Bolstering Faith with Facts: Supporting Independent Redistricting Commissions with Redistricting Algorithms

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Redistricting has seen progress in two seemingly distinct areas. On the technology side, a quantum leap in the development and maturation of redistricting algorithms has made it possible to generate and analyze large numbers of random, simulated districting plans that satisfy stated redistricting criteria. Analysis based on these algorithms and the simulated maps they drew was prominently featured in the last round of partisan gerrymandering litigation in federal courts. While those challenges did not succeed, the analytical contribution afforded by algorithms made it clear that these algorithms will play a prominent, if not starring, role in future redistricting reform. On the institutional side, independent redistricting commissions have emerged as the model reform for the fair maps movement. Yet their popularity belies vulnerabilities. Inability to ensure the independence of citizen commissioners threatens the legitimacy of redistricting commissions.

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For full disclosure, as a Skadden Fellow at the Voting Rights Project of the ACLU, I worked on Ohio A. Philip Randolph Inst. v. Householder, 373 F. Supp. 3d 978, 991 (S.D. Ohio 2019) (with Wendy Tam Cho, who served as an expert witness in the case and presented independent analysis based on output from her supercomputer-powered redistricting algorithm, credited at *id.* at 1031–38). This Article represents my views—and mistakes—alone.

This Article argues that there is synergy to be gained from joining these two areas of progress. It proposes incorporating redistricting algorithms into independent redistricting commissions' work. The evaluative function that the algorithms performed in the course of litigation—of what might be rational and expected redistricting outcomes given political geography—can be readily adapted for independent redistricting commissions. The availability of an external method of evaluating the work product of commissions takes pressure off the ever escalating yet never foolproof strategy of testing the political purity of citizen commissioners.

Moreover, redistricting algorithms can perform other functions to improve the work of independent redistricting commissions. The algorithms can serve as a tailored redistricting teaching aid to citizen commissioners, locate otherwise hard-to-find maps that optimize neutral redistricting criteria, and identify necessary trade-offs in time for them to be addressed. The future of redistricting reform depends on whether and how we pair institutional design with technological innovation.

INTRODUCTION

While the Supreme Court's decision in *Rucho v. Common Cause*[1] dashed hopes of federal courts playing a central role in reining in egregious partisan gerrymanders, the extensive partisan gerrymandering litigation leading up to

1. 139 S. Ct. 2484, 2508 (2019).

Rucho showcased what will become a key player in redistricting reform: redistricting algorithms. In those federal cases, and the state court decisions striking down partisan gerrymanders in Pennsylvania and North Carolina, judges relied—often heavily—on expert discovery derived from redistricting algorithms: large numbers of viable maps based on the same underlying political geography that collectively served as a baseline against which to measure the political bias of the challenged map. The prominence of redistricting algorithms in past and future partisan gerrymandering litigation (in state courts) makes clear that these algorithms are here to stay. The only question is what role they will play.

This Article considers how redistricting algorithms might aid the work of independent redistricting commissions, perhaps the most promising among institutional redistricting reforms in recent years.[2] Commissions were introduced to take redistricting out of the hands of legislators, who are either too self-interested not to redraw districts to secure their own political futures or too partisan motivated not to draw districts to entrench their party's power.

The independence of redistricting commissions has come to be understood as encompassing two key elements: (1) institutional insulation from the legislature and political influences more generally and (2) neutrality of personnel (i.e., who serves as commissioners).[3] The importance of institutional independence was made clear after early commissions (that had merely advisory authority or only served as backup in the event of political logjam) failed to prevent increasingly egregious gerrymandering.[4] Calls for commissions to have full control of redistricting escalated.

Now, independent redistricting commissions are increasingly synonymous with *citizen* redistricting commissions, where ordinary citizens serve as

2. Other reform goals that have gained popularity include transparency and public education. Transparency goals are often embedded in the creation of independent redistricting commissions. *See* Rebecca Green, *Redistricting Transparency*, 59 WM. & MARY L. REV. 1787 (2018) (discussing transparency of independent redistricting commissions). And in states that fail to adopt independent redistricting commissions, there are compelling reasons to enhance the transparency of the legislative redistricting process. *See* Rebecca Green, *More Redistricting Transparency, Less Litigation?*, SYRACUSE L. REV. (forthcoming) (noting the connection between enhanced transparency in redistricting and reduced redistricting litigation). Public education is related to transparency, but focuses more on empowering ordinary citizens with knowledge and expertise on redistricting. *See, e.g.*, PUB. MAPPING PROJECT, http://www.publicmapping.org [https://perma.cc/YZT6-3YAL] (making literature, data, and software available to the public); DAVE'S REDISTRICTING, https://davesredistricting.org/maps#home [https://perma.cc/W6H5-W9ZN] (offering an interactive site for amateur redistricting).

3. For an authoritative study of redistricting commissions, see Bruce E. Cain, *Redistricting Commissions: A Better Political Buffer?*, 121 YALE L.J. 1808, 1813–20 (2012), describing the progression of independent redistricting commissions over time and describing the two elements of independence as that of process and personnel.

4. See, for example, Ohio, which ostensibly drew its congressional districts via a commission (prior to the passage of Amendment 1 in 2018), *see infra* note 51, and was one of a small handful of states that had their congressional maps challenged in court in the last redistricting cycle as a partisan gerrymander. *See generally* Part I.B.

commissioners.[5] (And thus, this is the definition of independent redistricting commission I rely on in this Article, too.) The reform movement learned that securing formal, institutional separation for redistricting functions was not enough to ensure the true independence of commissions. Staffing commissions with career politicians of any stripe—legislators or otherwise—still permitted informal, careerist, and political interests to permeate the redistricting process.[6] Reformers feared that it was simply too tempting for politicians to abuse the redistricting process for their own advantage. Thus, the latest generation of independent redistricting commissions (starting with California and Arizona[7] and followed more recently by Michigan and Colorado) are staffed exclusively by citizens who are not politicians.

Yet as California and Arizona's experiences with citizen commissions have made clear, installing citizens at the helm of redistricting is not a panacea. The independence of citizen redistricting commissions, and therefore their legitimacy, hinges on the perceived and actual neutrality of the citizens who serve on them. Revelations of partisan connections, even at several degrees of separation, erode fragile public confidence in the independence of citizen commissioners who were selected on the basis of their lack of political affiliations. And they remind us that the current approach towards securing the independence of redistricting commissions is ultimately an indirect one: changing who draws the maps (personnel-based solution) or insulating redistricting from political pressures (process-based solution) in the hopes of affecting what maps are drawn. Escalating strategies to politically insulate commissions stem from the difficulty of enforcing the desired substantive outcome. Notwithstanding the immense progress that independent redistricting commissions represent for the reform movement, their evolution over time also reveals a certain helplessness: for now, at least, all that reformers can do to ensure that fair maps are drawn is to secure the integrity of the redistricting process and of redistricters.

For redistricting reform to succeed, we need not only trusted redistricters, but also reliable ways of assessing their performance. In short, we must strengthen personnel-based reforms like independent redistricting commissions with outcome-based evaluation. As the recent partisan gerrymandering litigation demonstrates, redistricting algorithms are well positioned to serve such an evaluative function.

Indeed, redistricting algorithms can and should play a role during commissions' map-drawing process. Incorporating results from redistricting algorithms at various stages of the redistricting process would not only bolster

5. *See* Cain, *supra* note 3, at 1817–21.

6. *See id.* at 1817–18 (describing this problem in degrees of separation from what he calls "legislative conflict of interest").

7. *Id.* at 1821 (describing the citizen independent redistricting commissions as the reform "frontier").

public confidence that the maps are fair, but also make the maps fairer to begin with.

This Article outlines several of the likely roles that redistricting algorithms can play in facilitating and improving the work of independent redistricting commissions. First, the algorithms can serve as a high-powered learning tool. Citizen commissioners must overcome a significant expertise hurdle; the algorithms can help to simplify and organize choices, answer discrete questions, and permit experimentation with map drawing. The algorithms can also produce optimized, instead of random, outcomes. In short, we can use the algorithms not only to draw lots of average maps, but also better maps. To the extent there are maps that optimize redistricting criteria, the algorithms can help us identify them. Finally, the algorithms can help unearth important and inevitable trade-offs in the redistricting process that are difficult for humans to identify given the many legal and prudential considerations involved. This is doubly important because commissions have a short time frame within which to draw maps. And because commissions solicit public input on their decisions, unlike legislatures that draw maps out of the public eye, it is all the more important to quickly identify where critical information needs to be gathered and determine which decisions will require the most attention.

This Article proceeds as follows: Part I describes what redistricting algorithms are, their origin, and past applications, both by social scientists to answer research questions and by courts to decide partisan gerrymandering cases. It demonstrates how these algorithms are a useful tool in helping us learn about and evaluate redistricting outcomes, and thus how important it is for the redistricting movement to take full advantage of what they have to offer.

Part II describes the unique contribution made—and challenges faced—by independent redistricting commissions. While they resolve an endemic conflict of interest problem posed by classic partisan redistricting, recent crises of confidence in the true independence of citizen commissioners in Arizona and California demonstrate that this institutional innovation has its own unique vulnerabilities. Redistricting algorithms can alleviate the personnel pressure point for these commissions. Instead of simply asking the public to keep faith in the good intentions and pure motives of citizen commissioners, these algorithms allow the public to directly evaluate commissions' work.

Part III outlines additional synergistic applications of redistricting algorithms and independent redistricting commissions. These include using algorithms to build learning tools, generate optimal maps, and identify necessary trade-offs between redistricting criteria and community interests. To the extent that independent redistricting commissions require formalized mechanisms to ensure that citizen commissioners arrive at credibly neutral outcomes, redistricting algorithms can supply suggested, default, or backup redistricting plans. The task ahead is therefore not simply to find useful functions for

redistricting algorithms, but also to devise formal and informal mechanisms to harness those functions systemically when appropriate.

I.
REDISTRICTING ALGORITHMS

I define redistricting algorithms in this Article as algorithms that generate large numbers of redistricting plans that satisfy a set of predetermined neutral criteria (e.g., population equality, compactness, or splitting no more than ten counties and twenty cities). As this Article will demonstrate, the reasons for drawing many maps have rightly shifted and expanded over time. In this Section, I describe the principal motivation behind the development of these algorithms—understanding the extent of partisan gerrymandering—and their application in litigation.

