischman & Lemley, *supra* note 41, at 290–91; Madison, *supra* note 7, at 667–68.

I do not mean to downplay the importance of effective network management.²⁵⁴ If effective management of the semi-rivalrous network—particularly during peak usage periods—requires usage limits, some type of limit should be permitted. But it is important to remember that managing an effective network is materially different than managing other traditional infrastructures that suffer from congestion issues, like a utility or a road.²⁵⁵ Unlike those networks, the Internet does not merely traffic in fungible commodities; it traffics in the individual expression vital to the creative process. As others argue, regulatory mechanisms to promote fairness and accessibility have been applied to many private entities that wield significant exclusionary power, particularly in uncompetitive industries involving public goods.²⁵⁶ Such mechanisms are particularly important where that exclusionary power governs a communications platform vital to the dissemination of speech and fundamental to democracy.²⁵⁷ This is even more so where that exclusionary power portends cognitive consequences like those discussed here.

To the extent these design choices have cognitive consequences, requiring some amount of transparency regarding how network operators manage their network, prioritize traffic, and deal with bandwidth congestion can ameliorate those consequences by providing users some control over their personal experience. Minimizing this information asymmetry limits the element of infrastructural surprise during the creative process. If an individual knows how a network prioritizes traffic, they can prioritize their usage and plan accordingly regarding when and how they conduct their creative endeavors in light of network realities.²⁵⁸ Knowing that their ISP will cap them at certain data or speed limits after a certain amount of activity means that an individual can ensure sufficient bandwidth and data remains for their critical creative needs. All other things being equal, transparency reduces mental transactions related to the

254. However, some network management choices are not dictated by actual network management concerns, but instead by incentives to rent-seek in uncompetitive markets. *E.g.*, Frischman & Schewick, *supra* note 115, at 392–98; Frischman & Lemley, *supra* note 41, at 290–91; *see also* Matthew Lasar, *Metered Billing: It's a Lack of Competition, Not Congestion*, ARS TECHNICA (July 12, 2011, 3:10 PM), <http://arstechnica.com/tech-policy/news/2011/07/metered-billing-its-a-lack-of-competition-not-congestion.ars>.

255. Frischman & Schewick, *supra* note 115, at 398.

256. *See, e.g.*, Frank Pasquale, *Beyond Innovation and Competition: The Need for Qualified Transparency in Internet Intermediaries*, 104 NW. U. L. REV. 105, 112 (2010); Wu, *supra* note 132, at 301–12; Werbach, *supra* note 234, at 1792.

257. Wu, *supra* note 132, at 301–02.

258. This is an imperfect solution, as creativity cannot be scheduled so conveniently. But it can mitigate the issue by facilitating greater consumer choice regarding ISPs and decreasing the incidence of surprise.

communications channel, and therefore reduces disruption during the creative process.²⁵⁹

B. *Fair Use and Cognitive Liberty*

In cognitive terms, some form of network neutrality can be understood as articulating the optimal default legal setting for the communications channel between the brain's cognitive architecture and the Internet's content layer. In this section, I address the optimal default legal setting for the cognitive architecture's interactions with the content layer of the Internet. Recall that the very act of interacting with content on the Internet can harm the process of converting working memory into long-term memory and can overwhelm the brain's working memory by flooding short-term memory with fragmented noise.²⁶⁰ That in turn short-circuits the brain's executive function and diminishes the brain's capacity to distinguish useful and irrelevant information.²⁶¹ This risks compromising the brain's processing efficiency, causing it to process irrelevant information as though it were relevant and useful when integrating it into long-term memory, or to lose relevant information in short-term memory before it is integrated into long-term memory or used as a trigger for convergent and divergent processes.²⁶² As I discuss in this section, copyright's fair use doctrine can serve as the basis for a default legal setting counteracting these problems.

Fair use is generally understood as a copyright safety valve, permitting uses of copyrighted materials that are technically infringing that promote certain policy goals,²⁶³ including promoting the free speech, dignitary, and expression interests of subsequent authors and the public, the ongoing progress of authorship, and learning.²⁶⁴ Fair use provides at least some legal grounding for much of the technology industry, including developers of innovative technologies that facilitate the consumption or distribution of copyrighted works, interoperability among software and platforms, and applications that facilitate the diffusion of and access to information, like

259. From an environmental perspective, this sort of "labeling" requirement is no different than requiring food sellers to list their food's content or polluters to list their pollution's contents. Minimizing informational asymmetry facilitates better decision-making, particularly where that asymmetry has cognitive consequences.

260. See *supra* notes 160–176 and accompanying text.

261. See *supra* notes 160–176 and accompanying text.

262. See *supra* notes 160–176 and accompanying text.

263. See Pamela Samuelson, *Unbundling Fair Uses*, 77 *FORDHAM L. REV.* 2537, 2540–42 (2009). The doctrine is codified at 17 U.S.C. § 107 (2006), which sets forth four factors for courts to consider when evaluating fair uses.

264. Samuelson, *supra* note 263.

search engines.²⁶⁵ Because fair use is technically a defense to copyright infringement and subject to case-by-case analysis,²⁶⁶ the doctrine provides minimal predictability.²⁶⁷ Moreover, as others have observed, fair use analysis has narrowed over the years, becoming primarily concerned with whether the proposed use is a commercial or non-commercial use and whether a permissions market facilitating licensing fees exists.²⁶⁸ Fair use is thus underinclusive in the range of creative endeavors it protects, and critics increasingly argue that this underinclusiveness harms both the public domain and creative infrastructure generally.²⁶⁹ Even so, fair use remains robust enough to facilitate a wide range of critical, educational, and nonprofit uses of copyrighted materials, while also supporting a multi-trillion dollar hardware and software industry by insulating dual-use technologies and software development techniques from technical infringement.²⁷⁰

Fair use, as I conceive of it here, establishes a right to control the arrangement and display of information on personal computers or mobile devices. This right provides both an independent set of cognitive design tools that can be employed in conjunction with other doctrines discussed here, and a backstop with which to manage cognitive intake in the event that the legal architecture governing the Internet is suboptimal from a cognitive perspective. The right would provide individuals the legal means to manage the inputs the Internet provides and, ultimately, the process of converting working memory into long-term memory and the cognitive load caused by short-term browsing experiences. It would also provide a shield against cognitive inputs that may portend neuroplastic change, such that an individual could manage inputs based on their perceived effect on their neural circuitry's structure.

Two examples of what I have in mind are the browser add-on Adblock, and software that blocks ISP rerouting.²⁷¹ Adblock is a browser add-on that

265. *Id.*

266. *See* Campbell v. Acuff-Rose Music, Inc., 510 U.S. 569, 577 (1994).

