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IN THE Supreme Court of the United States

ROBERT A. R

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## INTEREST OF AMICUS CURIAE

*Amicus Curiae* Eric S. Lander is an expert in the scientific analysis of large datasets, who has served as an advisor to the Government on matters of science and technology.

A mathematician and geneticist, Dr. Lander

This brief explains the principles underlying the application of extreme outlier tests at both the statewide and district levels and the results of applying them presented at trial.

#### SUMMARY OF THE ARGUMENT

This case presents the question of whether there exists any judicially manageable standard that would enable courts to determine when the partisan bias of a statewide redistricting plan, or any individual district within that plan, is so excessive as to render it unconstitutional.

gerrymandering is both harmful and unconstitutional. In Vieth v. Jubelirer, 541 U.S. 267 (2004), all nine Justices of this Court agreed that, while *some* partisanship is permitted in redistricting, excessive partisan gerrymanders are incompatible with democratic principles and violate the Constitution.

The open question has been whether there exists any cially discoverable and manageable for *recognizing* excessive partisan gerrymanders. *Vieth v. Jubelirer*, 541 U.S. 267, 277-278 (2004) ( principle: Just as political parties use computers to *create* excessive partisan gerrymanders by searching the universe of possible redistricting plans to find ones that impose an extreme burden on citizens who previously voted for an opposing party, one can use computers to *recognize* an excessive partisan gerrymander by seeing if its partisan impact is extreme *relative to the universe of possible plans*.

With modern computer technology, it is now straightforward to (i) generate a large collection of redistricting plans that are representative of all possible plans that

(e.g., compactness and contiguity); (ii) calculate the partisan outcome that would occur under each such plan, based upon actual precinct-level votes in one or more recent elections; (iii) display the distribution of the outcomes across these plans; and (iv) situate the

the degree to which that plan is an outlier. One can analyze outcomes for a statewide plan as a whole, or for an individual district within a plan.

In this way, it is now straightforward to measure the *quantitative degree* to which a partisan gerrymander is *excessive.* For example, one can readily determine whether a redistricting plan is more extremely partisan (at a statewide level or for any individual district) than, say, 80%, 90%, 95%, or 99% of the possible plans from which the State might have chosen.

Notably, the Federal Government relies upon the same approach (BTeng plan 73-331(r)4(ed)4(i6(at)-103(a)4(i6(atd14(c00) finance and health. Specific examples include the design of nuclear weapons, safety of nuclear weapons

would facilitate court efforts to identify and remedy the burdens, with judicial intervention limited by the 541 U.S. at 313 (Kennedy, J.,

concurring in the judgment).

In the past decade, advances in computer technology have now made.97 possible(a)e3(app)+928(tr)6(i)-4(c)4(Ema)] 362B0.0 straightforward, objective and judicially manageable test termed extreme outlier to enable courts to decide when a statewide redistricting plan or an individual district is so excessively partisan as to be unconstitutional.

An extreme outlier standard is based on a simple principle: Just as political parties use computers to *create* excessive partisan gerrymanders by searching the universe of possible redistricting plans to find ones that impose an extreme burden on citizens who previously voted for an opposing party, one can use computers to *recognize* an excessive partisan gerrymander by seeing if its partisan impact is extreme *relative to the universe of possible plans*.

While the principle is simple, it has not been feasible to apply it in practice until recently. In the past decade, how mean pweepe

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would allow them to discriminate against their opponents not just at the level of precincts, but at the level of city blocks, houses, apartments and individual persons.

If this Court finds that claims of excessive partisan gerrymandering are non-justiciable, partisan gerrymandering will likely become even more sophisticated, extreme and targeted.

compared to a large collection of plans sampled at random from the universe of all possible plans consistent with a redistricting goals (e.g., compactness and contiguity).

With modern computer technology, it is straightforward to (i) generate a large collection of redistricting plans that are representative of all possible plans that

(e.g., compactness and contiguity); (ii) calculate the partisan outcome that would occur under each such plan, based upon actual precinct-level votes in one or more recent elections; (iii) display the distribution of the outcomes across these plans; and (iv) situate the

the degree to which that plan is an outlier. One can analyze outcomes for a statewide plan as a whole, or for an individual district within a plan.

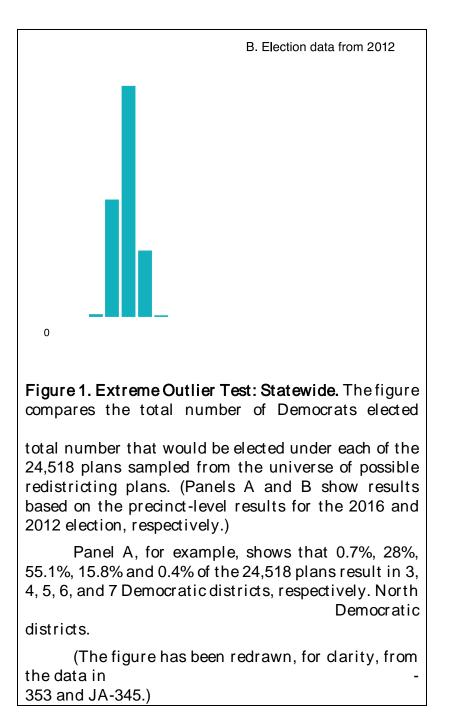
As described in Section VII *infra*, the approach of randomly sampling from a universe of outcomes to identify extreme outliers is routinely used by the Federal Government for a wide range of critical national needs, including national defense, the safety of nuclear power plants and hurricane storm track predictions.