A. Birth in Research

The principal research question driving the development of redistricting algorithms is an old and important one: what are the political consequences of electing representatives from single-member districts? Even the idea of using algorithms to draw simulated maps is not a new one. At least since the 1960s, scholars have proposed developing algorithms to resolve partisan gerrymanders.[8] And beginning in the late 1990s and early 2000s, scholars began making significant progress towards creating algorithms that could produce simulated outcomes.[9]

The elusiveness of the right baseline for understanding redistricting outcomes drove interest in developing algorithms that could generate simulated maps. The Anglo-American tradition of electing representatives using single-member districts makes it hard to evaluate the political neutrality of districting outcomes. Proportionality between a party's vote share and the number of seats each party obtains is imperfect when representatives are elected from districts. Unlike in a system of proportional representation, where a party's seats in the legislature are allocated based on its proportion of the total vote share, districted electoral systems apportion seats by geographic districts and candidates contest for seats within those districts.

Redistricting gives voice to political geography—i.e., where adherents of each party reside. As voters are clustered in non-random ways, where district lines are drawn clearly affect the political complexion of the district and hence that of the legislature. Political geography complicates the evaluation of political

8. Jowei Chen & Jonathan Rodden, *Unintentional Gerrymandering: Political Geography and Electoral Bias in Legislatures*, 8 Q.J. POL. SCI. 239, 248 (2013) (listing early proponents of redistricting algorithms); *see also* Robert E. Helbig, Patrick K. Orr & Robert R. Roediger, *Political Redistricting by Computer*, 15 COMMC'NS OF THE ACM 735 (1972).

9. Chen & Rodden, *supra* note 8, at 248 (citing the work of Robert Altman; Nolan McCarty, Keith T. Poole & Howard Rosenthal; Michael McDonald; and others).

outcomes from a districting scheme, and therefore the baseline against which to compare actual outcomes must take into account where voters reside.[10]

But how? Political geography is contextual both to the region underlying a redistricting scheme and the kind of redistricting scheme in question. Clearly, the political geographies of Alabama and Wyoming are different.[11] And even within the same state, political geography has different impacts on different levels of redistricting: the same cluster of like-minded voters might be grouped together for congressional redistricting, but spread out across several state house districts.[12] Thus, while understanding where Republicans and Democrats live has always been vital to evaluating redistricting outcomes, it has also been extremely difficult, if not impossible, to account for such political geography properly.

Redistricting algorithms allow researchers to "bake in" political geography into any analysis of districting outcomes. Simulated redistricting outcomes—maps drawn on the same underlying political geography—could provide a baseline against which to measure redistricting outcomes. Analytically, the availability of such a baseline is tantalizing. A baseline that is predicated on the particular state and redistricting scheme's political geography allows social scientists to isolate and measure distortions in political representation that cannot be attributed to political geography.

The need for valid baselines, intensifying concerns about extreme partisan gerrymandering, and improvements in computing power all helped spur the recent flourishing of redistricting algorithms. While partisan gerrymanders have always attracted controversy and criticism, those produced during the 2010 redistricting cycle—and the Republican Redistricting Majority Project known as REDMAP[13]—have ignited widespread outrage and popular demand for reform.[14] Pitched political polarization may have sensitized those losing out from

10. In the context of partisan gerrymandering, that counterfactual is what the districts would look like if the map was not a partisan gerrymander, i.e., the outcome *but for* the causal agent of inquiry.

11. Chen & Rodden, *supra* note 8, make this point, even if their cross-sectional analysis does not include Alabama.

12. Nicholas Eubank & Jonathan Rodden, *Who is My Neighbor? The Spatial Efficiency of Partisanship*, 7 STAT. & PUB. POL'Y. 87 (2020).

13. REDMAP was a concerted and coordinated effort to flip winnable state legislative seats ahead of the 2010 redistricting cycle in order to gain control of the redistricting process and draw maps that entrench partisan advantage throughout the decade. For gory details, see, for example, DAVID DALEY, RATF**KED (2016); *see also* David Daley, *The House the GOP Built: How Republicans Used Soft Money, Big Data, and High-Tech Mapping to Take Control of Congress and Increase Partisanship*, N.Y. MAG.: INTELLIGENCER (Apr. 24, 2016), https://nymag.com/intelligencer/2016/04/gops-house-seats-are-safe-heres-why.html [https://perma.cc/HV5P-NR6H] (summarizing Daley's book).

14. Behind the extensive litigation against partisan gerrymanders and ballot initiatives to introduce redistricting reform described in Part I.B is a large popular and grassroots movement. *See, e.g.*, Michael Wines, *In the War Against Gerrymandering, an Army of Voters Meets a Dug-in Foe*, N.Y. TIMES (Aug. 15, 2019), https://www.nytimes.com/2019/08/15/us/gerrymandering-redistricting-wisconsin.html [https://perma.cc/DAA2-GTE2] (describing a "citizen-led crusade against gerrymandering" in Wisconsin); Katie Fahey, *How My Facebook Post Sparked a Citizen Movement that Defeated Partisan Gerrymandering in Michigan*, FAST CO. (Apr. 21, 2020), https://www.fastcompany.com/90492100/how-my-facebook-post-sparked-a-citizen-movement-that-

new district lines to the harms of partisan control over the redistricting process. Sordid details of how the gerrymander was accomplished, by hired guns behind closed doors,[15] further tested the boundaries of what voters consider acceptable tactics of political warfare. In particular, voters in several states that tended to see well-matched partisan contests in the past now witness—and endure—one-party dominance because of partisan gerrymandering. Attempts to overcome gerrymanders at the ballot box have failed throughout the decade, as intended by the line-drawers who built in large margins of victories as buffers against changes in voter preferences.[16]

One obvious route to reform—that ultimately turned out to be a dead end—was through the Supreme Court. While the Court's controlling opinion in *Vieth v. Jubelirer* would have shut the door to partisan gerrymandering claims in federal court, Justice Kennedy's concurrence left it open.[17] Specifically, Justice Kennedy hinged the future of such claims on the possibility that "technologies may produce new methods of analysis that make more evident the precise nature of the burdens gerrymanders impose on the representational rights of voters and parties."[18] The Kennedy concurrence was an open invitation to social scientists to develop "judicially discernible and manageable standards" for adjudicating partisan gerrymandering claims.[19]

The groundswell of popular support for and the clear path to redistricting reform set social scientists off to work on developing redistricting algorithms. Computational capacity and technical sophistication made it possible for social

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defeated-partisan-gerrymandering-in-michigan [https://perma.cc/W2V6-LQ5L] (describing the "citizen movement" in Michigan that achieved what experts "deemed impossible—amending the state's constitution through a grassroots petition drive that lacked any support from the political establishment"). That movement was also supported by journalists and political commentators describing the problem and calling for reform. *See, e.g.*, Olga Pierce, Justin Elliott & Theodoric Meyer, *How Dark Money Helped Republicans Hold the House and Hurt Voters*, PROPUBLICA (Dec. 21, 2016), https://www.propublica.org/article/how-dark-money-helped-republicans-hold-the-house-and-hurt-voters [https://perma.cc/3XYV-MK43]; Rachel Maddow, *How Republicans Set Up a Decade-Long Advantage over Democrats*, MSNBC (Mar. 2, 2015), https://www.msnbc.com/rachel-maddow/watch/how-the-gop-gave-itself-a-ten-year-advantage-407234115988 [https://perma.cc/S33W-WB5Z]; Elizabeth Kolbert, *Drawing the Line: How Redistricting Turned America from Blue to Red*, NEW YORKER (June 27, 2016), https://www.newyorker.com/magazine/2016/06/27/ratfcked-the-influence-of-redistricting [https://perma.cc/2WXG-JCUL]; Vann R. Newkirk II, *How Redistricting Became a Technological Arms Race*, ATLANTIC (Oct. 28, 2017), https://www.theatlantic.com/politics/archive/2017/10/gerrymandering-technology-redmap-2020/543888/ [https://perma.cc/WUH4-NWXJ].

15. *See* Benisek v. Lamone, 348 F. Supp. 3d 493, 498–509 (D. Md. 2018) (detailing many unsavory facts about how the challenged partisan gerrymanders in each case were drawn). *See generally* Part I.B (describing similar facts in other partisan gerrymandering litigation).

16. For details of what partisan gerrymanders in Wisconsin, Ohio, Michigan, North Carolina, and Pennsylvania accomplished, see *infra* notes 30–39.

17. Vieth v. Jubelirer, 541 U.S. 267 (2004) (Kennedy, J., concurring).

18. *Id.* at 312–13.

19. *Id.* at 281 (Scalia, J., plurality).

scientists to improve these algorithms.[20] Good government groups also encouraged innovation and research in this area by channeling demand for reform into concrete policy proposals and doctrinal suggestions. For example, starting in 2015, Common Cause, a leading democracy reform nonprofit organization, sponsored a prominent writing competition on partisan gerrymandering. The competition was explicitly designed to generate social scientific measures that "could be used in court" to prove partisan gerrymanders.[21]

Looking back at the competition winners, one finds early hints of how prominent a role redistricting algorithms would play in the partisan gerrymandering litigation leading up to *Common Cause*. The second-place paper from 2015[22] and the first-place paper from 2016[23] both propose using simulated maps drawn from a redistricting algorithm to produce a benchmark against which to measure unconstitutional partisan gerrymandering. These early papers set the agenda for the research community in fleshing out different methodologies for algorithmic map drawing.[24] The scholarly community quickly saw the potential

20. These improvements are not trivial. For instance, prominent innovators in this area built their algorithms to run on supercomputers in order to harness the power of parallel computing. Yan Y. Liu, Wendy K. Tam Cho & Shaowen Wang, *PEAR: A Massively Parallel Evolutionary Computational Approach for Political Redistricting Optimization and Analysis*, 30 SWARM & EVOLUTIONARY COMPUTATION 78 (2016).

21. Press Release, Common Cause, Common Cause Announces Winners of National Contest to End Gerrymandering (June 20, 2016), https://www.commoncause.org/media/common-cause-announces-gerrymander-writing-winners/ [https://perma.cc/QKN2-J7HM].

22. Press Release, Common Cause, Common Cause "Gerrymander Standard" Second Place Winners (June 3, 2015), https://www.commoncause.org/democracy-wire/common-cause-gerrymander-2 [https://perma.cc/CPL6-QPZL]; Jowei Chen & Jonathan Rodden, *Cutting Through the Thicket: Redistricting Simulations and the Detection of Partisan Gerrymanders*, 14 ELECTION L.J. 331, 335 (2015).