267. *See, e.g.,* LAWRENCE LESSIG, FREE CULTURE: HOW BIG MEDIA USES TECHNOLOGY AND THE LAW TO LOCK DOWN CULTURE AND CONTROL CREATIVITY 187 (2004); Michael J. Madison, *A Pattern-Oriented Approach to Fair Use*, 45 WM. & MARY L. REV. 1525, 1666 (2004).

268. *See, e.g.,* Harper & Row, Publishers, Inc. v. Nation Enters., 471 U.S. 539, 562 (1985) (concluding that commercial uses are presumptively unfair); Barton Beebe, *An Empirical Study of U.S. Copyright Fair Use Opinions, 1978–2005*, 156 U. PA. L. REV. 549, 598–603 (2008); Jennifer E. Rothman, *Liberating Copyright: Thinking Beyond Free Speech*, 95 CORNELL L. REV. 463, 532 (2010).

269. Rothman, *supra* note 268, at 532.

270. Lastowka, *supra* note 58, at 1018; Litman, *supra* note 6, at 10 n.41.

271. *See* ADBLOCK PLUS, <http://adblockplus.org> (last visited Mar. 9, 2013). Although I limit my discussion here to two applications, the analysis here could just as easily apply to any browser add-on that affects the user's audiovisual display by blocking certain content or interfering with the web host's HTML code. Two additional examples include the browser add-ons Ghostery, which allows users to block code which permits third-party web trackers to monitor a user's web activity, and Disconnect,

prevents advertisements from loading on an individual's browser and permits users to tailor what types of ads, if any, they'd like to see.²⁷² In the process of loading up the screen free of advertisements, however, a browser running Adblock displays an altered audiovisual display of the website.²⁷³ Under the presently prevailing view of copyright law, this alteration of the audiovisual display and its loading into the computer RAM or cache can infringe copyright.²⁷⁴

ISP rerouting is more pernicious, but software combating rerouting functions similarly. When an individual enters a domain name, their ISP's Domain Name System ("DNS") translates that domain name into an IP address, to which it then connects the user.²⁷⁵ ISP rerouting involves routing an individual from their intended web destination to a destination provided by the ISP. Often, this involves a user mistyping a URL, which is then routed to an ISP-sponsored page with the ISP's own links and ads.²⁷⁶ The unstated purpose is to earn ad revenue based on links on the ISP's own page.²⁷⁷ However, ISPs also reroute search traffic. For example, some American ISPs filter search results through their own DNS servers and reroute search results, so that the page the user sees is chosen by the ISP based on the individual's search query.²⁷⁸ A fix involves installing a browser add-on like "HTTPS Everywhere," which forces a user's web

which similarly enables tracker blocking while also blocking search tracking. *See* GHOSTERY, <http://www.ghostery.com/about> (last visited Mar. 9, 2013); DISCONNECT, <http://disconnect.me/> (last visited Mar. 9, 2013).

272. ADBLOCK PLUS, *supra* note 271.

273. Some argue this harms the prevailing model of ad-supported, free web content. *See* Noam Cohen, *In Allowing Ad Blockers, a Test for Google*, N.Y. TIMES, Jan. 4, 2010, at B4.

274. *See, e.g.,* Micro Star v. Formgen Inc., 154 F.3d 1107, 1113 (9th Cir. 1998) (holding that code modifying an audiovisual display that relies on copyrighted elements infringes copyright); MAI Sys. Corp. v. Peak Computer, Inc., 991 F.2d 511, 518 (9th Cir. 1993) (holding RAM copies infringe copyright). Perhaps surprisingly, whether blocking advertisements is a copyright violation remains a murky issue. As this Article was going to press, a group of media companies sued the satellite television provider DISH Network, alleging that DISH's ad-skipping device called "AutoHop" violates their copyrights by enabling viewers to skip all advertisements automatically, rather than having to fast-forward through them as on other digital recording devices, thereby creating unauthorized copies of the media company's copyrighted works and distributing them to the public. *See* Complaint for Copyright Infringement and Breach of Contract at ¶¶ 51–76, Fox Broad. Co. v. Dish Network L.L.C., No. CV12-04529GHK (SHX), 2012 WL 1885240 (C.D. Cal. May 24, 2012). DISH countersued, seeking a declaratory judgment that their product does not infringe copyright. *See* Declaratory Judgment Complaint at ¶¶ 37–40, Dish Network L.L.C. v. Am. Broad. Cos., No. 12 CV 4155, 2012 WL 1880604 (S.D.N.Y. May 24, 2012).

275. *See* Jim Giles, *US Internet Providers Hijacking Users' Search Queries*, NEW SCIENTIST (Aug. 10, 2011, 2:01 PM), <http://www.newscientist.com/article/dn20768-us-internet-providers-hijacking-users-search-queries.html>; Christian Kreibich et al., *Widespread Hijacking of Search Traffic in the United States*, ELECTRONIC FRONTIER FOUND. (Aug. 4, 2011), <https://www.eff.org/deeplinks/2011/07/widespread-search-hijacking-in-the-us>.

276. Kreibich et al., *supra* note 275.

277. *Id.*

278. *Id.*; Giles, *supra* note 275.

browser to rely on the more secure HTTPS communications protocol, in effect blocking DNS rerouting in certain situations.²⁷⁹ Like Adblock, HTTPS Everywhere can alter the audiovisual display an ISP seeks to provide, potentially violating copyright law.²⁸⁰ Future rerouting may, for example, involve an ISP inserting code into a web page when loaded, altering the audiovisual display and layout of the page from its intended display. In this scenario, rerouting is directly embedded into the user experience.²⁸¹ Any program developed to combat the rerouting will face the same copyright problem—users, seeking to control their experience, must rely on alterations to the website or ISP’s selection and arrangement of the website or underlying code, both potential copyright violations.²⁸²

For our purposes, one strand of fair use case law is particularly important—that governing the regulation and development of applications that alter a program’s underlying code or block certain aspects of a webpage’s source code in order to facilitate alteration of the audiovisual experience of the software or web page. The seminal case is *Lewis Galoob Toys, Inc. v. Nintendo of America, Inc.*²⁸³ There, the Ninth Circuit held that using Galoob’s “Game Genie” software, which allowed players to make temporary changes to the play experience of Nintendo games by altering the code controlling the audiovisual display and the parameters of the game rules, was a fair use of the game.²⁸⁴ The important principle here is that fair use, at the very least, protects the means by which an individual personally

279. See *HTTPS Everywhere*, ELECTRONIC FRONTIER FOUND., <https://www EFF.org/https-everywhere> (last visited Mar. 9, 2013).