To illustrate the concept: A might be compared to a collection of 10,000 plans sampled

randomly from the universe of all possible plans that 3.4

For each district in each of those 10,000 plans, one can calculate the total number of Republican and Democratic votes that would have been cast in that district if the plan had been used in any recent election by simply adding up the votes that were cast in each precinct assigned to the district under the plan.

> This information can then be used to analyze wijedof y5F1[(t0057004B004800032a0(1 0 0 1 426.91 6



contrary, it was squarely in the middle of the distribution.<sup>11</sup>

(ii) District-level analysis. Dr. Mattingly sorted

proportion of Democratic voters. He then compared these proportions in each district to the proportion in the comparably ranked district in each of the 24,518 sampled plans.

Based on data from the 2016 election, the results, shown in Figure 2, clearly demonstrate that Plan is an extreme outlier at the district level for at least six districts.

The top three districts (NC-1, NC-4, NC-12) show *extreme packing*. The proportion of Democratic voters in these districts is *higher* than in, respectively, 99.7%, 100% and 100% of the 24,518 sampled plans.<sup>12</sup>

The next three districts (NC-13, NC-2, NC-9) show *extreme cracking* 

**Figure 2. Extreme Outlier Test: Individual districts**. The figure shows an extreme outlier test applied to the six districts with the highest proportion of Democratic voters (*NC-1, NC-4, NC-12, NC-13, NC-2, NC-9*).

For each of the individual districts, the plot shows the proportion of Democratic voters under (blue circle) and the percentiles for the corresponding districts in each of the 24,518 plans sampled from the universe of possible redistricting plans. (The leftmost and rightmost bars indicate the 1<sup>st</sup>

level of many individual districts<sup>17</sup> is an extreme partisan gerrymander that violates the Constitution.

## VI. AN EXTREME OUTLIER STANDARD IS NOT SUSCEPTIBLE TO CRITICISMS THAT HAVE BEEN LEVELLED AT SOME PREVIOUSLY PROPOSED APPROACHES

An extreme outlier standard is not susceptible to criticisms that have been levelled at some approaches that have been used in partisan gerrymandering cases.<sup>18</sup> In particular, an extreme outlier standard (i) is judicially discoverable and manageable, (ii) employs an objective, wellestablished mathematical method, with a *right* answer, I geography, and (iv) does not expect or enforce

proportional representation.

# A. An extreme outlier standard is judicially discoverable and manageable.

An extreme outlier standard is judicially discoverable in the sense that it fl1r10()-371(a)-3(nd)15()] TJETBT1001158.4

In *Baker v. Carr*, 369 U.S. 186 (1962), for example, this Court found that claims of excessive population differences between legislative districts are justiciable, and in *Reynolds v. Sims*, 377 U.S. 533 (1964), this Court held that the Constitution requires substantially equal legislative representation for all citizens in a State regardless of where they reside. 377 U.S. at 565.

In those cases, the constitutional problem (excessive population differences between districts) implied a natural judicial standard for recognizing it (measuring how excessive the differences are).

The remaining issue was to decide, in any given case, whether the population difference between districts was *too* excessive.

No mathematically ordained threshold is set forth or inherent in the Constitution concerning when population differences between districts are too excessive. However, this Court adopted a reasonable threshold to make the standard readily manageable.

With respect to state legislative districts, this Court held that, as a general matter, an apportionment plan with a maximum population range under 10% falls within the category of minor deviations, but a plan with larger disparities requires justification by the State. *See, e.g., Voinovich v. Quilter,* 507 U.S. 146 (1993); *Gaffney v. Cummings,* 412 U.S. 735 (1973).<sup>19</sup>

<sup>&</sup>lt;sup>19</sup> With respect to *congressional* districts, Art. I, § 2,

is practicable; the State must demonstrate that any population deviations were necessary to achieve some legitimate state

Similarly, this Court has long agreed that *excessive* partisan gerrymandering violates the Constitution. The constitutional problem (excessive partisan gerrymandering) implies the

to which there is a *right* answer: What fraction of redistricting plans are less extreme than the plan?

Extreme outlier analysis belongs to a wellestablished field and, as described in Section VII *infra*, the method is widely used by the Federal Government for a wide range of critical needs, including national defense and public safety.

If a redistricting plan were to be challenged,

#### C. An extreme outlier standard accounts

An extreme outlier standard accounts for a , because it compares a redistricting plan to the universe of all possible redistricting plans drawn on the same politi

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otab8.TJ Eay, a extreme ier standard does not consider in any way whether a plan achieves proportionalresentation.