23. Wendy K. Tam Cho & Yan Y. Liu, *Towards a Talismanic Redistricting Tool: A Computational Method for Identifying Extreme Redistricting Plans*, 15 ELECTION L.J. 351, 353 (2016).

24. Here, I will attempt to be comprehensive in citing papers written based on new redistricting algorithms. Any omission is inadvertent. For recent published work using redistricting algorithms, see Yan Y. Liu, Wendy K. Tam Cho & Shaowen Wang, *A Scalable Computational Approach to Political Redistricting Optimization*, XSEDE '15: PROCEEDINGS OF THE 2015 XSEDE CONF.: SCI. ADVANCEMENTS ENABLED BY ENHANCED CYBERINFRASTRUCTURE (2015); Liu et al., *supra* note 20; Maria Chikina, Alan Frieze & Wesley Pegden, *Assessing Significance in a Markov Chain Without Mixing*, 114 PNAS 2860 (2017); Wendy K. Tam Cho & Yan Y. Liu, *A Massively Parallel Evolutionary Markov Chain Monte Carlo Algorithm for Sampling Complicated Multimodal State Spaces*, SC '18: PROCEEDINGS OF THE INT'L CONF. FOR HIGH PERFORMANCE COMPUTING, NETWORKING, STORAGE & ANALYSIS (2018); Wendy K. Tam Cho & Yan Y. Liu, *Sampling from Complicated and Unknown Distributions: Monte Carlo and Markov Chain Monte Carlo Methods for Redistricting*, 506 PHYSICA A 170 (2018); Vincent Cohen-Addad, Philip N. Klein & Neal E. Young, *Balanced Centroidal Power Diagrams for Redistricting*, SIGSPATIAL '18: PROC. OF THE 26TH ACM SIGSPATIAL (2018); Daniel B. Magleby & Daniel B. Mosesson, *A New Approach for Developing Neutral Redistricting Plans*, 26 POL. ANALYSIS 147 (2018); Gregory Herschlag, Han Sung Kang, Justin Luo, Christy Vaughn Graves, Sachet Bangia, Robert Ravier & Jonathan C. Mattingly, *Quantifying Gerrymandering in North Carolina*, 7 STAT. & PUB. POL'Y 30 (2020); Daniel Carter, Zach Hunter, Dan Teague, Gregory Herschlag & Jonathan Mattingly, *Optimal Legislative County Clustering in North Carolina*, 7 STAT. & PUB. POL'Y 19 (2020); Harry A. Levin & Sorelle A. Friedler, *Automated Congressional Redistricting*,

of the simulated analyses for proving partisan gerrymandering claims.[25] As advocacy groups brought partisan gerrymandering claims in court, new and improved redistricting algorithms were ready to meet the moment.

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24 ACM J. EXPERIMENTAL ALGORITHMICS 1.10:1 (2019); Maria Chikina, Alan Frieze, Jonathan C. Mattingly & Wesley Pegden, *Separating Effect from Significance in Markov Chain Tests*, 7 STAT. & PUB. POL'Y 101 (2020); Benjamin Fifield, Michael Higgins, Kosuke Imai & Alexander Tarr, *Automated Redistricting Simulation Using Markov Chain Monte Carlo*, 29 J. COMPUTATIONAL & GRAPHICAL STAT. 715 (2020); Yan Y. Liu & Wendy K. Tam Cho, *A Spatially Explicit Evolutionary Algorithm for the Spatial Partitioning Problem*, 90 APPLIED SOFT COMPUTING J. 1 (2020); Daryl DeFord, Moon Duchin & Justin Solomon, *Recombination: A Family of Markov Chains for Redistricting*, HARV. DATA SCI. REV., Winter 2021, at 1 (2021).

For recent unpublished work, see Jonathan C. Mattingly & Christy Vaughn, Redistricting and the Will of the People (Oct. 29, 2014) (unpublished paper), https://arxiv.org/pdf/1410.8796.pdf [https://perma.cc/A5YE-ZWPS]; Gregory Herschlag, Robert Ravier & Jonathan C. Mattingly, Evaluating Partisan Gerrymandering in Wisconsin (Sept. 7, 2017) (unpublished paper), https://arxiv.org/pdf/1709.01596.pdf [https://perma.cc/NJ9U-B4XA]; Sachet Bangia, Christy Vaughn Graves, Gregory Herschlag, Han Sung Kang, Justin Luo, Jonathan C. Mattingly & Robert Ravier, Redistricting: Drawing the Line (May 8, 2017) (unpublished paper), https://arxiv.org/pdf/1704.03360.pdf [https://perma.cc/LE3E-VUP7]; Maria Chikina, Alan Frieze & Wesley Pegden, An Analysis of the Act 43 Wisconsin Assembly District Map Using the √ε Test (Oct. 3, 2017) (unpublished paper), https://arxiv.org/pdf/1708.09852.pdf [https://perma.cc/CQ6G-YXPF]; Wesley Pegden, Ariel D. Progaccia & Dingli Yu, A Partisan Districting Protocol with Provably Nonpartisan Outcomes (Oct. 24, 2017) (unpublished paper), https://arxiv.org/pdf/1710.08781.pdf [https://perma.cc/23EQ-Q8ZH]; Yan Y. Liu, High-Performance Evolutionary Computation Framework for Scalable Spatial Optimization (Dec. 1, 2017) (Ph.D. dissertation, University of Illinois at Urbana-Champaign), http://hdl.handle.net/2142/99346 [https://perma.cc/AP36-US9B]; Vincent Cohen-Addad, Philip N. Klein & Neal E. Young, Balanced Power Diagrams for Redistricting (Jan. 6, 2018) (unpublished paper), https://arxiv.org/pdf/1710.03358.pdf [https://perma.cc/E3Q5-3Y7S]; Matt Jacobs & Olivia Walch, A Partial Differential Equations Approach to Defeating Partisan Gerrymandering (June 17, 2018) (unpublished paper), https://arxiv.org/pdf/1806.07725.pdf [https://perma.cc/BPW9-XFGA]; Daniel Carter, Gregory Herschlag, Zach Hunter & Jonathan Mattingly, A Merge-Split Proposal for Reversible Monte Carlo Markov Chain Sampling of Redistricting Plans (Oct. 28, 2019) (unpublished paper), https://arxiv.org/pdf/1911.01503.pdf [https://perma.cc/4EXB-K4SJ]; Luke Farrell & Jacob Shulman, Detecting Partisan Gerrymandering: Stratified Sampling the Space of Possible North Carolina Congressional Redistrictings (2019) (Graduate Thesis, Duke University Department of Computer Science), https://sites.duke.edu/quantifyinggerrymandering/files/2020/05/Computer_Science_Gerrymandering_Thesis_Shulman_Farrell.pdf [https://perma.cc/8AGY-TDDU]; Eric A. Autry, Daniel Carter, Gregory Herschlag, Zach Hunter & Jonathan C. Mattingly, Multi-Scale Merge-Split Markov Chain Monte Carlo for Redistricting (Aug. 18, 2020) (unpublished paper), https://arxiv.org/pdf/2008.08054.pdf [https://perma.cc/2ERF-4MZN]; Cory McCartan & Kosuke Imai, Sequential Monte Carlo for Sampling Balanced and Compact Redistricting Plans (Dec. 25, 2020) (unpublished paper), https://arxiv.org/pdf/2008.06131.pdf [https://perma.cc/SLJ2-K52W]; Gregory Herschlag, Jonathan C. Mattingly, Matthias Sachs & Evan Wyse, Non-Reversible Markov Chain Monte Carlo for Sampling of Districting Maps (Aug. 18, 2020) (unpublished paper), https://arxiv.org/pdf/2008.07843.pdf [https://perma.cc/VSD4-L7XK]; Moon Duchin, Tom Needham & Thomas Weighill, The (Homological) Persistence of Gerrymandering (July 5, 2020) (unpublished paper), https://arxiv.org/pdf/2007.02390.pdf [https://perma.cc/LF5G-SYXF].

25. *See, e.g.*, Bruce E. Cain, Wendy K. Tam Cho, Yan Y. Liu & Emily R. Zhang, *A Reasonable Bias Approach to Gerrymandering: Using Automated Plan Generation to Evaluate Redistricting Proposals*, 59 WM. & MARY L. REV. 1521 (2018); Wendy K. Tam Cho, *Technology-Enabled Coin Flips for Judging Partisan Gerrymandering*, 93 S. CAL. L. REV. POSTSCRIPT 11 (2019); Andrew Chin, Gregory Herschlag & Jonathan Mattingly, *The Signature of Gerrymandering in* Rucho v. Common Cause, 70 S.C. L. REV. 1241 (2019).

B. Headlong into Courtrooms

Redistricting algorithms entered the partisan gerrymandering cases after the Supreme Court in *Gill v. Whitford* dashed early hope that a new measure of partisan gerrymandering, called the efficiency gap,[26] would provide the manageable standard Justice Kennedy sought in *Vieth*.[27] In the spate of partisan gerrymandering cases that followed, expert witnesses prominently presented—and three-judge panels heavily credited—algorithms and the simulated maps they produced.[28] While those cases ultimately failed to persuade the Supreme Court that partisan gerrymandering claims in federal courts can be governed by manageable standards,[29] they showcased one of the many possible applications of redistricting algorithms to lasting redistricting reform: the ability to contextualize and evaluate line-drawers' decisions.

In almost every one of those cases (challenging maps from North Carolina,[30] Michigan,[31] and Ohio[32]), expert analysis based on maps simulated from redistricting algorithms played a starring role. The same was true for much of the partisan gerrymandering litigation in state courts as well.[33]

The transition from academic research to practical application in litigation was easy. The scholarly use of algorithms required only minimal adaptation for evaluating partisan gerrymanders in court. Both the academic and judicial inquiries depend on comparing actual outcomes to simulated redistricting plans and measuring differences between the two.

Courts easily understood what these algorithms had to offer. They used the simulated maps generated from the algorithms to perform two related functions.

First, simulated maps were recognized as a valid baseline against which to measure the challenged map because they indicated what a "typical map that

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26. *See* Nicholas O. Stephanopoulos & Eric M. McGhee, *Partisan Gerrymandering and the Efficiency Gap*, 82 U. CHI. L. REV. 831, 834 (2015); *see also* Whitford v. Gill, 218 F. Supp. 3d 837, 854–55 (W.D. Wis. 2016) (proposing a three-part test for partisan gerrymandering that incorporates the use of the efficiency gap), *vacated and remanded*, 138 S. Ct. 1916 (2018).