280. Another solution involves using a DNS router of one’s choosing, which avoids ISP rerouting. This also presents a copyright problem, as an ISP could condition access to use of their specific DNS router. Violating that condition can be a copyright violation. See, e.g., *Sun Microsystems, Inc. v. Microsoft Corp.*, 188 F.3d 1115, 1121 (9th Cir. 1999); *S.O.S., Inc. v. Payday, Inc.*, 886 F.2d 1081, 1087 (9th Cir. 1989).

281. A current proposal involves inserting digital rights management code into HTML in conjunction with hardware specifications that block circumvention of the HTML code. See David Dorwin et al., *Encrypted Media Extensions: W3C Editor’s Draft*, WORLD WIDE WEB CONSORTIUM (W3C) (Feb. 26, 2013), <http://dvcs.w3.org/hg/html-media/raw-file/tip/encrypted-media/encrypted-media.html>; Ryan Paul, “Unethical” HTML Video Copy Protection Proposal Draws Criticism from W3C Reps, ARS TECHNICA (Feb. 23, 2012, 2:00 AM), <http://arstechnica.com/business/2012/02/unethical-html-video-copy-protection-proposal-criticized-by-standards-stakeholders/>.

282. This also raises the problem of terms of service violations constituting copyright violations. Paul, *supra* note 281; see also *Facebook, Inc. v. Power Ventures, Inc.*, No. C 08–5780 JF (RS), 2009 WL 1299698, at *4 (N.D. Cal. May 11, 2009) (finding that accessing Facebook to copy user-data violates Facebook’s terms of service and could therefore infringe copyright).

283. *Lewis Galoob Toys, Inc. v. Nintendo of Am., Inc.*, 964 F.2d 965 (9th Cir. 1992).

284. *Id.* at 972; see also *Perfect 10, Inc. v. Amazon.com, Inc.*, 508 F.3d 1146, 1161–62 (9th Cir. 2007) (no infringing work where Google search engine provides HTML code directing end user to copy of allegedly infringed work). But see *Micro Star v. Formgen Inc.*, 154 F.3d 1107, 1113 (9th Cir. 1998) (ruling that a third-party compiler of user-generated content that relied on copyrighted source code infringed copyright).

consumes a copyrighted work.²⁸⁵ That is, fair use extends to adapting the experience of consuming creative works in order to enable consumers to consume those works in ways that they want to consume them.²⁸⁶ This can be so even where the act of tailoring the consumptive experience creates temporary copies of media or source code in a computer's RAM or a browser's cache.²⁸⁷

This principle provides the baseline for an individual right to dictate the audiovisual makeup of your computer or mobile screen, but it is only half of the puzzle. The other half requires grappling with the anticircumvention constraints of the DMCA, which generally are not subject to fair use.²⁸⁸ The DMCA is relevant because while blocking certain code when loading up a web page may be fair use, circumventing hard-coded restrictions in hardware is not. The DMCA expressly forbids the circumvention of code protecting access to hardware devices, and owners of hardware are quite keen on keeping it that way.²⁸⁹ Thus, a device manufacturer can incorporate code forcing interruption on users in the form of ads,²⁹⁰ and can even remotely disable a device without providing the user any immediate recourse to combat disablement.²⁹¹ As discussed, forced interruption is problematic because it overwhelms working memory, thus retarding the development of long-term memory networks, and distracts an individual with excessive noise-to-signal when seeking out a connection or chasing down an idea. That distraction weakens the brain's ability to distinguish relevant and irrelevant information while also overtaxing the

285. *Lewis Galoob Toys, Inc.*, 964 F.2d at 971 (“[A] party who distributes a copyrighted work cannot dictate how that work is to be enjoyed.”); *see also* Jessica Litman, *Lawful Personal Use*, 85 TEX. L. REV. 1871 (2007); Samuelson, *supra* note 263, at 2588–92.

286. Litman, *supra* note 285, at 1891.

287. *See, e.g.*, *Perfect 10, Inc. v. Amazon.com, Inc.*, 487 F.3d 701, 726–27 (9th Cir. 2007) (holding that full copies of copyrighted works in computer cache are fair use in the context of a search engine), *amended on reh'g*, 508 F.3d 1146 (9th Cir. 2007); *see also* WILLIAM F. PATRY, PATRY ON FAIR USE § 3:51 (2012 ed.); Mark A. Lemley, *Dealing with Overlapping Copyrights on the Internet*, 22 U. DAYTON L. REV. 547, 567 (1997) (suggesting that implied license provides a defense). For a discussion on the problem of the RAM copy doctrine, *see* Aaron Perzanowski, *Fixing Ram Copies*, 104 NW. U. L. REV. 1067 (2010).

288. *MDY Indus., LLC v. Blizzard Entm't, Inc.*, 629 F.3d 928, 948 n.10 (9th Cir. 2010), *amended and superseded on denial of reh'g* by Nos. 09-15932, 09-16044, 2011 WL 538748 (9th Cir. Dec. 14, 2010).

289. 17 U.S.C. § 1201(a)(1) (2006 & Supp. V 2011); *MDY*, 629 F.3d at 948; *see* David Kravets, *Sony Settles PlayStation Hacking Lacksuit*, WIRED (Apr. 11, 2011, 1:45 PM), <http://www.wired.com/threatlevel/2011/04/sony-settles-ps3-lawsuit/>. *But see* *Rulemaking on Anticircumvention*, U.S. COPYRIGHT OFFICE, <http://www.copyright.gov/1201/2010> (last modified Feb. 7, 2011).

290. Randall Stross, *Apple Wouldn't Risk Its Cool Over a Gimmick, Would It?*, N.Y. TIMES, Nov. 15, 2009, at B4.

291. A worrisome example is a recent patent issued to Apple for a method of disabling video cameras on iPhones based on third-party input. *See* U.S. Patent No. 20,110,128,384 (filed Dec. 2, 2009).

brain's executive function, resulting in the integration of irrelevant information into long-term memory and inducing the brain's reliance on that information once internalized.²⁹² Finally, forced interruption of the use of software or hardware forces a disconnect between the brain's cognitive architecture and any external elements of that architecture's cognitive processes.²⁹³ Because cognition is not necessarily limited to the brain, but in fact can rely on bodily actions or tools external to the body, such interruptions further risk degrading the creative process itself.²⁹⁴ Extending fair use to the DMCA's prohibitions on circumventing code that facilitates this interruption would solve the problem without any tangible harm to the device manufacturer.²⁹⁵

