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2 PETITIONERS' DEPOSITION EXHIBITS: PAGE:	2
3 Number 43 904	3 Harrisburg, Pennsylvania
4	4 December 13, 2017; 9:32 a.m.
5	5
6 Number 45 921	6 THE CLERK: Good morning, everyone.
7	7 Welcome to Commonwealth Court.
8	8 Just a reminder, make sure all cell
9	9 phones and electronics are turned off, other
10	10 than counsel.
11	11 Thank you.
12	12 (Pause.)
13	13 THE CLERK: All rise. The
14	14 Commonwealth Court is now in session, the
15	15 Honorable Judge Kevin Brobson presiding.
16	16 THE COURT: Please be seated,
17	17 everyone.
18	18 Petitioners ready to call their next
19	19 witness?
20	20 MR. JONES: Your Honor,
21	21 Stanton Jones for the Petitioners.
22	22 Our witness is here. He's ready to
23	23 go. But we have just one brief matter to
24	24 take up with the Court before we call him,
25	25 which is that last evening, Ms. Gake

704	<p>1 e-mailed the counsel for all parties and</p> <p>2 asked us to send her Word versions of the</p> <p>3 exhibit lists that were PACFiled with the</p> <p>4 Court on Friday with the pretrial</p> <p>5 memorandum.</p> <p>6 Legislative Respondents sent a Word</p> <p>7 document that is not the exhibit list that</p> <p>8 was PACFiled with the Court. They have</p> <p>9 added additional exhibits to their exhibit</p> <p>10 list that did not appear originally.</p> <p>11 Those new exhibits are the maps, the</p> <p>12 artist renditions that were created by</p> <p>13 Dr. Gimpel and used by</p> <p>14 Legislative Respondents on cross-examination</p> <p>15 with Dr. Chen yesterday. And we object to</p> <p>16 the addition -- to the additional exhibits</p> <p>17 on the exhibit list that they provided</p> <p>18 through e-mail for a couple of reasons.</p> <p>19 First of all, we think that if</p> <p>20 Ms. Gake requests Word versions of documents</p> <p>21 that have been PDF PACFiled with the Court,</p> <p>22 the parties should just provide the exact</p> <p>23 Word version of what was filed with the</p> <p>24 Court --</p> <p>25 THE COURT: Counsel, can I ask you</p>	706	<p>1 off the record with the Court.</p> <p>2 THE COURT: Thank you, thank you.</p> <p>3 MR. JONES: Sure.</p> <p>4 THE COURT: Please call your first</p> <p>5 witness -- well, does anybody else have any</p> <p>6 preliminary matters that they want to</p> <p>7 address?</p> <p>8 I will -- I will say that we will</p> <p>9 review what was submitted at -- at the</p> <p>10 Court's request in the Word version and</p> <p>11 compare it to what was filed. And if it is</p> <p>12 inconsistent, the Court will work with the</p> <p>13 parties to make sure that they are</p> <p>14 consistent.</p> <p>15 MR. JONES: Certainly, Your Honor.</p> <p>16 THE COURT: Okay.</p> <p>17 MR. GEFFEN: Good morning,</p> <p>18 Your Honor. Ben Geffen from the Public</p> <p>19 Interest Law Center representing the</p> <p>20 Petitioners.</p> <p>21 And we now call Wesley Pegden.</p> <p>22</p> <p>23</p> <p>24</p> <p>25</p>
705	<p>1 a question? Why are we raising this on the</p> <p>2 record now? Why couldn't this simply have</p> <p>3 been resolved off the record between</p> <p>4 counsel?</p> <p>5 MR. JONES: We did -- we did raise</p> <p>6 it with them this morning, and they refused</p> <p>7 to withdraw it, refusing to make any --</p> <p>8 THE COURT: It's not been filed,</p> <p>9 though. This was a -- this was a -- it</p> <p>10 sounds, to me, like you're raising an issue</p> <p>11 about a request that the Court made to</p> <p>12 counsel for Word versions of what were</p> <p>13 filed.</p> <p>14 MR. JONES: Correct.