27. *See* Gill v. Whitford, 138 S. Ct. 1916, 1933 (2018) (finding that efficiency gap and other measures did not support finding of injury-in-fact requirement for standing and thus declining to decide, as the three-judge panel did below, 218 F. Supp. 3d at 898–910, that efficiency gap proves discriminatory partisan effect).

28. *Infra* note 40.

29. Rucho v. Common Cause, 139 S. Ct. 2484, 2508 (2019).

30. *See* Common Cause v. Rucho, 318 F. Supp. 3d 777, 870–80 (M.D.N.C. 2018), *vacated and remanded*, 139 S. Ct. 2484 (2019).

31. *See* League of Women Voters of Mich. v. Benson, 373 F. Supp. 3d 867, 893–908 (E.D. Mich. 2019), *vacated*, 140 S. Ct. 429 (2019).

32. *See* Ohio A. Philip Randolph Inst. v. Householder, 373 F. Supp. 3d 978, 1025–62 (S.D. Ohio 2019), *vacated and remanded*, Chabot v. Ohio A. Philip Randolph Inst., 140 S. Ct. 102 (2019).

33. *See* League of Women Voters of Pa. v. Commonwealth, 178 A.3d 737, 770–81 (Pa. 2018); Common Cause v. Lewis, No. 18-CVS-014001, 2019 WL 4569584 (N.C. Super. Ct. Sept. 3, 2019). In fact, modern redistricting algorithms' first appearance in litigation was in Florida state court before this recent wave of partisan gerrymandering litigation. *See* League of Women Voters of Fla. v. Detzner, 172 So. 3d 363, 407–08 (Fla. 2015).

would emerge from a non-partisan" map-drawing process would look like.[34] Accounting for—and putting aside—any partisan effect of neutral redistricting criteria is critical because only intentional partisan gerrymandering is culpable. For example, the Pennsylvania Supreme Court's decision striking down the state's congressional district plan as a partisan gerrymander recognized that because of the Commonwealth's political geography, even a neutral, evenhanded congressional redistricting process would deliver a "small natural geographic advantage" to Republicans.[35] Simulated maps permitted the court to distinguish between natural and unnatural political advantage:[36] natural political advantage resulted from the Commonwealth's innate political geography, whereas unnatural and impermissible political advantage resulted from intentional entrenchment of one party's advantage through gerrymandering. Comparing them against the challenged map allows courts to isolate any partisan advantage of the unnatural—and illegal—variety.[37]

Second, courts derived the likelihood that the challenged map was or was not a partisan gerrymander by comparing the challenged map against the simulated ones. The distance between the partisan makeup of the simulated maps and the challenged map gave courts a measure of how confident they should be that the challenged map was drawn to advantage one party over another. This confidence was formalized through assessing how much of a "statistical outlier" the challenged map was relative to the simulated baseline maps.[38] Indeed, many of the challenged maps were such outliers that their partisan profile could not be

34. *Ohio A. Philip Randolph Inst.*, 373 F. Supp. 3d at 1032 (quotations omitted).

35. *League of Women Voters of Pa.*, 178 A.3d at 774.

36. It is worth noting additionally that redistricting algorithms were not only able to provide valid baseline maps for evaluating map-wide characteristics, but that they could provide individual analysis as well. In some of the litigation, the simulated maps also helped provide a baseline for understanding the typical district individual plaintiffs would live in if the district lines were politically neutral. These analyses helped courts determine whether each individual plaintiff lived in a cracked or packed district, and if so, how badly cracked and packed their districts were. *See, e.g.*, *Ohio A. Philip Randolph Inst.*, 373 F. Supp. 3d at 1063–70; *League of Women Voters of Mich.*, 373 F. Supp. 3d at 903–04.

37. *See* League of Women Voters of Pa. v. Commonwealth, 178 A.3d 737, 774 (Pa. 2018); *see also id.* at 776–77 (crediting testimony of Dr. Wesley Pegden in determining whether the partisan bias in the challenged plan "could be explained by the interaction of political geography and traditional districting criteria in Pennsylvania"); Ohio A. Philip Randolph Inst. v. Householder, 373 F. Supp. 3d 978, 1032 (S.D. Ohio 2019) (noting that simulated maps permitted the court to evaluate whether skewed political outcomes could be explained by "neutral factors, primarily political geography"), *vacated and remanded*, Chabot v. Ohio A. Philip Randolph Inst., 140 S. Ct. 102 (2019); Common Cause v. Rucho, 318 F. Supp. 3d 777, 897 (M.D.N.C. 2018) (noting that simulated analyses that accounted for the state's political geography found that "natural packing" of Democrats did not explain "partisan effects"), *vacated and remanded*, 138 S. Ct. 1916 (2018); League of Women Voters of Mich. v. Benson, 373 F. Supp. 3d 867, 898–91 (E.D. Mich. 2019) (noting that simulated districts account for "district geography"), *vacated*, 140 S. Ct. 429 (2019).

38. *Common Cause*, 318 F. Supp.3d at 876; *see also League of Women Voters of Mich.*, 373 F. Supp. 3d at 897–98, 903–04 (comparing maps to look for "partisan outliers"); *Ohio A. Philip Randolph Inst.*, 373 F. Supp. 3d at 1030 (noting that one of the expert witnesses determined the legislature-drawn map was an outlier).

observed in any of the simulated maps.[39] Visual presentations of how dramatically the challenged maps favored one party played an important role at trial. And the analysis based on simulated maps featured prominently in almost all the opinions,[40] which courts described as providing "strong"[41] and "compelling"[42] evidence of partisan gerrymandering.

C. Where to Next?

The intellectual and inferential firepower of the simulated map evidence notwithstanding, the Supreme Court decided in *Rucho v. Common Cause*[43] that partisan gerrymandering claims had no place in federal courts after all. This rendered futile the immense amount of human labor and ingenuity that went into all of the analysis described in the previous section. But Justice Kagan's reference to the "extreme outlier approach" offered by simulated maps in her *tour de force* dissent[44] offered some consolation—and invites consideration of the other ways in which this powerful tool might serve redistricting reform.

Of course, redistricting algorithms will likely continue to play a starring role in state courts that hear partisan gerrymandering claims. As algorithms continue to improve and standards of assurance for the quality of these algorithms tighten, there is no doubt that simulated maps will become standard evidence for proving state partisan gerrymandering claims.[45] But such claims are available in only a small handful of states,[46] with little prospect of becoming available in others. And thus, redistricting algorithms' days in court are also going to be limited.[47]

While federal courts did not turn out to be the right home for redistricting algorithms, they were useful laboratories for the algorithms to test out how their analyses would be received, by some very well-educated consumers no less. The persuasive authority that the algorithms commanded before federal judges is suggestive that the broader public will also find simulated district analysis

39. *See, e.g.*, Common Cause v. Lewis, No. 18-CVS-014001, 2019 WL 4569584, at *38–39 (N.C. Super. Ct. Sept. 3, 2019) (using Chen's simulated maps to show that result cannot be explained other than by partisan drawing).

40. Even a cursory glance at the opinions cited *supra* at notes 30–39 shows how carefully courts considered the simulated maps in their decisions.

41. *Common Cause*, 318 F. Supp. 3d at 874.

42. *Id.* at 876.

43. 139 S. Ct. 2484 (2019).

44. *Id.* at 2518 (Kagan, J., dissenting).

45. North Carolina, Pennsylvania, and Florida state courts have accepted and heard partisan gerrymandering claims supported by evidence of simulated map analyses. *See supra* note 33.

46. Apart from the states mentioned *supra* note 33, there is no indication thus far that there are others prepared to recognize partisan gerrymandering claims under state constitutional protections for the right to vote.

47. Of course, redistricting algorithms will always have a place in the academic social science literature. Novel questions continue to be answered with the help of redistricting algorithms. *See, e.g.*, Jowei Chen & Nicholas O. Stephanopoulos, *The Race-Blind Future of Voting Rights*, 130 YALE L.J. 862 (2021).

interesting and useful. And while the technology was new and unfamiliar to judges, they nevertheless understood the technology's contribution and capabilities. Federal judges quickly grasped the importance of having the right baseline in evaluating redistricting outcomes, and the potential of simulated maps to supply that baseline.[48]

The clear contribution and intuitive appeal of using redistricting algorithms to evaluate redistricting outcomes can and should find other applications. I, like others,[49] see independent redistricting commissions, the most credible of contemporary redistricting reform institutions, as the most promising institutional home for what redistricting algorithms can offer.

II.
INDEPENDENT REDISTRICTING COMMISSIONS

Understanding why and how independent redistricting commissions would benefit from the evaluative function performed by redistricting algorithms requires an appreciation of the commissions' institutional contribution and their vulnerabilities. This Section starts by describing how independent redistricting commissions solve an important conflict of interest inherent in legislative redistricting. It then introduces the crisis of confidence that commissions are suffering from in early-adoption states, namely California and Arizona, because the public doubts the true independence of citizen commissioners. Finally, it addresses why objective methods of evaluation supplied by redistricting algorithms would support commissions' work and boost their legitimacy.

A. Independence as Strength

Independent redistricting commissions—where ordinary citizens instead of politicians draw redistricting plans—have become the premier institutional solution to the problem of partisan gerrymandering. While there is a variety of redistricting commission models, commissions consisting of ordinary citizens who are not professional politicians like those in California and Arizona have emerged as the perceived gold standard for true and lasting reform.[50] They are at the forefront of an ever-escalating reform strategy of purging politics from redistricting: injecting greater degrees of separation between line-drawers and partisan politics.

Prying the power to redistrict or influence the redistricting process out of the hands of legislators is no small feat. Many redistricting commissions, independent citizen commissions or otherwise, were created via ballot initiative,

48. *See generally supra* notes 30–39.

49. This point was first made by Wendy Tam Cho, creator of the most sophisticated and rigorously vetted redistricting algorithms, and Bruce Cain, veteran map-drawer and special master in redistricting cases. Wendy K. Tam Cho & Bruce E. Cain, *Human-Centered Redistricting Automation in the Age of AI*, 369 SCI. 1179 (2020).