Conceiving of fair use as providing a right to organize the process of media consumption also builds on and strengthens the role fair use plays as a "First Amendment safeguard[]." ²⁹⁶ In *Eldred v. Ashcroft* the Court rejected a First Amendment challenge to the Copyright Term Extension Act, reasoning, in part, that fair use safeguards First Amendment concerns.²⁹⁷ The Court suggested Congress's exercise of its copyright power could only be challenged on First Amendment grounds if it altered "the traditional contours of copyright protection," including the scope of fair use.²⁹⁸ If fair use is copyright doctrine's built-in First Amendment safety valve, then it should reflect the First Amendment's protection of the "freedom of thought."²⁹⁹ As the Supreme Court has emphasized, the First Amendment protects an individual's right to receive or to *not* receive ideas and to control the content of their own thoughts.³⁰⁰ Facilitating a user's ability to curate their web browsing experience in order to manage exposure to cognitive inputs that might harm long-term memory development and the cognitive processes undergirding creativity similarly safeguards that "freedom of thought." Put another way, given what we now know about cognition, the right to receive or not to receive ideas should similarly protect an individual's right to receive or *not* to receive cognitive

292. See discussion *supra* Part III.B.

293. See *supra* notes 186–187 and accompanying text.

294. See *supra* notes 186–187 and accompanying text.

295. Absent congressional revision, the Librarian of Congress can exempt such uses from the DMCA. See 17 U.S.C. § 1201(a)(1) (2006 & Supp. V 2011).

296. *Eldred v. Ashcroft*, 537 U.S. 186, 220 (2003); see also *Golan v. Holder*, 132 S. Ct. 873, 889–94 (2012).

297. *Eldred*, 537 U.S. at 220.

298. *Id.* at 221.

299. *Palko v. Connecticut*, 302 U.S. 319, 326–27 (1937) ("[F]reedom of thought . . . is the matrix, the indispensable condition, of nearly every other form of freedom. With rare aberrations a pervasive recognition of that truth can be traced in our history, political and legal."); see also *Stanley v. Georgia*, 394 U.S. 557, 562 n.7 (1969); Neil M. Richards, *Intellectual Privacy*, 87 TEX. L. REV. 387, 418–19 (2008).

300. *Stanley*, 394 U.S. at 565.

inputs that run counter to the way an individual wishes to organize their cognitive architecture.³⁰¹ That right of self-organization, a species of cognitive liberty, finds firm footing in the Supreme Court's "freedom of thought" case law.³⁰² Although the descriptive details and normative implications of this claim are beyond the scope of this paper,³⁰³ conceiving of the First Amendment as protecting a right to cognitive integrity provides constitutional support for conceiving of fair use as a necessary safety valve for individuals accessing the Internet and navigating its disruptive shoals.

The point here is that fair use is the most logical legal instrument an individual can invoke when seeking to curate the quality and substance of their thoughts by managing the process by which short-term memory becomes long-term memory and by which information from the world at large is presented and displayed on the last segment of the communications channel between the Internet and their brains—their computers or mobile devices. The alternative—a world where forced disruption is hard-wired into the design of the Internet ecosystem—runs contrary to the design principles discussed here. This does not call for dismantling the present model of ad-supported, free Internet and its concomitant distractions. Relying on such free models of Internet access is a choice, and should remain so, particularly where the alternative is an Internet of the elite, populated only by those who can afford to access it. Even so, the greater the incidence of disruption in this environment, the less likely the cognitive architecture will achieve its task. What is needed then is a safety valve that allows individuals to design their cognitive architecture and circumvent short-term disruption. Fair use, adapted to cognitive realities, can serve this function.

301. The idea could be conceived of as a right not to be forced to disseminate outputs. For example, iPhone owners can remotely wipe their phones if stolen. See *iCloud: Troubleshooting the Find My iPhone App*, APPLE, <http://support.apple.com/kb/TS3376> (last visited Mar. 10, 2013). Viewing fair use as protecting a cognitive liberty would privilege such remote-wipe functions even where the hardware or software implementation might technically infringe copyright or violate the DMCA's anticircumvention rules.

302. See *Stanley*, 394 U.S. at 662–65; *Palko*, 302 U.S. at 326–27.

303. Although scholars have yet to explore the ramifications of neuroscientific research on First and Fourth amendment doctrine, scholars have begun theorizing the internal mind as subject to "freedom of thought" or "freedom from surveillance." See Marc Jonathan Blitz, *Freedom of Thought for the Extended Mind: Cognitive Enhancement and the Constitution*, 2010 WIS. L. REV. 1049, 1098–99 (2010); Richards, *supra* note 299, at 418–19 (2007); Christian M. Halliburton, *Letting Katz out of the Bag: Cognitive Freedom and Fourth Amendment Fidelity*, 59 HASTINGS L. J. 309, 314 (2007); Rodney J.S. Deaton, *Neuroscience and the In Corpore-ated First Amendment*, 4 FIRST AMEND. L. REV. 181, 183 (2006). In future work, I will apply the cognitive model developed here to this question.

C. Content Layer

The last piece of the system's design puzzle is the Internet's content layer. Here I focus on several distinct but overlapping areas of the law governing content removal, particularly the DMCA takedown regime and increasing Government efforts to combat Internet piracy by seizing domains and blocking content.

I. DMCA

As discussed, the DMCA provides ISPs and content hosts immunity from copyright lawsuits if they comply with the DMCA's takedown provisions.³⁰⁴ Although the DMCA lists four distinct classes of service providers with specific procedural prerequisites,³⁰⁵ the general structure is the same—service providers who, upon notification of claimed infringement, respond expeditiously to remove, or disable access to, the material and who do not benefit financially from infringing activity, are immune from liability for users' copyright infringement.³⁰⁶ The process works as follows: copyright owners contact a designated agent with claims of infringement,³⁰⁷ stating, under penalty of perjury, that they are authorized to act on behalf of the owner of an exclusive right that is allegedly infringed.³⁰⁸ An individual whose content is removed—but not any third parties relying on that content—can file a counter-notification but must provide a statement, under penalty of perjury, that the material was removed as a result of a mistake or misidentification of the material meant to be removed.³⁰⁹ Should the service provider agree, they may restore the material no sooner than ten business days after receiving the counter-notice.³¹⁰

The problem with the DMCA, as many have argued, is that it reverses the default procedural presumptions regarding free speech.³¹¹ Ordinarily, speech is presumptively valid and remains available until someone successfully procures an injunction against that speech.³¹² The DMCA reverses this presumption, forcing speakers to act to assert their speech's

304. See 17 U.S.C. § 512 (2006 & Supp. V 2011).

305. These are providers of connectivity, caching, hosting, and "information location" or linking services. *Id.*

306. *Id.*

307. *Id.* at § 512(c)(2), (g).

308. *Id.* at § 512(c)(3)(A)(vi).