</p> <p>15 THE COURT: If they -- they -- they</p> <p>16 didn't file something that wasn't previously</p> <p>17 filed; it was something that was supplied to</p> <p>18 the Court as a courtesy that we asked for</p> <p>19 all parties to provide.</p> <p>20 If the concern you have is that they</p> <p>21 provided a Word version of a document that</p> <p>22 is not consistent with the pack filed</p> <p>23 document, I'm not sure why that can't be</p> <p>24 addressed off the record.</p> <p>25 MR. JONES: Okay. We'll raise it</p>	707	<p>1 - - -</p> <p>2 WESLEY PEGDEN, PH.D.,</p> <p>3 after having been first duly sworn, was</p> <p>4 examined and testified as follows:</p> <p>5 - - -</p> <p>6 - - -</p> <p>7 VOIR DIRE</p> <p>8 - - -</p> <p>9 BY MR. GEFFEN:</p> <p>10 Q. Good morning.</p> <p>11 A. Good morning.</p> <p>12 Q. You need to pull the microphone closer.</p> <p>13 I don't know how it got spun there.</p> <p>14 There you go.</p> <p>15 And would you please state and spell</p> <p>16 your name for the record?</p> <p>17 A. It's Wesley Pegden, W-E-S-L-E-Y, and</p> <p>18 then P-E-G-D-E-N.</p> <p>19 Q. Where do you work?</p> <p>20 A. Carnegie Mellon University.</p> <p>21 Q. All right. And what do you do at</p> <p>22 Carnegie Mellon?</p> <p>23 A. I'm an associate professor in the</p> <p>24 department of mathematical sciences.</p> <p>25 MR. GEFFEN: I'd like to put on the</p>

708	<p>1 screen an exhibit that's been marked as</p> <p>2 Petitioners' Exhibit 118.</p> <p>3 BY MR. GEFFEN:</p> <p>4 Q. Do you recognize this document?</p> <p>5 A. Yeah. This is the first page of my CV.</p> <p>6 Q. Okay. And is this CV a fair and</p> <p>7 accurate description of your qualifications and</p> <p>8 experience?</p> <p>9 A. Yes.</p> <p>10 Q. Professor Pegden, have you ever</p> <p>11 testified in a court before?</p> <p>12 A. No.</p> <p>13 Q. Have you ever been an expert witness</p> <p>14 before?</p> <p>15 A. No.</p> <p>16 Q. I see that you got your Ph.D. in 2010.</p> <p>17 A. Yes.</p> <p>18 Q. What field was it in?</p> <p>19 A. Mathematics.</p> <p>20 THE COURT: Dr. Pegden, could you</p> <p>21 do me a favor and either pull that</p> <p>22 microphone towards you or try to speak into</p> <p>23 it a little bit more directly? That would</p> <p>24 be great.</p> <p>25 THE WITNESS: Absolutely,</p>	710	<p>1 A. Yes. So my area of specialty is</p> <p>2 discrete mathematics and probability.</p> <p>3 Q. Okay. And I see also on your CV that</p> <p>4 you had a number of publications.</p> <p>5 Can you tell me about some of these</p> <p>6 journals that you've published in?</p> <p>7 A. Sure. So -- okay. The first</p> <p>8 publication here, this is actually the publication</p> <p>9 that forms the basis for my expert report. So this</p> <p>10 is published in the Proceedings of the National</p> <p>11 Academy of Sciences, which is -- so the top three</p> <p>12 journals across science, in terms of citations are</p> <p>13 Science, Nature and the -- and the Proceedings of the</p> <p>14 National Academy of Sciences, so it's a prestigious</p> <p>15 journal across science.</p> <p>16 Annals of Applied Probability is one of</p> <p>17 the top journals in probability. Annals of</p> <p>18 Mathematics is widely considered to be the top</p> <p>19 journal in mathematics. So they publish between 20</p> <p>20 and 30 papers a year from fields across mathematics.</p> <p>21 Q. Okay. Thank you.</p> <p>22 A. Sure.</p> <p>23 Q. And you mentioned that the paper you</p> <p>24 published in PNAS has to do with the topic of your</p> <p>25 expert report?</p>