50. *See* Cain, *supra* note 3, at 1817–20.

demonstrating both the difficulty of redistricting reform and the immense public desire for it.[51] As there are few special and wealthy interests behind redistricting reform, the creation of commissions has largely been a grassroots effort supported by good government reform nonprofits.[52]

Michigan's 2018 adoption of an independent redistricting commission via ballot initiative is emblematic of these dynamics. The state's gerrymanders were some of the most egregious from the 2010 redistricting cycle, and they were the subjects of litigation in the small handful of partisan gerrymandering cases in federal court leading up to *Whitford* and *Rucho*.[53] Public outrage over the partisan gerrymanders translated into a citizen-led effort to adopt an independent redistricting commission.[54] As the name of the citizen-led group—Voters not Politicians[55]—makes clear, the selling point of the ballot initiative was that ordinary voters, not seasoned politicians, would be at the helm of the redistricting process. From the get-go, the initiative was popular. The petition to put the

51. *See* Fahey, *supra* note 14 for details on the passage of the Michigan independent redistricting commission in 2018. That same year, Colorado, Utah, and Ohio all passed ballot initiatives to create or empower redistricting commissions (although only Colorado's was a citizen redistricting commission). COLO. INDEP. REDISTRICTING COMM'NS, https://redistricting.colorado.gov/ [https://perma.cc/HXG5-LYL9] (noting that the two ballot initiatives to create the commissions were passed with over 70 percent of the vote); *Utah Proposition 4, Independent Advisory Commission on Redistricting Initiative (2018)*, BALLOTPEDIA, https://ballotpedia.org/Utah_Proposition_4,_Independent_Advisory_Commission_on_Redistricting_Initiative_(2018) [https://perma.cc/25ZY-E88U] (establishing an appointed redistricting commission); *Ohio Issue 1, Congressional Redistricting Procedures Amendment (May 2018)*, BALLOTPEDIA, https://ballotpedia.org/Ohio_Issue_1,_Congressional_Redistricting_Procedures_Amendment_(May_2018) [https://perma.cc/GST5-Q6X5] (empowering an existing commission, also adopted through a ballot initiative, vis-à-vis the legislature). The independent redistricting commissions in California and Arizona were implemented pursuant to ballot initiatives. *See Laws and Regulations*, CAL. CITIZENS REDISTRICTING COMM'N, https://wedrawthelines.ca.gov/regulation_archive/ [https://perma.cc/AMM5-S7PM]; *About IRC*, ARIZ. INDEP. REDISTRICTING COMM'N, https://azredistricting.org/About-IRC/default.asp [https://perma.cc/4S6F-ACUU].

52. *See e.g.*, Fahey, *supra* note 14 (describing citizen movement behind the Michigan independent redistricting commission ballot initiative); John Wildermuth, *Prop. 11 Calls for Redistricting Overhaul*, SFGATE (Sept. 29, 2008), https://www.sfgate.com/bayarea/article/Prop-11-calls-for-redistricting-overhaul-3192722.php [https://perma.cc/YX35-BZEF] (noting that the groups backing the creation of the California Redistricting Commission are nonpartisan groups).

53. League of Women Voters of Mich. v. Benson, 373 F. Supp. 3d 867, 901–04 (E.D. Mich. 2019) (citing Dr. Chris Warshaw's expert analysis showing that metrics of partisan gerrymandering for Michigan plans were outliers), *vacated*, 140 S. Ct. 429 (2019).

54. *See* Fahey, *supra* note 14 and accompanying text; *see also* Sam Levine, *Republicans Tried to Rig the Vote in Michigan—But 'Political Novices' Just Defeated Them*, GUARDIAN (Nov. 27, 2019), https://www.theguardian.com/us-news/2019/nov/27/gerrymandering-michigan-citizens-voters-not-politicians [https://perma.cc/EGU9-49BY].

55. VOTERS NOT POLITICIANS, https://votersnotpoliticians.com/ [https://perma.cc/5XZL-DK8J].

initiative on the ballot received almost a third more signatures than necessary.[56] And the initiative eventually passed with 61 percent of the vote in 2018.[57]

The popularity of independent redistricting commissions derives from a growing consensus that legislative control of the redistricting process is or has become fundamentally problematic and undemocratic. The common and evocative description of that process is one in which politicians choose their voters, not the other way around. Enthusiasm for citizen redistricting reflects voters' cynicism that politicians will ever be able to control the redistricting process without manipulating it to their party's advantage. In an era of hyper-political polarization,[58] voters simply do not and cannot trust politicians to control something as consequential as redistricting without abusing that power to advantage their own party's political fortunes.

B. Independence as Weakness

Independence from politics is thus crucial to the appeal—and legitimacy—of independent redistricting commissions. As Bruce Cain has explained, independence in this context encompasses two key elements: independence of personnel and independence of process.[59] Having citizens draw district lines removes the conflict of interest that occurs when politicians draw their own districts.[60] And replacing politicians with citizens also helps keep party interests from permeating the redistricting process. Allowing citizen commissions to draw maps without needing to seek approval from legislators or elected politicians ensures that citizens do not face formal pressure to draw maps with a particular party valence.

Much of the popular appeal of independent redistricting commissions derives from independence of personnel; independence of process tends to take a backseat. However, independence of process is perhaps equally important, as the early experience with independent redistricting commission in Arizona and California teaches.[61] Procedural safeguards of independence—for instance, those preventing political bias from simply being displaced from commissioners to technical staff or those ensuring proper funding for and financial independence of commissions[62]—are vital to protecting citizen commissioners from partisan influence.

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56. Annie Lo, *Citizen and Legislative Efforts to Reform Redistricting in 2018*, BRENNAN CTR. FOR JUST. (Nov. 7, 2018), https://www.brennancenter.org/our-work/analysis-opinion/citizen-and-legislative-efforts-reform-redistricting-2018 [https://perma.cc/CS4B-F6B6].

57. *Id.*; *2018 Michigan Election Results*, OFF. MICH. SEC'Y OF ST. (Nov. 26, 2018), https://mielections.us/election/results/2018GEN_CENR.html [https://perma.cc/L3XY-DPJ8].

58. For background on partisan polarization and its effect on voting rights and election law, see Bruce E. Cain & Emily R. Zhang, *Blurred Lines: Conjoined Polarization and Voting Rights*, 77 OHIO ST. L.J. 867 (2016).

59. *See* Cain, *supra* note 3, at 1817–19.

60. *Id.* at 1818–19.

61. *Id.* at 1834–37.

62. *See id.*

Moreover, the reform movement's singular focus on *who* draws the lines has put pressure on the legitimacy and efficacy of independent redistricting commissions. Like any good political narrative, the story of how fair maps will finally be drawn depends on identifying villains (partisan politicians) and elevating saviors (well-informed, pure-intentioned, and non-partisan citizens). The tale of redistricting reform is cast in the time-honored plot in which the pure of heart, be it "a farmer, a homemaker, a sports doctor[, or] an architect,"[63] saves us all. To be sure, political narratives are not meant to be taken literally, and they often play an important role in making the stakes and necessity of reform accessible to the public. But in the case of independent redistricting commissions, idealizing the independence of citizens has proved counterproductive.

Citizen commissioners, however well intentioned, likely have at least some preconceived notions about redistricting. This is because expertise and agenda often come bundled together. As has long been identified in the bureaucratic politics literature, individuals who invest in policy expertise also tend to have views about policy choices.[64] Citizens who become informed and care about fair districts are unlikely to be non-partisan; many come to care about unfair maps because their party was a victim of unfair maps. Conversely, the truly disinterested are unlikely to have subject matter expertise. As most methods of selecting citizen commissioners require that individuals volunteer themselves for the position, it is natural that those who seek the office are at least politically aware if not politically active.[65]

None of this implies that citizen commissioners would not and do not serve in an evenhanded and non-partisan way. It is simply that the citizen redistricting commission model is vulnerable to attacks on the authenticity of citizen commissioners' political independence. Controversies surrounding the Arizona Independent Redistricting Commission provide a case in point. Like other citizen commissions, the Arizona commission is comprised of citizens who are registered partisans and those who are unaffiliated[66] in order to maintain ideological diversity on the commission. In operation, this arrangement makes the neutrality of the unaffiliated commissioner(s) the central determinant of the commission's independence, notwithstanding how large the commission itself

63. These are among some of the citizen commissioners on California's independent redistricting commission. Olga Pierce & Jeff Larson, *How Democrats Fooled California's Redistricting Commission*, PROPUBLICA (Dec. 21, 2011), https://www.propublica.org/article/how-democrats-fooled-californias-redistricting-commission [https://perma.cc/5HTH-LT79].

64. *See, e.g.*, Sean Gailmard & John W. Patty, *Slackers and Zealots: Civil Service, Policy Discretion, and Bureaucratic Expertise*, 51 AM. J. POL. SCI. 873 (2007). This is the seminal work in this area.

65. See, for example, Cain, *supra* note 3, at 1824–27 for California's citizen commissioner application process.

66. ARIZ. CONST. art. IV, pt. II, § 1(3).

might be. Independents are the swing voters or tie-breakers on the commission and hence the decision-makers.

The harrowing experience of Colleen Mathis, the lone independent serving alongside two Democrats and two Republicans on Arizona's Independent Redistricting Commission in the last redistricting cycle demonstrates just how quickly and easily unaffiliated commissioners can become the lightning rods of public suspicion of bias—and ire.[67] Rumors of Mathis's partisan bias surfaced almost immediately, whether because she hired a left-leaning mapping consultant, or because her husband previously worked for a moderate Democrat (on fundraising and outreach to Republicans).[68] In the course of her work on the commission, she faced a level of vitriol that is unusual even for seasoned politicians, let alone an ordinary citizen, to encounter.[69] The governor even tried unsuccessfully to remove her from the commission.[70]

While political smears and partisan gamesmanship were responsible for much of Mathis's experience, Arizona's commission still performed as it was designed to. Indeed, the maps the commission drew have repeatedly been held up as some of the fairest in the country and the commission has been hailed as a bright star in the redistricting reform movement.[71] Despite her experience, Mathis herself has not lost faith in the work that independent redistricting commissions do. In fact, the experience only seems to have made her a more vocal proponent of independent redistricting commissions.[72]

Mathis's experience shows that in an era of hyper-political polarization, neutrality is no longer implied by non-partisanship (i.e., the lack of bias towards one party over another), and is instead synonymous with being apolitical (i.e., the lack of political affiliations). Public support for existing commissions—and those still to come—rests on the public's fragile faith that citizen commissioners

67. Dillon Rosenblatt, *IRC Chair – The State's Most Important Political Figure*, ARIZ. CAPITOL TIMES (Aug. 28, 2020), https://azcapitoltimes.com/news/2020/08/28/irc-chair-the-states-most-important-political-figure/ [https://perma.cc/66Q5-J4QK].

68. Matt Vasilogambros, *The Tumultuous Life of an Independent Redistricting Commissioner*, STATELINE (Nov. 26, 2019), https://www.pewtrusts.org/en/research-and-analysis/blogs/stateline/2019/11/26/the-tumultuous-life-of-an-independent-redistricting-commissioner [https://perma.cc/BH3J-HXN5].