309. *Id.*

310. *Id.* at § 512(g)(2)(C). The DMCA provides a remedy for those harmed by knowing and material misrepresentations that material is infringing. *Id.* at § 512(f).

311. See, e.g., Seltzer, *supra* note 129, at 177.

312. *Id.* at 190.

lawfulness through counter-notification or a lawsuit. This reversal combined with the safe harbor creates a set of incentives that facilitate over claiming by content owners and zealous takedowns by ISPs eager to keep their immunity.³¹³ It provides service providers insufficient incentive to ensure the factual or legal basis for the takedown and therefore also encourages copyright owners to use copyright claims as a route to expeditious takedown.³¹⁴ Moreover, it underincentivizes counter-notices by placing the burden on the takedown recipient. Facing the choice of litigating the propriety of their post or accepting the takedown, only those with time and resources will choose the former, expensive path.³¹⁵ Essentially, the DMCA makes it too easy for inappropriate claims of infringement to produce takedowns of speech and encourages service providers to take down speech on notice even if the notice is factually questionable or flawed.³¹⁶

This is problematic because it constricts the range of inputs available to the brain. This is not to say that an individual has some absolute right to access any information online, including obviously infringing materials. Indeed, one could argue that even an over-inclusive takedown regime leaves a user with far more information to access than they would have in the pre-Internet, analog world. But this response ignores the realities of memory outsourcing and transactive memory discussed above. False positives that result in the erroneous removal of content not only constrict the scope of knowledge available for the creative process, but can essentially erase outsourced memory.³¹⁷ The point is not to require access to all materials, including infringing materials, but to facilitate access to all noninfringing materials, especially those materials transactive memory refers to.

The problem is compounded by the rise of cloud computing. Today, individuals and businesses are increasingly moving much of their content into the “cloud.” Advances in bandwidth and the rise of mobile devices as the primary means of accessing the Internet have facilitated a shift from first-party to third-party storage of data and applications.³¹⁸ Purveyors of computer software host their applications on the Internet, rather than on

313. *Id.* at 201–10; NETANEL, *supra* note 17, at 115.

314. As Wendy Seltzer has argued, the DMCA establishes a takedown regime that is cheap for the claimant, but more expensive for the counter-claimant. Seltzer, *supra* note 129, at 206–07, 227.

315. *Id.*; NETANEL, *supra* note 17, at 115.

316. The asymmetry in incentives means that intermediaries have little incentive to contest demands that can be avoided by sacrificing a marginal user of their services. Seltzer, *supra* note 129, at 177; NETANEL, *supra* note 17, at 115; Seth F. Kreimer, *Censorship by Proxy: The First Amendment, Internet Intermediaries, and the Problem of the Weakest Link*, 155 U. PA. L. REV. 11, 50 (2006).

317. As others have shown, the takedown regime can result in the removal of large amounts of non-infringing information. See Seltzer, *supra* note 129, at 210–18.

318. See Werbach, *supra* note 234, at 1812–14.

individual computers, and content purveyors are relying on remote, cloud-based content which users stream to their devices, rather than storing media on individual devices.³¹⁹ Moreover, individuals are storing personal data and media in the cloud that was previously stored and immediately accessible on their own hard drives.³²⁰ The problem for cognitive purposes is twofold. First, cloud storage places information that was once immediately within an individual's reach—say, in their office, home or computer—outside that reach. It can be accessed from anywhere, certainly a benefit, but only if the Internet is working at that particular moment with sufficient speed and their content is accessible. Second, as to applications and third-party content, the shift puts an additional layer of intermediation between individuals and software content needed for creative or consumptive activities. In both situations, the DMCA can be used to remove content and access to it, even where that content is an individual's work product, rather than something infringing.³²¹ As we have seen, such false positives bode ill for optimal cognitive architecture.³²²

These false positives have an easy fix—flip the DMCA's default presumption back to the traditional First Amendment framework. Content should be presumed legitimate until proven otherwise, and that should require more than a takedown notice alleging infringement. But even failing a wholesale reversal of the DMCA's burden presumptions, the risks the DMCA poses to the brains' cognitive architecture suggest linking ISP immunity to increased incentives for ISPs to ensure the validity of DMCA claims. This can be achieved in a number of ways, including narrowing the class of uses for which takedowns are available, increasing the identification requirements of takedown issuers, and balancing the burdens of claims and responses.³²³ Rather than immediate takedown, content removal could be deferred until the subject of the takedown receives notice and an opportunity to respond directly or through a third-party intervenor, particularly if the content is the individual's work-product or creative materials, rather than a complete copy of the takedown issuer's copyrighted

319. *Id.*

320. *See id.* Several popular applications include Apple's iCloud, Amazon's cloud storage, and Dropbox. *See iCloud*, APPLE, <http://www.apple.com/icloud> (last visited Mar. 10, 2013); *Amazon Cloud Drive: Learn More*, AMAZON, <https://www.amazon.com/clouddrive/learnmore> (last visited Mar. 10, 2013); *About Dropbox*, DROPBOX, <http://www.dropbox.com/about> (last visited Mar. 10, 2013).

321. Storage lockers can be used for copyright infringement purposes. *See, e.g., Perfect 10, Inc. v. Megaupload Ltd.*, No. 11cv0191-IEG (BLM), 2011 WL 3203117 (S.D. Cal. July 27, 2011). But they are also used for legitimate reasons. *See, e.g., Capitol Records, Inc. v. MP3Tunes, LLC*, 821 F. Supp. 2d 627 (S.D.N.Y. 2011) (holding that music lockers do not violate copyright).

322. Consider, for example, an individual using an iPhone to access their cloud-based information on Apple's servers. Not only could the user's ISP issue a takedown notice to Apple which Apple has no legal incentive to vet, but Apple or third parties can disable that individual's iPhone remotely, thus blocking access on the user's end as well.

323. Seltzer, *supra* note 129, at 228–29.

work. Such revision could exclude wholesale copyists from its scope, maintaining the present framework at least where the takedown issuer, under penalty of perjury, alleges a wholesale infringement for commercial or non-fair-use purposes. Or the takedown issuer could be required to post some form of bond which would be forfeited if the takedown notice is found to have been issued in bad faith and could be used to compensate individuals harmed by false takedowns. This alone would narrow the range of materials subject to false positives, while also responding to legitimate concerns of copyright holders.

Regardless of what steps, if any, are taken, the important point is that going forward, any discussion of reforming or expanding the DMCA or similar statutes governing Internet content must account for the cognitive consequences of the takedown mechanism.