709	<p>1 absolutely.</p> <p>2 THE COURT: Thank you.</p> <p>3 BY MR. GEFFEN:</p> <p>4 Q. And I see there's a section labeled</p> <p>5 Grants, Fellowships and Awards.</p> <p>6 Can you tell me just a bit about some</p> <p>7 of those?</p> <p>8 A. Yeah, sure. So the -- the two NSF</p> <p>9 grants here, these are -- this is funding that the</p> <p>10 National Science Foundation awards me for my</p> <p>11 research -- to conduct my research. The Sloan</p> <p>12 Fellowship, this is a relatively prestigious</p> <p>13 fellowship for junior faculty members, so it's across</p> <p>14 science. There's maybe between 20 or 30 in</p> <p>15 mathematics a year in North America.</p> <p>16 The Kavli fellow -- so Kavli fellows</p> <p>17 are people chosen by the National Academy of Sciences</p> <p>18 to attend conferences which span topics in science.</p> <p>19 So, in particular, I attended a conference in Germany</p> <p>20 that included American, German and Japanese</p> <p>21 scientists. And the American participants are chosen</p> <p>22 by the National Academy.</p> <p>23 Q. Thank you.</p> <p>24 And is there a particular area of math</p> <p>25 that you specialize in?</p>	711	<p>1 A. Yes.</p> <p>2 Q. Can you just briefly summarize what</p> <p>3 that paper is about?</p> <p>4 A. Yeah. So that paper gives a rigorous</p> <p>5 way of identifying whether a configuration is an</p> <p>6 outlier with respect to a set of candidate</p> <p>7 configurations, and it gives a new way of doing that.</p> <p>8 Q. Okay. And is that specific to</p> <p>9 redistricting?</p> <p>10 A. No, not necessarily. So we</p> <p>11 illustrate -- in that paper, we illustrated the</p> <p>12 application of the method with redistricting, but</p> <p>13 Markov chains, which you see appear in the title of</p> <p>14 the paper, are used throughout scientific disciplines</p> <p>15 in areas as diverse as protein folding, simulations</p> <p>16 of chemical reactions, phylogenetic trees.</p> <p>17 And -- and it's -- and, actually, we</p> <p>18 suspect that our method may have utility in -- in</p> <p>19 several of these areas, which is part of why it</p> <p>20 was -- our result was considered enough of a</p> <p>21 breakthrough to be published in this journal.</p> <p>22 Q. Thank you.</p> <p>23 MR. GEFFEN: And if we could see</p> <p>24 Petitioners' Exhibit 119.</p> <p>25</p>

712	<p>1 BY MR. GEFFEN:</p> <p>2 Q. Is this a copy of that PNAS as paper?</p> <p>3 A. Yes. This is the first page.</p> <p>4 Q. And is PNAS a peer-reviewed</p> <p>5 publication?</p> <p>6 A. Yes.</p> <p>7 Q. And so you mentioned that it's a</p> <p>8 -- you -- you developed a mathematical tool in this</p> <p>9 paper that has a number of applications, but I</p> <p>10 believe you discussed one specific application in</p> <p>11 this paper?</p> <p>12 A. Yes. So we illustrate application of</p> <p>13 the method to detecting gerrymandering in</p> <p>14 Congressional districts and, actually -- specifically</p> <p>15 with respect to Pennsylvania.</p> <p>16 Q. Okay. And why did you decide to focus</p> <p>17 on Pennsylvania in this paper?</p> <p>18 A. So -- so I'm a professor at</p> <p>19 Carnegie Mellon. Alan Frieze is a also faculty in my</p> <p>20 department at Carnegie Mellon. Maria Chikina is at</p> <p>21 the University of Pittsburgh. So we're all -- we're</p> <p>22 all Pennsylvanians, currently.</p> <p>23 And I'm also from Pennsylvania,</p> <p>24 originally. I was born in State College. So</p> <p>25 Pennsylvania is just a natural state for us to choose</p>	714	<p>1 119 was admitted into evidence.)</p> <p>2 - - -</p> <p>3 MR. GEFFEN: And Petitioners offer</p> <p>4 Dr. Pegden to testify as an expert in</p> <p>5 probability.