69. *See id.*

70. *See id.*

71. *See, e.g.*, Yurij Rudensky, *Arizona's Redistricting System is a Huge Success. Some Legislators Want to Gut It.*, BRENNAN CTR. FOR JUST. (May 4, 2018), https://www.brennancenter.org/our-work/analysis-opinion/arizonas-redistricting-system-huge-success-some-legislators-want-gut-it [https://perma.cc/GXZ4-Y8DC]; Sam Gringlas, *Success of Independent Redistricting Boards a Work in Progress*, NBC NEWS (Jul. 28, 2015), https://www.nbcnews.com/politics/politics-news/independent-redistricting-boards-are-constitutional-how-effective-are-they-n399311 [https://perma.cc/5MXQ-JLN9].

72. *See* COLLEEN MATHIS, DANIEL MOSKOWITZ & BENJAMIN SCHNEER, THE ARIZONA INDEPENDENT REDISTRICTING COMMISSION: ONE STATE'S MODEL FOR GERRYMANDERING REFORM, HARV. KENNEDY SCHOOL ASH CTR. FOR DEMOCRATIC GOVERNANCE & INNOVATION (2019), https://ash.harvard.edu/files/ash/files/az_redistricting_policy_brief.pdf [https://perma.cc/X7WU-VCCZ].

are politically pure of heart. Yet the existing strategy of escalating political purity tests and rigorous vetting will not produce lasting solutions.[73] Consider, for instance, the lengths that California goes to in order to "squeeze every ounce of incumbent and legislative influence out of redistricting."[74] Commissioners and their family members cannot have contributed over $2,500 to political candidates; cannot have ever sought or attained congressional or state office; cannot have worked for a congressional or state campaign; and cannot have worked as a lobbyist or political consultant.[75] Additionally, applicants must submit a lengthy application that attempts to smoke out partisan sympathies (by examining the applicant's "professional, social, political, volunteer, and community activities") and elicit information on relevant expertise and background (e.g., the applicant's appreciation for California's diverse demographics and geography).[76]

The California requirements are a reminder of the bundling problem of expertise and agenda described above. The supplemental application questions try to thread the thin line between purging political influences and ensuring the competence of selected commissioners. What is paradoxical about these application questions is that the more questions there are, the more the process selects for individuals who are motivated, for whatever reason, to serve as commissioners (and hence willing to plow through a lengthy written application).

Requirements like California's are at once intrusive and futile.[77] The intrusion extends not only to the First Amendment-protected activity of the commissioners themselves, but also to those of commissioners' family members. Though the requirements will no doubt sift out some individuals with strong partisan interests, and perhaps even select for politically insulated individuals most of the time, it would only take one scandal of an undisclosed relative or

73. For an early warning against taking this strategy, see Cain, *supra* note 3, at 1812.

74. Cain, *supra* note 3, at 1824.

75. *Am I Eligible to Apply?*, SHAPE CAL.'S FUTURE, https://shapecaliforniasfuture.auditor.ca.gov/example-applications/info_graphic.html [https://perma.cc/MS46-9ZNP]; *see also* Pierce & Larson, *supra* note 63 (highlighting an additional important flaw of independent redistricting commissions: partisan interests can masquerade as public input and still wield significant influence in the map-drawing process).

76. For a sample of the application, see *Supplemental Application for Citizens Redistricting Commission*, CAL. CITIZENS REDISTRICTING COMM'N, https://wedrawthelines.ca.gov/supplemental-application-example/ [https://perma.cc/M8XV-3Z5G].

77. The newly established independent redistricting commission in Michigan takes an entirely different tack by selecting commissioners through random selection. *See Frequently Asked Questions*, OFF. MICH. SEC'Y OF ST.: INDEP. CITIZENS REDISTRICTING COMM'N, https://www.michigan.gov/sos/0,4670,7-127-1633_91141-488602--,00.html [https://perma.cc/9QZZ-R7QU] ("Q: How does the random selection process work? What role does the Legislature play?;" "Q: Is the selection process truly random?"). But choosing to randomly select commissioners as opposed to heavily vet them does not sidestep the legitimacy vulnerability posed by unaffiliated—and supposedly neutral—commissioners. A Colleen Mathis who was randomly (rather than intentionally) selected would have produced the same scandal as in Arizona.

involvement in a college social group, for example, to taint the independence of the commission. In an era of political polarization, professional, social, volunteer, and community organizations have increasingly taken on political stances, if they were not already historically aligned with one party. The question is not whether a purportedly independent commissioner will come to be suspected of being a wolf masquerading in sheep's clothing; the only question will be whether the apparent sheep is actually an elephant or a donkey. Without knowing what is in the heads of commissioners, a skeptical public will find reason to doubt the authenticity of their professed independence. Those reasons do not need to be justifiable to test the public's fragile faith in independent redistricting commissions.

C. Evaluate Independence of Outcome

Ensuring that the public has confidence in the independence of independent redistricting commissions is crucial to the success of redistricting reform. This is where redistricting algorithms could come in. They can help commissions and the public directly evaluate the commissions' work product. Having a scientifically rigorous method of evaluating the maps that commissions draw takes away some of the need to scrutinize who commissioners are and who they associate with, and instead focuses the public's attention on the substance of commissions' work. The inquiry of whether commissioners are truly independent can rightly take second place to that of whether the maps drawn by the commission are fair.

To see why an external method[78] of evaluating the work of commissions would be meaningful, we must first understand what drives the obsessive search for authentic independence of commissioners. Without methods of ensuring that commissioners in fact draw fairer maps, the only way to ensure fair outcomes is to select citizen commissioners who are as insulated as possible from the political process. The obsession with purging political influences from the redistricting process reflects capability more than preference: tightening up who is selected as a commissioner is one of the few things that can be done to ensure that fair maps are drawn.

Thus, the problem is not that independent redistricting commissions do not adequately evaluate commissioner candidates. They do. And as demonstrated by

78. By external, I do not mean to suggest that commissions' maps necessarily need to be evaluated in a formal process external to the structure of independent commissions. Indeed, the evaluation function can be performed under many possible institutional arrangements that vary from internal use to an external watchdog function. Usually, reformers suggest that new redistricting technologies be used by citizens to impose public pressure on hidden or non-transparent redistricting processes. *See, e.g.*, MICHAEL P. MCDONALD & MICAH ALTMAN, THE PUBLIC MAPPING PROJECT: HOW PUBLIC PARTICIPATION CAN REVOLUTIONIZE REDISTRICTING (2018). But since independent redistricting commissions are more transparent by design, methods of harnessing algorithms for use internal to commissions should perhaps be privileged. Part III provides additional reasons why internal use of algorithms by commissions is a good idea.

the example above of California's vetting process, they evaluate extensively and intrusively. But the commissioner selection process is more a reflection of the aspirations of those who designed it than a guarantee that the selected cohort will possess the desired characteristics. And safeguarding the integrity of commissions' work by evaluating the independence of those drawing maps is ultimately an indirect way of ensuring that the maps drawn are fair.

The key point is not that redistricting algorithms obviate the need for selection criteria of commissioners, but rather that they can change the source of commissions' legitimacy. With redistricting algorithms, the locus of commissions' legitimacy shifts from who the commissioners are to what they produce. Redistricting algorithms can provide a way of directly evaluating whether the output from commissions is actually fair. The ability to evaluate commissions using algorithms makes them more immune to the very real danger that, despite the toughest vetting criteria, a commissioner's undisclosed, seemingly innocuous, or long-forgotten background, participation, or acquaintance will rightly or wrongly corrode the perceived integrity of the commission and its work.

Admittedly, the algorithms would not eliminate all controversy over the fairness of independent redistricting commissions, but they might help channel controversy in a more productive direction. Instead of being forced to explain away personal history or interpersonal ties, commissioners can and should defend their line-drawing choices and provide justifications for their substantive decisions.

The partisan gerrymandering cases—conceptually, at least—offered a fully fleshed out blueprint for how algorithms can be used to evaluate redistricting plans.[79] But simply replicating the role that redistricting algorithms played in litigation would sell the algorithms and the independent redistricting commissions short. The evaluative role that the algorithms played was of a specific nature: post-hoc determination of how badly a map had been gerrymandered for partisan gain. The key question answered by algorithms was: just how unfair is the challenged map?

Since commissions are less likely than party operatives to draw extreme gerrymanders, algorithms will not so much help with measuring the degree of extremity as situating where the normal distribution is. And since commissions are not, like courts, only in a position to strike maps down post-hoc, algorithms can play their evaluative function before and during the line-drawing process as well. Finally, since the point of applying algorithms to the work of commissions is not, like that of courts, to have maps struck down, the evaluative function should also be conceived of broadly, not simply to judge but also to understand.

79. *See* Part I.B.

Using redistricting algorithms to produce a distribution of redistricting outcomes that satisfy commissions' specific redistricting criteria[80] can serve an important educational goal even before maps are drawn. How a state's political geography influences any particular redistricting task is highly contextual.[81] And even if citizen commissioners are well versed in the communities of interest they reside in or are proximate to, they are unlikely to have full knowledge of the entire state's political geography, especially how it implicates redistricting outcomes.

Generating simulated maps early in the process can also help set the right public expectations about the maps that are likely to come out of commissions. Because single-member districts complicate the translation of votes into seats, voters may have unrealistic expectations of the partisan balance of their eventual districts. Simulated maps can reset expectations by informing voters and commissioners of the actual baseline against which any redistricting plan should be measured. Baseline measures can also be produced for neutral redistricting criteria like compactness. A state with a ragged coastline, or oddly shaped cities or counties, might produce non-compact district maps even when the map-drawing process does not take politics into account.

Providing information about the districting baseline can also put political parties, interest groups, and politicians on notice. Informing stakeholders and the public of where the normal distribution lies early in the redistricting process could deter partisans from lobbying for extreme outcomes in both overt and surreptitious ways. Simulated maps can therefore help frame reasonable demands, or at least provide a rebuttal against unreasonable demands.

While independent redistricting commissions keep parties away from drawing the maps themselves, commissions do not and cannot wholly exclude parties from exerting influence on the process. Indeed, as the experience with the California Redistricting Commission demonstrates, the parties will try hard to influence the process in one way or another. The enormous political stakes of where lines are drawn make the redistricting process simply too irresistible for the parties not to. In California, organized partisan interests used public comments and citizen input as a Trojan horse to sneak in suggestions phrased in neutral redistricting criteria but that had a clear political valence.[82] Similar incidents were detected in Florida in the 2000 redistricting cycle: plans

80. Independent redistricting commissions tend to follow state-specific mandates about what kinds of redistricting criteria to include and privilege in their map-drawing process. Thus, simulated maps to aid each commission should also be tailored to the specific mandates of the commission involved.