2. *Domain Seizures and Content Blocking*

Recent efforts by traditional copyright industries to lobby Congress for more robust protections reinforce the importance of considering the cognitive consequences of copyright legislation. Presently, the Department of Homeland Security (DHS), relying on the Protect IP Act³²⁴ and asset forfeiture rules, routinely seizes American domain names as property allegedly used for copyright infringement.³²⁵ In hundreds of cases, DHS has sought to seize domains without notice to the registrant and with minimal investigation of whether the domains are in fact violating the law.³²⁶ The agency has admitted to seizing domain names that are not violating copyright law, causing serious financial harm and underscoring the danger of allowing such actions to be taken with minimal procedural safeguards.³²⁷ The agency has also seized cloud storage providers whose

324. Prioritizing Resources and Organization for Intellectual Property Act of 2008, Pub. L. No. 110-403, 112 Stat. 4256 (codified in scattered sections of 15, 17, 18, 19, and 42 U.S.C.).

325. Larry Downes, *Leahy's Protect IP Bill Even Worse than COICA*, CNET (May 12, 2011, 6:21 PM), <http://news.cnet.com/8301-135783-20062419-38.html#ixzz1SlqW4xkv>.

326. *Id.* Somewhat comically, these seized domains are then converted into Government speech against copyright infringement. See Greg Sandoval, *Seized Web Sites Won't End Up Like Drug Dealers' Cars*, CNET (Apr. 26, 2011, 2:52 PM), <http://news.cnet.com/8301-310013-20057613-261.html>.

327. Downes, *supra* note 325; Nate Anderson, *Takedowns Run Amok?*, ARS TECHNICA (Feb. 16, 2012, 4:44 PM), <http://arstechnica.com/tech-policy/news/2012/02/secret-service-asks-for-shutdown-of-legit-website-over-user-content-godaddy-complies.ars>; Timothy B. Lee, *ICE Admits Year-Long Seizure of Music Blog Was a Mistake*, ARS TECHNICA (DEC. 8, 2011, 5:14 PM), <http://arstechnica.com/tech-policy/news/2011/12/ice-admits-months-long-seizure-of-music-blog-was-a-mistake.ars>. Several lawsuits against the agency alleging constitutional violations are ongoing. See, e.g., Puerto 80 Projects, S.L.U. v. United States, 1:11-cv-04139-PAC (S.D.N.Y. Aug. 4, 2011).

servers are used by thousands of individuals to store personal documents and data and which those individuals do not have personal backups for.³²⁸

Under the so-called Protect IP Act and the Stop Online Piracy Act,³²⁹ which the music and film industries are lobbying Congress to pass, the Department of Justice (DOJ) would have similar powers against foreign domains. The Acts empower DOJ to seek court orders against allegedly infringing sites that essentially render the sites invisible.³³⁰ However, private copyright holders may also seek court injunctions blocking domains.³³¹ The proposed bills also require that information location tools like search engines, “take technically feasible and reasonable measures, as expeditiously as possible, to . . . remove or disable access to the Internet site associated with the domain name set forth in the order,”³³² and delete all hyperlinks to the offending “Internet site.”³³³ At a technical level DNS routers would be required to not route users to blocked sites.³³⁴ The bills also require credit card companies and advertising networks to stop doing business with sites the government blocks and sites private copyright or trademark owners assert are predominantly infringing.³³⁵

Although requiring a court order before blocking access to specific websites is a positive step, there is reason to doubt that the provisions will not produce the same false positive problem as the DMCA. First, the Acts permit same-day injunctions removing content without any opportunity for either the domain owner or individuals relying on the website to respond or present evidence of noninfringement.³³⁶ Affected domain owners, but not those relying on the information suppressed,³³⁷ may file a lawsuit after the

328. See Michael Nunez, *Megaupload Shutdown: Why Internet Piracy Will Prevail*, INT'L BUS. TIMES (Jan. 30, 2012, 5:05 PM), <http://www.ibtimes.com/articles/289919/20120130/megaupload-shutdown-internet-piracy-bittorrent-cyberlocker-netflix.htm>. This in turn has chilled innovation among other purveyors of legal cloud storage services. See Nicole Perlroth & Quentin Hardy, *Antipiracy Case Sends Shivers Through Some Legitimate Storage Sites*, N.Y. TIMES, Jan. 21, 2012, at B1.

329. Preventing Real Online Threats to Economic Creativity and Theft of Intellectual Property Act of 2011, S. 968, 112th Cong. (2011) (hereinafter Protect IP); Stop Online Piracy Act of 2011, H.R. 3261, 112th Cong. (2011) (hereinafter SOPA).

330. Protect IP § 3; SOPA § 102; Nate Anderson, *Revised 'Net Censorship Bill Requires Search Engines to Block Sites, Too*, ARS TECHNICA (May 10, 2011, 9:44 PM), <http://arstechnica.com/tech-policy/news/2011/05/revised-net-censorship-bill-requires-search-engines-to-block-sites-too.ars>.

331. Protect IP § 4(e); SOPA § 103(c); Anderson, *supra* note 330.

332. Protect IP § 3(d)(2)(D); SOPA § 103(d)(2). Protect IP refers to these as “information location tool[s],” while SOPA simply calls them search engines.

333. Protect IP § 3(d)(2)(D); SOPA § 102(c)(2)(B).

334. Protect IP § 3(d)(2)(A); SOPA § 102(c)(2)(A).

335. Protect IP § 4(a)(1); SOPA § 102(c)(2)(C)–(D).

336. Protect IP § 3(e); SOPA § 103(c)(5); see Letter from Law Professors to Congress in Opposition to Protect IP Act of 2011 (July 5, 2011), available at <http://www.scribd.com/doc/59241037/PROTECT-IP-Letter-Final>.

337. Notably, no party representing the interests of someone other than the copyright owner can intervene in the process to represent competing public interests to the court.

fact, long after the speech is out of circulation.³³⁸ No notice need be given domain owners before domains are blocked.³³⁹ This is a far cry from the mandatory “adversary proceeding” the Supreme Court routinely requires before speech in circulation can be removed.³⁴⁰ Second, the Acts facilitate blocking entire domains, rather than specific, pinpointed infringing materials.³⁴¹ Thus, vast amounts of protected speech containing no infringing content can be blocked and removed from circulation based solely on the presence of one specific instance of infringement on a single subdomain.³⁴² Third, requiring individual ISPs to make individual, country-specific decisions about who can find what on the Internet threatens the Internet’s neutral DNS interconnection system. Neutral DNS is a key feature of the Internet’s end-to-end design, providing universal domain name accessibility across countries and languages, and is central to the operation, usability, and scalability of the Internet.