</p> <p>6 THE COURT: Any objection to the</p> <p>7 proffer?</p> <p>8 MR. JACOBSON: Can we just do a very</p> <p>9 short voir dire?</p> <p>10 THE COURT: Absolutely.</p> <p>11 - - -</p> <p>12 VOIR DIRE</p> <p>13 - - -</p> <p>14 BY MR. LEWIS:</p> <p>15 Q. Good morning, Dr. Pegden. My name is</p> <p>16 Patrick Lewis. I'm an attorney representing</p> <p>17 Speaker Michael Turzai.</p> <p>18 Dr. Pegden, have you taken -- have you</p> <p>19 had any coursework in the field of political science?</p> <p>20 A. Not at the graduate level or higher,</p> <p>21 no.</p> <p>22 Q. Okay. In law?</p> <p>23 A. No.</p> <p>24 Q. Sociology?</p> <p>25 A. No.</p>
713	<p>1 to illustrate the method.</p> <p>2 Q. Okay. Thank you.</p> <p>3 And I notice that you're listed as the</p> <p>4 last author on the paper.</p> <p>5 Is there any significance to that?</p> <p>6 A. Yeah. So in mathematics, the</p> <p>7 convention is just that author lists are always</p> <p>8 alphabetical. So if you look at all of my papers, I</p> <p>9 am always wherever the P goes.</p> <p>10 So that's extent of the import of that.</p> <p>11 MR. GEFFEN: Petitioners move to</p> <p>12 admit Petitioners' Exhibits 118, the CV, and</p> <p>13 119, the paper, into evidence.</p> <p>14 THE COURT: Any objection?</p> <p>15 MS. MCKENZIE: No objection.</p> <p>16 THE COURT: Without objection,</p> <p>17 Petitioners' Exhibits 118 and 119 are</p> <p>18 admitted.</p> <p>19 - - -</p> <p>20 (Whereupon, Petitioners' Exhibit Number</p> <p>21 118 was admitted into evidence.)</p> <p>22 - - -</p> <p>23 - - -</p> <p>24 (Whereupon, Petitioners' Exhibit Number</p> <p>25</p>	715	<p>1 Q. Anthropology?</p> <p>2 A. No.</p> <p>3 Q. Dr. Pegden, do you consider yourself a</p> <p>4 political scientist?</p> <p>5 A. No.</p> <p>6 Q. Have you published any research in</p> <p>7 political science journals?</p> <p>8 A. No.</p> <p>9 MR. LEWIS: Thank you.</p> <p>10 THE COURT: After your voir dire,</p> <p>11 do you have any objection to Dr. Pegden</p> <p>12 being qualified as an expert in probability?</p> <p>13 MR. LEWIS: I do not.</p> <p>14 THE COURT: Okay. He will -- I'm</p> <p>15 assuming probability -- we're talking about</p> <p>16 mathematical probability?</p> <p>17 MR. GEFFEN: Yes, Your Honor.</p> <p>18 THE COURT: Okay. Not the</p> <p>19 probability that my daughter is going to</p> <p>20 clean her room tomorrow morning?</p> <p>21 THE WITNESS: I can offer a guess.</p> <p>22 (Laughter.)</p> <p>23 THE COURT: This is going to be</p> <p>24 fun.</p> <p>25 The Court will accept Dr. Pegden's</p>

716	<p>1 testimony as an expert in mathematical 2 probability. 3 MR. GEFFEN: Thank you, Your Honor. 4 - - - 5 DIRECT EXAMINATION 6 - - - 7 BY MR. GEFFEN: 8 Q. Just some preliminaries, 9 Professor Pegden. 10 Who retained you in this case? 11 A. The lawyers for the Plaintiffs. 12 Q. And when did the lawyers for the 13 Plaintiffs first contact you? 14 A. In April of 2017. 15 Q. When was your PNAS paper published? 16 A. It was published in January of 2017. 17 Q. Okay. How are you being compensated 18 today for your services? 