81. *See* Eubank & Rodden, *supra* note 12, at 92 fig.4 (showing that spatial inefficiency differs for different levels of districting even within the same state).

82. Pierce & Larson, *supra* note 63.

purportedly drawn and submitted by ordinary, concerned citizens were in fact careful gerrymanders handcrafted by seasoned partisan gurus.[83]

Guarding against surreptitious partisan manipulation will require much more than introducing redistricting algorithms into commissions' work. But anchoring baselines and expectations early on in the redistricting process for commissioners, the public, and political interests can not only help deter extreme attempts to produce outcomes far away from the norm, but also put the burden of persuasion on those seeking to deviate from it.

To be sure, deviations from the distribution of baselines should be expected. The use of redistricting algorithms is not meant to lock commissions into a particular set of outcomes, but rather to inform commissioners and the public about what the norm is and to encourage debates and discussions about whether deviation is justified in any particular instance.

Moreover, the relevant baseline could and should change during the learning, deliberation, and bargaining process. An initial set of simulations might be drawn based on a bare-bones set of criteria set out by law. Public comment, new information, and legal analysis might impose additional conditions on the redistricting process. For instance, analysis of racially polarized voting might inform how districts ought to be drawn in compliance with Section 2 of the Voting Rights Acts.[84] Prior baseline maps drawn on outdated redistricting criteria would no longer be the right baseline. Thus, even though partisan gerrymandering litigation demanded only one set of maps generated from a static set of constraints, commissions may require many sets developed over time and with different constraints.

Shifting redistricting algorithms from one-time adjudicative use in courtrooms to iterative, customizable use by commissions will require careful attention to the institutional needs of commissions. Given the diversity of approaches taken by independent redistricting commissions towards redistricting criteria and map-drawing procedures, it is important that algorithms are tailored for the specific commission and state they are in service of. To truly move redistricting reform beyond second-best outcomes, we need to consider how redistricting algorithms can amplify the institutional strength of independent redistricting commissions.

III.
INSTITUTIONALIZING ALGORITHMS

The evaluative function of redistricting algorithms as applied in the partisan gerrymandering litigation (and in the social science literature) only begins to scratch the surface of how these algorithms might contribute to fairer

83. Planet Money, *Ungerrymandering Florida*, NPR (June 8, 2018), https://www.npr.org/transcripts/618415954 [https://perma.cc/63VC-Q86E].

84. 52 U.S.C. § 10301. States must comply with the provision in redistricting. *See, e.g.*, League of United Latin Am. Citizens v. Perry, 548 U.S. 399, 427–43 (2006).

redistricting outcomes. While adapting that evaluative function for commissions will go a long way towards helping protect their legitimacy and preserving public faith in what they offer, we still have a long way to go towards drawing consistently fair maps in a way that commands public confidence. In order to push the reform frontier, we need to think even more creatively about how technological advances in redistricting technologies might serve reform institutions like independent redistricting commissions. The reform agenda depends on harnessing both technological advancements and institutional innovations—and their synergistic contributions as well.

Redistricting technologies as they exist today will quickly become outdated. Indeed, even the sampling technology at the core of modern redistricting algorithms is still in its relative infancy. While there has been a profusion of algorithms that claim to sample randomly, evaluation of the algorithms, with only a few exceptions,[85] is still largely non-existent. Crucially, in order to credibly evaluate redistricting outcomes, the algorithms must draw not just any sample from the universe of maps that satisfy the stated criteria, but a representative one at that. Much work still lies ahead in ensuring that the algorithms perform as claimed and that the baseline maps are indeed a representative sample.[86] Reliance on such technologies to address credibility gaps in institutions will surely backfire if the technology itself is flawed.[87]

Not only will redistricting algorithms get better at performing the tasks they already do, but they will also perform new tasks that could better serve independent redistricting commissions. In this Section, I first sketch out some broad ways in which redistricting algorithms might contribute to the work of

85. *See, e.g.*, Wendy K. Tam Cho & Simon Rubinstein-Salzedo, *Understanding Significance Tests From a Non-Mixing Markov Chain for Partisan Gerrymandering Claims*, 6 STAT. & PUB. POL'Y 44 (2019); Wendy K. Tam Cho & Yan Y. Liu, *Sampling From Complicated and Unknown Distributions: Monte Carlo and Markov Chain Monte Carlo Methods for Redistricting*, 506 PHYSICA A 170 (2018); Benjamin Fifield, Kosuke Imai, Jun Kawahara & Christopher T. Kenny, *The Essential Role of Empirical Validation in Legislative Redistricting Simulatio*n, 7 STAT. & PUB. POL'Y 52 (2020).

86. The partisan gerrymandering litigation discussed in Part I hinted at quality control issues of redistricting algorithms. To my knowledge, in all but one case, plaintiffs' evidence of simulated maps from redistricting algorithms was not met with rebuttal evidence of the same. *See* League of Women Voters v. Commonwealth, 178 A.3d 737, 779–81 (Pa. 2018). The vital aspect for quality control is whether the algorithms produce a representative sample of the maps satisfying the stated criteria. If the sample of maps the algorithm produces is not representative of the universe of possible maps, then it is not a valid baseline against which to compare the challenged map. The representative issue embeds two sub-inquiries: 1) whether the representativeness of the sample is mathematically and theoretically grounded; and 2) whether the algorithm has been computed in accordance with its theoretical basis. As to the first sub-inquiry, Markov Chain Monte Carlo has emerged as the dominant method of drawing representative samples of redistricting maps. Much less work has been done on the second sub-inquiry: whether proposed redistricting algorithms are in fact able to computationally accomplish such representative samples as provided for by such theorems remains to be seen. The evaluations that have been conducted do not inspire confidence in the algorithms across the board. *See generally supra* note 85.

87. Tam Cho and Cain warn against the danger of junk science in this field as well. *See* Cho & Cain*, supra* note 49, at 1180. Open and honest academic debate about the relative strengths of various methodologies is necessary to identifying defects in algorithms—and to improving them.

commissions, based on known or nascent areas of technological development. As the needs of commissions evolve, and the dialogue between technical and institutional innovators grows, the contribution that algorithms make will surely expand. Second, I note that in order to maximize the contributions of redistricting algorithms, further work must be done on the institutional end to devise structures, procedures, and mechanisms for independent redistricting commissions to harness the many functions that the algorithms perform. Whether to produce standards or rules, or to produce guidelines, benchmarks, or goals, redistricting algorithms have a role to play.

A. New Functions

Existing redistricting algorithms can perform three functions for independent redistricting commissions: teaching, optimizing, and identifying necessary trade-offs.

1. Teaching

Redistricting algorithms can serve as a powerful teaching aid for commissioners in the redistricting process. To arrive at a final redistricting plan, citizen commissioners must make, within broad constraints, a large number of policy judgments and even more micro-decisions about how those judgments should be carried out concretely when drawing district lines. Because they often lack experience with redistricting, citizen commissioners can find the process daunting. Redistricting algorithms can help organize the decision-making process, answer questions posed during redistricting, and teach commissioners about the strength of the constraints they operate under.

First, redistricting algorithms can help guide commissioners through a set of discrete decisions, and organize the massive decision space that commissioners face. Algorithms can allow commissioners to break the line-drawing process down into a set of discrete and manageable decisions, and only introduce complexity when necessary.

Consider how redistricting algorithms might help with the beginning of the map-drawing process. How does one start to draw a redistricting plan? Redistricting algorithms can turn an empty page into a multiple choice question. They can not only generate large numbers of simulated plans, but also organize simulated plans into categories and highlight commonalities. Algorithms can help commissioners understand that the map they are supposed to draw is, at a high level, a choice between broad categories of maps. Commissioners can organize these categories according to what the commission's mandate is. The categories could be geographically defined (e.g., certain regions either have to be split or go together), or outcome defined (e.g., drawing very compact districts will produce particular outcomes). Commissioners can discuss the pros and cons of each category before delving into the specifics of where each jurisdiction or community should go.

Second, redistricting algorithms can be used to answer certain difficult questions that arise during the redistricting process. These questions might include the following: What would it mean to draw compact districts in the state? What kind of maps would we get if we kept as many jurisdictions together as possible? Is it possible to draw a district that complies with Section 2 of the Voting Rights Act and minimizes the fracturing of neighboring minority communities? The answers, even if entirely hypothetical, can nevertheless yield insights and sharpen the inquiry for commissioners.

Finally, redistricting algorithms can help commissioners understand the constraining force of any given redistricting criteria in context. Using algorithms, commissioners can experiment with different permissible choices of how strictly to follow neutral criteria, and observe how sensitive outcomes are to those choices. For instance, commissioners may want to reduce city and county splits to the maximum extent possible. But what is the cost of doing so? Indeed, maintaining some counties whole may entail splitting some cities. A redistricting algorithm would allow commissioners to learn whether the desire to minimize city and county splits constrains their choices with respect to other redistricting criteria. Experimentation will allow commissioners to differentiate between tight and loose constraints in specific parts of the state. This is important because map-drawing is an iterative process. Commissioners need to know what can and cannot be altered in the course of map-drawing. Understanding just how much redistricting criteria constrain the proposed outcomes allow commissioners to identify where changes are possible and what kind of changes could be implemented.

2. Drawing Better Maps

The goal of independent redistricting commissions is not to draw a typical map. It is to draw a good map. And thus far, the primary goal of redistricting algorithms is not to draw good maps (i.e., to optimize), but rather, to draw typical maps (i.e., to sample). This is not to say that redistricting optimization algorithms have not been on the scholarly agenda; they have.[88] But since the evaluative function of redistricting algorithms was what was needed for litigation and scholarship related to partisan gerrymandering, the sampling function of redistricting algorithms is what drew the greatest attention. To perform the sampling function, a set of redistricting criteria are inputted and a set of maps satisfying those criteria are generated. Typicality of the maps produced is what informs the baseline analysis.

But algorithms can also perform optimization functions to more directly help commissions find good maps. Redistricting presents a computationally demanding optimization problem along many dimensions. Given the number of criteria typically present and the spatial nature of how the criteria operate, it is

88. *See, e.g.*, Liu et al., *supra* note 20.

not easy for humans to find optimal redistricting outcomes on their own. After all, good maps exist alongside many more bad ones in the "unfathomably large and complex informational landscape."[89] Put simply, good maps are needles in a haystack of bad or at least worse maps.