Considered against the design principles articulated above, the legislation and domain seizures are huge steps backwards. By sanctioning the removal of information, infringing or not, from circulation, it harms both the process of building long-term neural networks and the efficacy of transactive memory. More subtly, SOPA, Protect IP, and similar legislation harm Internet innovation. Anyone who starts a web-based company is at risk of having their source of customers and revenue, indeed, their website itself—disappear at a moment’s notice. Moreover, the requirements the Acts place on ISPs, financial firms, advertisers, and search engines will require those entities to consult an endlessly growing list of prohibited sites they are not allowed to connect to or do business with. Both the costs of compliance by incumbents and the inherent unreliability of building a web business will serve as serious drags on innovation. For cognitive purposes, this means fewer efficient means of accessing information, fewer platforms for communicating information, and fewer sources of information.

Moreover, the seizures of online storage lockers, which are legal means of storing information online,³⁴³ remove large swaths of legitimate, noninfringing information from an individual’s personal cloud storage by

338. Protect IP § 3(f); SOPA § 103(e). *See* Bambauer, *supra* note 132, at 867.

339. Protect IP § 3(a)–(c); SOPA § 103(a)–(c). *See* Letter from Law Professors, *supra* note 336. *See also* Bambauer, *supra* note 132, at 867.

340. *See, e.g.*, *Fort Wayne Books, Inc. v. Indiana*, 489 U.S. 46, 51–63 (1989); *Freedman v. Maryland*, 380 U.S. 51, 58–60 (1965).

341. For an explanation on how this would work functionally, see STEVE CROCKER ET AL., SECURITY AND OTHER TECHNICAL CONCERNS RAISED BY THE DNS FILTERING REQUIREMENTS IN THE PROTECT IP BILL (2011), available at <http://www.shinkuro.com/PROTECT%20IP%20Technical%20Whitepaper%20Final.pdf>.

342. *Id.*

343. *See, e.g.*, *Perfect 10, Inc. v. Megaupload Ltd.*, No. 11cv0191-IEG (BLM), 2011 WL 3203117 (S.D. Cal. July 27, 2011).

shutting down cloud storage sites in their entirety.³⁴⁴ This failure to distinguish between noninfringing and infringing accounts removes information whose location can be stored in the brain as transactive memory. Such overinclusive seizures leave individuals relying on these services severed from information their brain's wiring assumes it has access to.³⁴⁵ The end result is to seriously constrict the flow of information cognitive architecture relies on, while also underproducing innovative technological activity that feeds back into that cognitive architecture. Indeed, the Acts and seizures as currently executed conflict with every design principle discussed in this Article.

At a bare minimum, future legislation should be far more narrowly tailored to address the specific issue the SOPA and Protect IP purport to address—providing copyright holders remedies against foreign websites who host infringing content. The current iterations of these bills are far more overinclusive than they need to be to address this issue and sweep content and third parties within their ambit that cannot be fairly said to infringe copyrights. As with the DMCA, content ought to be presumed legitimate until proven otherwise, and that should require more than a takedown notice alleging infringement. Moreover, greater procedural safeguards permitting recipients of takedowns to challenge the proposed seizure of their web domains prior to the actual seizure of those domains as contemplated by Supreme Court precedent are needed. Domain seizures, when used, need to be far more narrowly tailored and provide innocent users a means of collecting their content before it is deleted. Currently no such mechanism is provided to cloud storage users, but one could easily be fashioned by requiring the DOJ to present a court with evidence that either all users of a storage service are infringers or that innocent users' information will be safeguarded and returned to users. Likewise, requiring content owners to either post a bond or swear under penalty of perjury regarding alleged infringement will minimize the impact of false positives on web hosts and those relying on those websites for information and third parties like ISPs, financial firms, advertisers, and search engines.³⁴⁶ The point is to constrict the range of information subject to false positives, while responding more narrowly to copyright holders' or law enforcement's legitimate concerns. More targeted legislation could potentially avoid many of the cognitive pitfalls plaguing both the current bills and the execution of domain seizures by the DOJ.

344. See sources cited *supra* note 328.

345. See sources cited *supra* notes 177–189 and accompanying text.

346. For a particularly egregious example, see Anderson, *supra* note 327.

D. Peer Production

Finally, the cognitive design principles articulated here provide guidance to the question of how to design optimal creative environments in light of emerging peer production trends. As has been documented elsewhere, the Internet facilitates large-scale peer production of creative projects of serious complexity and utility not possible during the analog days of the twentieth century.³⁴⁷ Contributors self-select, obviating any need to guess whom to hire or support and participants know market needs because they largely form the marketplace. Projects develop rapidly because participants bring a diversity of knowledge and experience to such issues as identifying and fixing problems. Once a project is developed, there are no high prices, reduced output, deadweight losses, or holdouts. Users have freedom to customize the work to their own needs. Moreover, a robust psychological literature has shown that nonprofit group collaboration in fact encourages greater collaboration and creativity because it seizes upon inherent human desires for intrinsic motivation rather than extrinsic, financial motivation.³⁴⁸ This is true in scientific communities,³⁴⁹ amateur communities,³⁵⁰ open-source software communities,³⁵¹ and user-generated content communities.³⁵² In all these endeavors, individual intrinsic motivations thrive in the collaborative, not-for-profit environment, and that environment in turn facilitates group members' building on other members' contributions in a synergistic, collaborative process. Indeed, peer production is a species of the general design principle articulated in this paper—individuals and groups produce more creative outputs at greater frequency when working in environments that facilitate information spillover and cross pollination of inputs.

Some peer production proponents argue that the success of peer production suggests scaling back copyright entitlements.³⁵³ The argument assumes that if IP rights were scaled back, peer production would replace the cultural output and infrastructure lost.³⁵⁴ Peer production, like other

347. See Benkler, *supra* note 5, at 302–03, 326; Reuveni, *supra* note 30, at 285–86.

348. See sources cited *supra* note 5.

349. Rochelle Cooper Dreyfuss, *Does IP Need IP?: Accommodating Intellectual Production Outside the Intellectual Property Paradigm*, 31 CARDOZO L. REV. 1437, 1444–45 (2010).

350. ERIC VON HIPPEL, *DEMOCRATIZING INNOVATION* 104–05 (2005).

351. Benkler, *supra* note 5, at 336.

352. Reuveni, *supra* note 30, at 287. This subcategory includes a wide swath of creative activity. See Dreyfuss *supra* note 349, at 1444–45.