19 A. \$250 per hour. 20 Q. Okay. And what were you asked to 21 evaluate in this case? 22 A. I was asked to evaluate whether 23 Pennsylvania's districting is an outlier with respect 24 to partisan bias and, if so, if that could be 25 explained by the interaction of political geography</p>	718	<p>1 Q. Okay. And did you use commercial 2 software to do this? 3 A. No. So the actual implementation of 4 our test we wrote ourselves. So we wrote the code 5 for our test, and this code is available -- it's been 6 available on my Web site since the paper was 7 published. So anybody can download the software that 8 we used -- not just the software, but the code, try 9 out different options, try out different constraints, 10 and even alter the code itself to try to implement 11 other features that they might be interested in. 12 And I should also say people have done 13 this. So I've received e-mails from people that have 14 downloaded our code and, you know, had questions 15 about how they could try different things. 16 Q. Okay. And the data that you use to run 17 your analysis, is that also available on your 18 Web site? 19 A. Yes. That's part of the package that 20 you get when you download the software. You get the 21 software code, and you get input files for 22 Pennsylvania and, also, an input file for Wisconsin, 23 because, at some point, we did some analysis of 24 Wisconsin. 25 Q. And how long has that been on your</p>
717	<p>1 and traditional districting criteria in Pennsylvania. 2 Q. And, very briefly, what did you 3 conclude? 4 A. I found that it was indeed an extreme 5 outlier with respect to partisan bias in a way that 6 could not be explained by the interaction of 7 political geography and the districting criteria that 8 I considered. 9 Q. Okay. And what technique -- 10 THE COURT: Hold on for a second, 11 Counsel. Please suspend. 12 I'm going to ask you to slow down in 13 your answers a little bit. In addition to 14 my brain, the court reporter, although 15 skilled, still needs to take down everything 16 you say. 17 THE WITNESS: Okay. 18 THE COURT: Thank you. 19 BY MR. GEFFEN: 20 Q. Dr. Pegden Pegden, what technique did 21 you use to reach the conclusions that you just 22 mentioned? 23 A. Right. So we used this technique that 24 we developed in our paper that was published in PNAS, 25 which is a new statistical technique.</p>	719	<p>1 Web site? 2 A. So the code and the input for 3 Pennsylvania has been on my Web site since at least 4 January 2017 when the PNAS paper was published. 5 Q. Okay. So you mentioned that you 6 developed a new statistical theorem in your paper. 7 Can you tell me what's important about 8 your new theorem? 9 A. Yes. So the way to think about this 10 is -- suppose that, in general, I have the problem of 11 showing that a configuration is an outlier with 12 respect to some bag of possible configurations. And 13 in this scenario, a configuration could be a 14 districting of a state, it could be a folding of a 15 protein, it could be any of a number of things. 16 Okay? 17 And, again, the task that I want to 18 solve is showing that this configuration that I have 19 is unusual with respect to this bag of possibilities. 20 So the most naive way of solving this 21 problem would be simply to look, one by one, at every 22 configuration of the bag to determine whether this 23 one that I'm studying is unusual with respect to the 24 bag -- 25 THE COURT: I'm sorry.</p>

720	<p>1 Dr. Pegden Pegden, you're saying a bag of --</p> <p>2 THE WITNESS: A bag of</p> <p>3 possibilities. Just -- I just have a set of</p> <p>4 possible things, like a universe of</p> <p>5 possibilities --</p> <p>6 THE COURT: You're comparing one</p> <p>7 set to the bag?</p> <p>8 THE WITNESS: Yeah. I have one</p> <p>9 configuration, and then I have this bag of</p> <p>10 configurations --</p> <p>11 THE COURT: Okay.</p> <p>12 THE WITNESS: -- so in the case of</p> <p>13 districtings, it will be the current</p> <p>14 districting of Pennsylvania and the bag of</p> <p>15 all possible districtings, in some sense.