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#### VII. THE UNITED STATES RELIES ON AN EXTREME OUTLIER APPROACH FOR A WIDE RANGE OF CRITICAL NEEDS, INCLUDING NATIONAL DEFENSE

An extreme outlier standard for excessive partisan gerrymandering would be analogous to extreme outlier approaches used in many other settings.

Almost immediately after computers were developed, scientists realized that they could be used to make accurate inferences about distributions of outcomes, even when the number of underlying possibilities is extremely large. In particular, these methods can be used to recognize whether an outcome is an extreme outlier.

The concept first arose in 1946 in the context of designing a hydrogen bomb.<sup>22</sup> As the power of modern computers has grown, a variety of computational methods have been developed for drawing a large sample that is representative of an entire universe of outcomes.<sup>23</sup>

The technology is now routinely applied to many critical real-world situations, including

<sup>&</sup>lt;sup>22</sup> Nicholas Metropolis, *The Beginning of the Monte Carlo Method*, 15 Los Alamos Sci. 125 (1987), available at http://permalink.lanl.gov/object/tr?what=info:lanl-repo/lareport/LA-UR

national defense, public safety, finance, and health. A few examples include:

Design of nuclear weapons, safety of nuclear weapons in storage, and safety of nuclear power plants. As to weapons design, the computational analysis considers the vast number of paths that

will fail to occur. In the latter two cases, the analysis considers the risk that it *will* occur.<sup>24</sup>

Hurricane storm track prediction. Methods called ensemble-based forecasting represent the

accurate assessments of which cities are safe and which are at risk.  $^{\rm 25}$ 

that can occur, to identify extreme outliers.<sup>26</sup> Stress tests continue to be applied.<sup>27</sup>

proliferation of extreme partisan gerrymandering.<sup>33</sup> But, the technology to *evaluate* redistricting plans lagged behind.

The situation has changed in the last decade, as computer technology has caught up with the problem that it spawned. The computing power available to professionals has increased by more than a million-fold in the past twenty-five years, owing to increases in processor speed and computer architectures that employ many processors in parallel.<sup>34</sup>

Multiple researchers have employed various computational methods to finally be able to evaluate redistricting plans by comparing them to a large

declared goals.

Over the past decade, the field has matured rapidly. There are many distinguished computational scientists actively applying extreme outlier methods, including Dr. Jonathan Mattingly of Duke University; <sup>35</sup> Dr. Jowei Chen of the University of

<sup>&</sup>lt;sup>33</sup> Micah Altman, Karin MacDonald & Michael McDonald,

Michigan, Dr. Wendy Cho of the University of Illinois; <sup>36</sup> Dr. Jonathan Rodden of Stanford University, and Dr. David Cottrell of Dartmouth College; <sup>37</sup> and Dr. Michael McDonald of Binghamton

*Drawing the Line*, arXiv:1704.03360 (arXiv preprint 2017), available at: https://arxiv.org/pdf/1704.03360.pdf (last visited Feb. 19, 2019)

University.<sup>38</sup> As noted above, the first two of these experts testified in the case before this Court.

These scientists have applied their computer code to redistricting plans in various States showing that some plans are comfortably within the normal range of plans, while others lie far outside the ordinary distribution of outcomes.

Notably, the results have been consistent even when experts use different computational algorithms and computer hardware to draw large, representative samples exactly as one would expect for a mathematical analysis when properly performed.

While the extreme outlier methodology has become firmly established over the past decade, this case is the first in which the Court has had the opportunity to consider its application to partisan gerrymandering.

## IX. AN EXTREME OUTLIER STANDARD WOULD PROVIDE GUIDANCE TO THE PARTIES AND BOLSTER CONFIDENCE IN THE COURTS

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which they are excessive. In this way, States could ensure that their enacted plans would be shielded from a successful court challenge.

Similarly, potential challengers could run their own evaluations to assess whether a plan would likely withstand challenge under this objective, quantitative standard.

In both ways, the adoption of the proposed approach would likely have the salutary effect of reducing litigation.

Where such litigation was brought, the objective nature of the extreme outlier approach would tend to bolster public confidence in the courts.

In those cases where a court found that a plan was unconstitutionally partisan, the clear, impartial and reliable nature of the extreme outlier standard could help communicate the legitimacy of the decision and thus to shield the court from claims of judicial activism.

For example, the public could readily understand the legitimacy of court action striking down an extreme gerrymander that was objectively more biased than, say, 90% of all possible plans that the State could have chosen and that comparably achieved the Sta

In short, an extreme outlier standard, by providing clear, objective and reliable quantitative information about the degree of partisan bias of a restricting plan, at either the statewide or district level, would bolster the perceived neutrality and

#### CONCLUSION

For the reasons set forth above, this Court should endorse an extreme outlier standard as a judicially manageable standard for resolving claims of excessive partisan gerrymandering, and should hold that, in light of that standard, such claims are justiciable.

Respectfully submitted,

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