Enter redistricting algorithms. They are capable of "meticulous exploration of the astronomical number of ways in which a state can be partitioned."[90] They can identify possible configurations of districts and zero in on the maps that best meet the redistricting criteria. The algorithms sort through the haystack more efficiently and more systematically so that the needle—the better maps—can be found.

The good maps in question are the elusive maps that are optimized according to the redistricting criteria. Redistricting involves balancing the satisfaction of various criteria, from the mandatory (contiguity[91]) to the discretionary (splitting some cities and counties but not others), and from the quantifiable (equipopulous districts) to the more ineffable (preserving communities of interest). Improvement according to one criterion can have downstream consequences for other criteria. Deciding to keep a county whole instead of splitting it across two districts changes at least the boundaries of all neighboring districts, and could come at the cost of other redistricting criteria, such as making the map as a whole less compact. Other alterations might preserve other redistricting criteria at their current levels—or even improve them.

Those maps that improve on some criteria without sacrificing others are the elusive Pareto-improved maps that algorithms can help identify. The name "Pareto-improved" is borrowed from economics:[92] a Pareto-efficient allocation of resources improves the lot of at least one person without making anyone else worse off. A Pareto-improved map is one that improves on at least one neutral redistricting criteria (e.g., equipopulation, compactness, preservation of cities and counties) without having to sacrifice on any other. Without the aid of computer models, Pareto-improved maps are very difficult to find in a systematic and reproducible way. A single decision can have downstream implications for the rest of the map that even seasoned line-drawers cannot always fully account for or predict.

89. Tam Cho & Cain, *supra* note 49, at 1179.

90. *Id.*

91. Contiguity is required for districting in many states but not for all districts and not in all states. *See Redistricting Criteria*, NAT'L CONF. OF ST. LEGISLATURES (Apr. 23, 2019), https://www.ncsl.org/research/redistricting/redistricting-criteria.aspx [https://perma.cc/5RZK-5FY2].

92. *Pareto efficiency*, OXFORD REFERENCE, https://www.oxfordreference.com/view/10.1093/oi/authority.20110803100306253 [https://perma.cc/5PQG-ZDTD].

None of this is to suggest that independent redistricting commissions should necessarily adopt the optimal plans that the algorithm finds.[93] And of course, what makes the plans optimal should be defined by human decision-makers. For instance, commissioners can figure out which counties should be kept whole, and let the algorithms figure out whether there are better maps that preserve the designated counties. Or a set of maps that improve upon the previous redistricting cycle's redistricting plan can be provided as a starting point for the current cycle's process. The point simply is that where desired, optimizing algorithms can be deployed to improve upon human decision-making.

3. Identifying Tradeoffs Early

Pareto-improved maps could be discovered with the help of optimization algorithms. But Pareto-optimal outcomes do not always exist. Rarely are redistricters able to please one group without disappointing another. And independent redistricting commissions are placed in the difficult position of making necessary trade-offs between competing interests. Sometimes they must make trade-offs between two identifiable groups of individuals (e.g., adjacent urban, suburban, and rural communities). Other times, they must weigh the interests of local communities against map-wide criteria like compactness or jurisdiction splits. In order to make these decisions well, commissions need to first identify the trade-offs, and then gather information, hear from affected citizens, and consider specific solutions that minimize injury to important interests.

It is difficult for commissions to make these decisions in the short amount of time afforded them. There is little time—usually only a matter of months—between when census data is released and when maps have to be completed either for use in elections or as prescribed by state statute.[94] The short timeline for redistricting is especially a problem for independent redistricting commissions, as compared to legislatures, because they genuinely seek public input on their decisions. Not only do commissions have to wade through public input, but they also need to incorporate that input into the map-drawing process and make difficult decisions about which interests to prioritize.

93. Even before the modern crop of sophisticated redistricting algorithms was introduced, Justin Levitt addressed the many reasons why having "the Magical Redistricting Machine" draw redistricting plans would not be a good idea. Justin Levitt, *Essay*: *Weighing the Potential of Citizen Redistricting*, 44 LOY. L.A. L. REV. 513, 522–26 (2011).

94. *See* YURIJ RUDENSKY, MICHAEL LI & ANNIE LO, BRENNAN CTR. FOR JUST., HOW CHANGES TO THE 2020 CENSUS TIMELINE WILL IMPACT REDISTRICTING 2 (2020), https://www.brennancenter.org/sites/default/files/2020-05/2020_04_RedistrictingMemo.pdf [https://perma.cc/H6C4-7UMC] (providing a 50-state survey of redistricting deadlines for the 2020 round of redistricting, and noting that a four-month delay in the delivery of the 2020 census would impact the redistricting process in an "overwhelming majority of states").

Given the difficult and time-sensitive nature of the tasks at hand, it is all the more important for independent redistricting commissions to quickly identify what critical information needs to be gathered and determine which of the many decisions that must be made will require the most attention. Redistricting algorithms can identify when optimization of criteria is not possible and which criteria are in conflict. For instance, an algorithm might identify that either county A or B has to be split; city C has to be split at least 3 ways; and a compact district cannot be drawn while keeping community of interest D together. Systematic identification of conflicts early on in the redistricting process can provide notice to affected individuals and prepare commissioners to solicit testimony from them.

Early identification of necessary sets of trade-offs is especially valuable when the integrity of certain communities of interest is at stake. Drawing lines through a self-identified community of interest is always a sensitive issue. Residents have strong feelings about what and who their community consists of, and district lines drawn through cohesive neighborhoods can be seen as attempts to fracture the community. Such concerns, even if unwarranted, should be expected given the history of racially motivated gerrymandering in this country.[95] At the same time, respecting communities of interest has long been recognized as one of the mushiest of redistricting criteria.[96] It blends subjective experience with objective indicators. And of course, in order to balance the number of persons among districts, some communities necessarily have to be split.

Redistricting inevitably produces winners and losers: acceptance of the redistricting process depends on whether losers feel that their injury was justified and their interests were taken seriously. While it will never be easy for affected citizens to accept that district lines must be drawn through their communities, proper care and attention in the decision-making process will hopefully alleviate the sense of injury. But without early detection, injured parties and their interests may never even get aired before lines have to be drawn. Redistricting algorithms can provide crucial information about necessary trade-offs so that affected citizens have an opportunity to organize and be heard, and commissioners have a chance to solicit the information necessary, decide which splits are necessary, and explain their decision to the public.

B. New Mechanisms

The functions of redistricting algorithms described above—and others—can and should be embedded into independent redistricting commissions' institutional design to facilitate and, if necessary, enforce the drawing of fair

95. The most infamous example of this is probably *Gomillion v. Lightfoot*, 364 U.S. 339 (1960).

96. This is despite laudable attempts to define and measure them. *See, e.g.*, Nicholas O. Stephanopoulos, *Redistricting and the Territorial Community*, 160 U. PA. L. REV. 1379 (2012).

maps.[97] A variety of institutional arrangements could embed algorithms into the structure of independent redistricting commissions. The algorithms can be used simply for informational and learning purposes, to produce advisory materials, or to set mandatory benchmarks, standards, or rules about how maps should be drawn. At different times and in different places, independent redistricting commissions will likely face different challenges. Successfully navigating those challenges will not only require that commissions voluntarily harness the power of redistricting algorithms, but also that algorithms be incorporated into the design of commissions to help resolve—and prevent—issues that can be expected to arise.

Certainly, institutionalizing algorithms into the structure of independent redistricting commissions should be undertaken with great care as institutional arrangements are classically path dependent and are hard to reverse. But in order to fully take advantage of what algorithms have to offer, commissions should devise strategies to institutionalize algorithmic functions.

These strategies must be tailored to the specific issues faced by the particular commission. For instance, a commission that faces overwhelming public pressure on a single swing citizen commissioner might benefit from using algorithms to produce benchmarks for adopted maps to meet. Those benchmarks might preclude the commission from drawing maps that deviate from some set range of acceptable outcomes produced by redistricting algorithms. Removing extreme outcomes from the decision space could take some of the heat off of swing independent commissioners. A commission that faces a substantial risk of impasse among the commissioners might instead benefit from having redistricting algorithms produce optimal outcomes to serve as backups in the event that a consensus cannot be reached. Indeed, a backup option that is randomly selected from a range of optimized outcomes not known ex-ante might incentivize risk-averse commissioners to reach consensus rather than risk adopting an unknown map. A commission that heavily favors neutrality at the expense of expertise might benefit from having algorithms produce a small number of optimized maps so that commissioners can simply be tasked with choosing among options as opposed to drawing maps from scratch. And a commission that expects partisan interests to infiltrate the public input process might devise mechanisms to score public proposals.

These examples are not meant to be exhaustive, only suggestive of what the possibilities might be. Learning new functions of redistricting algorithms is

97. To my knowledge, Mexico is the only country that uses redistricting algorithms in drawing its districts, and its experience is worthy of study. *See* Micah Altman, Eric Magar, Michael McDonald & Alejandro Trelles, The Effects of Automated Redistricting and Partisan Strategic Interaction on Representation: The Case of Mexico (Aug. 25, 2014) (unpublished manuscript), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2486885 [https://perma.cc/Y5BG-64UW]. But since Mexico, like many other countries that elect representatives from single-member districts, puts redistricting authority in the hands of the bureaucracy, its institutional incorporation of algorithms may not be instructive for U.S. independent redistricting commissions.

only the beginning of the enterprise of making full use of them. The important next step is to incorporate these functions into the institutional design of commissions.

CONCLUSION

Whether we make significant progress in redistricting reform will depend on how we combine the immense capabilities of redistricting algorithms with the institutional credibility of independent redistricting commissions. Redistricting algorithms can provide the critical external validation needed to secure public confidence in the true independence of independent redistricting commissions. They can also help commissions do their work better and faster. Algorithms can provide useful heuristics for commissions to rely on, identify improved outcomes that commissions might not find on their own, and detect tough decisions ahead so that commissions have plenty of time to make them.

The roles that redistricting algorithms can play are flexible. States can choose and adjust the particular functions of redistricting algorithms as desired. The roles outlined above are also non-exhaustive. Real-world problems encountered by independent redistricting commissions will put new demands on redistricting algorithms and shape their evolution. And the policy relevance of redistricting algorithms' application will also ensure that they become more user-friendly, accessible, and accountable.