</p> <p>16 Okay. So the first way, again,</p> <p>17 would be to just look, one by one, at</p> <p>18 everything in this bag. Okay?</p> <p>19 Now, oftentimes, the bag is simply</p> <p>20 too big to actually look at everything in</p> <p>21 the bag, as is the case for districting. So</p> <p>22 the number of districtings of a state is</p> <p>23 probably astronomically large, and,</p> <p>24 certainly, we don't have a way of looking at</p> <p>25 every single possibility.</p>	722	<p>1 1,001 instances if, really, there was</p> <p>2 nothing strange about it.</p> <p>3 So we give a third way of showing</p> <p>4 that something is an outlier with respect to</p> <p>5 the bag, which doesn't require drawing</p> <p>6 samples from the bag.</p> <p>7 BY MR. GEFFEN:</p> <p>8 Q. Thank you.</p> <p>9 I'd like you to briefly walk us through</p> <p>10 how this new way, this third way of analyzing this,</p> <p>11 works. So if you could just please give a nutshell</p> <p>12 version of how your analysis works.</p> <p>13 A. Sure, right. So the basic idea in the</p> <p>14 case of districting is we'll start with the actual</p> <p>15 districting that we're studying -- that we're</p> <p>16 interested in. We'll start with this candidate for</p> <p>17 which we're trying to evaluate whether it's an</p> <p>18 outlier -- so in the case of Pennsylvania, this is</p> <p>19 the 2011 Congressional redistricting -- and we'll</p> <p>20 make a sequence of small random changes to it, and</p> <p>21 we'll observe whether the partisan bias in the</p> <p>22 districting evaporates, or decreases, upon this</p> <p>23 sequence of small random changes.</p> <p>24 And we'll see -- later, when we discuss</p> <p>25 the results, we'll see that, actually, the</p>
721	<p>1 So the second way of approaching</p> <p>2 this problem -- so the classical statistical</p> <p>3 way of approaching this problem is to draw</p> <p>4 random samples from the bag. Okay? And</p> <p>5 suppose, for example, that I draw a thousand</p> <p>6 random samples from the bag, and I observe</p> <p>7 that this one configuration I'm studying is</p> <p>8 worse in whichever way I care about than all</p> <p>9 thousand of the random samples that I drew.</p> <p>10 Okay. If this configuration was</p> <p>11 really a representative member of the bag,</p> <p>12 if it was, itself, a random member of the</p> <p>13 bag, then this would have a probability, at</p> <p>14 most, 1 over a 1,001 of happening, because</p> <p>15 there are 1,001 choices in total, the thing</p> <p>16 I'm studying and the thousand I drew.</p> <p>17 Why is this one the smallest? They</p> <p>18 could -- they could have all equally likely</p> <p>19 been the smallest.</p> <p>20 So this is a classical application</p> <p>21 of statistics. You would get a p-value of 1</p> <p>22 over a 1,001, so, roughly, .001. That's</p> <p>23 telling you the probability that you would</p> <p>24 have observed just by chance that this</p> <p>25 configuration was the worse out of these</p>	723	<p>1 districting -- the partisan bias evaporates in an</p> <p>2 astonishing way. So that the districtings -- an</p> <p>3 overwhelming fraction of the districtings that you</p> <p>4 encounter when you make the changes are fairer.</p> <p>5 And -- right.</p> <p>6 So our method --</p> <p>7 THE COURT: Are what, sir?</p> <p>8 THE WITNESS: Are fairer.</p> <p>9 THE COURT: Are fairer?</p> <p>10 THE WITNESS: Fairer, according to</p> <p>11 our metric.</p> <p>12 THE COURT: Okay.</p> <p>13 THE WITNESS: Okay. So our method</p> <p>14 calls something -- calls something an</p> <p>15 "outlier" when that's the case, when its --</p> <p>16 when its bias decreases when you make these</p> <p>17 small random changes. And our result from</p> <p>18 our paper gives a rigorous quantification of</p> <p>19 how likely this can be to happen for a</p> <p>20 representative districting of Pennsylvania.</p> <p>21 So that's the rough outline.</p> <p>22 BY MR. GEFFEN:</p> <p>23 Q. Thank you.</p> <p>24 MR. GEFFEN: I'd like to put on the</p> <p>25 screen Petitioners' Exhibit 117.</p>