353. For examples of such arguments, see the works of Yochai Benkler cited *supra* notes 5, 17, and 35.

354. See Adam Fish et al., *Birds of the Internet: Towards a Field Guide to the Organization and Governance of Participation*, 4 J. CULTURAL ECON. 157 (2011), available at <http://www.tandfonline.com/doi/abs/10.1080/17530350.2011.563069> (showing that peer production

creativity, relies on the entire ecosystem and infrastructure of creative endeavor, and cannot be analyzed in a vacuum. Oftentimes, peer production is a product of market and nonmarket hybridity.³⁵⁵ Indeed, private, hierarchical firms subsidize many cooperative open source projects by enabling programmers to make a living at their “day jobs,” freeing them to pursue their nonmarket passions after (or during) business hours.³⁵⁶ This mirrors the “patronage” model that makes nonprofit academic environments effective.³⁵⁷ In both, a guaranteed salary allows employees to pursue their work without worrying about making ends meet. That guarantee of income is what facilitates nonmarket-oriented creative work.³⁵⁸

The takeaway for cognitive design purposes is that the creative ecosystem remains a hybrid of market and nonmarket structures and interactions between them. Thus, it is important to articulate cognitive design principles as a baseline for all participants within the copyright ecosystem. As I suggested earlier,³⁵⁹ this baseline is individuals. An individual’s cognitive architecture is the fulcrum of any creative interaction within groups, across networks, and with the Internet, regardless of their position in the for-profit or nonprofit matrix.³⁶⁰ All individuals benefit from an environmental design that minimizes disruption and mirrors the brain’s cognitive architecture. From the corporate side, these benefits spillover into final products these entities can market and disseminate, as before, which contribute to the larger creative ecosystem. At the same time, for-profit models of creativity rely heavily on the outputs of nonprofit research

enterprises employ both “formal social enterprise” and an “organized public” that stand in some structural and temporal relationship to one another, and that not all such relationships would exist absent for-profit structures); Dreyfuss *supra* note 349, at 1444–45 (arguing that nonmarket peer production often requires market-based IP rights to provide the necessary infrastructure which facilitates peer-production).

355. In other examples, for-profit corporations adopt the looser structure of peer production in the design of their manufacturing or sales models. Two examples include Toyota’s manufacturing process and IBM’s open-source services model. See Benkler, *supra* note 5, at 203.

356. See Fred Turner, *Burning Man at Google: A Cultural Infrastructure for New Media Production*, 11 *NEW MEDIA & SOC’Y* 73, 78–79 (2009), available at <http://nms.sagepub.com/content/11/1-2/73>.

357. JOHNSON, *supra* note 31, at 232–35.

358. Proponents of peer production, including myself, have focused on specific subsets of peer production. Benkler, *supra* note 5; Reuveni, *supra* note 30. While some of these may not require market-based mechanisms or IP rights as a precondition, others very well might. See Fish et al., *supra* note 354. See also Dreyfuss *supra* note 349; Jonathan M. Barnett, *Intellectual Property as a Law of Organization* (Univ. of S. Cal. Center in Law and Economics Working Paper Series, Paper No. 116, 2010), available at <http://law.bepress.com/usclwps-lewps/art116>; Dan L. Burk & Brett H. McDonnell, *The Goldilocks Hypothesis: Balancing Intellectual Property Rights at the Boundary of the Firm*, 2007 *U. ILL. L. REV.* 575 (2007).

359. See *supra* Part I.B.

360. Market-oriented industries adopting some aspects of peer production within their firms can in fact make their environments more creative and innovative. See, e.g., Benkler, *supra* note 5, at 3.

oriented structures, including collaborative end-user innovation.³⁶¹ Because individuals exist in any creative model, the goal should be to design a system that facilitates optimal interplay between all networks within the creative ecosystem, including both peer production and for-profit models.

Focusing on the individual as the fulcrum of environmental design also avoids the tradeoffs inherent in preferring peer production or centralized market-based production. Both systems remain vital, but both suggest different optimal settings and design choices. The systems design literature does not provide a one-size-fits-all answer to the question of what organizational forms best produce creativity. Eschewing the organizational narrative that the literature focuses on³⁶² in favor of an individualistic model avoids this debate. The individual brain is the core of any creative environment, the precondition to any subsequent creativity in any system. Focusing on the individual provides a baseline that optimizes all other design choices regarding creative environments, regardless of whether the model is premised on selfish-actor rationalists, utilitarianism, peer production, or any other rationale, while alleviating any risk of erroneous design choices based on the policy goals and assumptions of any specific model.³⁶³

Human minds are the products not only of neural processing, but also the complex and iterated interplay between brains, bodies, and the many designer environments in which we increasingly live and work. Even so, it is the human brain itself that remains the hub at the center of the creative wheel. An environment that optimizes creativity at the neural level will spillover into every other design decision we make. And given what we now know about the science of creativity, copyright law and information policy have a critical role to play in designing those environments.

CONCLUSION

This Article has developed a scientific account of how creativity functions on a neurobiological level and relied on that account to argue that encouraging creativity should be understood as a matter of environmental design, with the brain's creative process that environment's hub and copyright law and information policy design levers in engineering that environment. As we have seen, copyright law and related laws governing the content and infrastructure of the Internet—what I have termed

361. See Patricia Cohen, *Innovation Far Removed From the Lab*, N.Y. TIMES, Feb. 10, 2011, at C1.

362. E.g., Benkler, *supra* note 5, at 1–18.

363. On the problem of viewpoint tainting systems design analysis in the peer production context, see Fish et al., *supra* note 354, at 2–4.

“information policy”—influence the efficacy of this system and therefore function as key design elements in any creative environment.

Using these levers, the Article proposed several modifications to copyright doctrine and the laws governing the Internet. These include implementing some form of network neutrality, permitting narrowly targeted data caps and graduated response mechanisms where congestion is shown to be a problem, and developing a robust conception of personal fair use as a basis for cognitive liberty. Moreover, laws regulating the takedown, blocking, or seizure of Internet content like the DMCA, SOPA, or the Protect IP Act need to be more narrowly tailored and contain sufficient procedural safeguards and initial burdens of proof on the part of the government or content owners to ensure content that the cognitive architecture depends on is not improperly blocked, seized, or removed. These changes establish a legal regime that complements the realities of long-term memory development, working memory, and transactive memory in the digital age, while also providing a baseline that benefits all stakeholders in the copyright debate.

To be sure, this is a nascent framework, and much empirical work remains to be done on specific applications of the design principles articulated in this Article in specific environments. However, an understanding of information policy’s cognitive effects provides a foundation for future research and a blueprint for designers of any creative environment. Armed with an understanding of how the individual cognitive architecture of creativity works, we can articulate a generalizable set of design principles applicable in every design choice regarding creative environments in the Internet age. Given what we now know about the human brain’s cognitive architecture, creativity can no longer be viewed in a scientific vacuum. Moving forward, cognitive policy should join intellectual property’s other theoretical concerns as a guiding polestar in any future legal and policy debates.