724	<p>1 THE COURT: Dr. Pegden, I'm going 2 to come down here for a second. I'm just 3 going to do this. Okay. 4 THE WITNESS: Okay. I have a 5 message, yes. I've gotten it. 6 My goal is that you don't come down 7 again. 8 THE COURT: I get that a lot. 9 BY MR. GEFFEN: 10 Q. Professor Pegden, do you recognize 11 Petitioners' Exhibit 117? 12 A. Yes. This is the first page of my 13 expert report. 14 Q. Okay. And let's turn to Page 4 of the 15 report, if we can. 16 And I see, in the middle of the page 17 there, there's this bullet list, 1, 2, 3, 4. 18 MR. GEFFEN: Can we zoom in on that? 19 BY MR. GEFFEN: 20 Q. And I understand that you have a 21 copy -- a paper copy of your expert report at the 22 witness stand with you? 23 A. That's what I'm looking at right here. 24 Q. Okay. So I'd like you to take us 25 through, please, these four steps. And let's just</p>	726	<p>1 boundary of two districts, and then we attempt to 2 swap this precinct from the district that it's in to 3 that other district on the other side of the 4 boundary. Okay? 5 And we'll have a set of constraints 6 that we're trying to maintain about our districting 7 when we do our procedure. So, for example, we'll 8 want to make sure the districts remain contiguous, 9 that they satisfy various compactness criteria, that 10 the districts are roughly equal in population. And 11 so we'll try to do the swap, and we'll check whether, 12 after making the swap, the districting would still 13 satisfy all of our constraints. 14 And if it does, then we make the swap; 15 and if we don't -- if -- if it would break the 16 constraints, then the swap is not made. 17 MR. GEFFEN: To illustrate how this 18 works to clarify a little, can we look at 19 Petitioners' Exhibit 121, please? 20 BY MR. GEFFEN: 21 Q. Do you recognize this document? 22 A. Yes. This is Figure 2 from my report. 23 Q. Okay. Later on, I'm going to ask you 24 to describe in more detail the various constraints 25 that you use.</p>
725	<p>1 start with Step 1. 2 Could you please explain Step 1? 3 A. Right. So, again, we're trying to 4 validate whether the 2011 Congressional districting 5 of Pennsylvania is an outlier. And for our test, 6 that means we start from this districting that we're 7 trying to evaluate. 8 So that's the starting point for our 9 test. 10 Q. Okay. And let's turn now to Step 2 and 11 just -- first, I understand that there's a 12 terminological mistake in your report here? 13 A. Yes. So in Step 2, it says, We 14 randomly select a census tract. So here and 15 throughout this report, wherever it says census 16 tract, it should say precinct. 17 Q. Okay. Thank you. 18 And how large is a precinct, 19 approximately? 20 A. It's on the order of a thousand or so 21 people. 22 Q. Okay. So explain to us what happens in 23 Step 2, please. 24 A. So in Step 2, we have some districting 25 of Pennsylvania. We choose a precinct on the</p>	727	<p>1 For now, can you please just give an 2 example of how this swap that you mentioned worked? 3 A. Can we zoom in on just the top map? 4 That's just a current map of Pennsylvania. 5 Yeah, so -- okay. So this is the 6 current map of Pennsylvania. These little regions 7 that you see here are precincts, so -- let me see if 8 the pointer works -- 9 Q. I think those are municipalities. 10 A. No, no; in this map, it's precincts. 11 Q. My mistake. 12 A. Okay. 13 So this is Pennsylvania divided into 14 these precincts that we use. And -- right. So the 15 way our algorithm works is on a step of the 16 algorithm, it will randomly choose a precinct on the 17 boundary of two districts. So you can see there's 18 this -- it would -- if you go around the boundaries 19 of districts, there are precincts around the 20 boundary. It would randomly choose one of them, like 21 maybe this one here, and try -- I think that's 22 District 5 here and District 3 here. 23 So if it chose this one in District 5, 24 it would then attempt to swap its -- to move it into 25 District 3. So I would say, Suppose I reassign it</p>

728	<p>1 from District 5 to District 3. Is my districting 2 still a valid member of my bag of districtings in the 3 sense that it still has contiguous districts, 4 satisfies our population requirements as compact 5 districts according to the various metrics that we 6 use and, presumably, we'll discuss later, et cetera. 7 And if the swap can be made, then it's done. 8 So notice that sometimes swaps will 9 break constraints. For example, at least from where 10 I'm sitting, it looks like if I swap this precinct 11 here from this purplish district up to District 5, if 12 I assign its membership to District 5, then it would 13 disconnect this district into two pieces. And so 14 that swap would not be allowed. 15 Q. Thank you. 16 MR. GEFFEN: And if we could go 17 back, please, to Exhibit 117, to Page 4 of 18 that exhibit. This was the -- the 1 through 19 4 that we had zoomed in before. If we could 20 zoom back in on that, please. 21 BY MR. GEFFEN: 22 Q. And I'll ask just to keep the talking 23 really slow because we don't want to get ahead of the 24 stenographer's fingertips here. And she's been doing 25 a terrific job.</p>	730	<p>1 the very beginning of the algorithm, which is the 2 current 2011 districting of Pennsylvania. So the 3 algorithm keeps track of how many districtings 4 encountered in -- in its run are worse than the 5 districting in Pennsylvania or, let's say, how many 6 are more partisan and how many are only as partisan 7 as -- as the districting in Pennsylvania -- sorry. I 8 said that imprecisely. 9 Can I rephrase? 10 Q. Sure. But, please, slowly. 11 A. Okay. 12 So we keep track of how many 13 districtings are less partisan than Pennsylvania, and 14 how many are just as partisan or conceivably worse. 15 Q. Okay. And when you use the term 16 "worse," you mean -- 17 A. More partisan. 18 Q. Meaning having a greater -- 19 A. Greater than or equal to level of 20 partisan bias, according to the median versus mean 21 metric that we use. 22 Q. Thank you. 23 Step 4 -- can you please explain Step 4 24 to us? 25 A. Step 4 just says that these Steps 2 and</p>
729	<p>1 So if we can move on to -- well, before 2 I move on to Step 3 -- so you mentioned that there 3 are different possible constraints that you can use 4 at Step 2 to see if it satisfies your -- if it's a 5 member of your bag of districtings? 6 A. That's right. 7 Q. And you ran your test a variety of 8 times with different constraints each time? 9 A. Yes. So this expert report includes 10 eight runs, each with a different set of constraints, 11 to check that our method is robust to the particular 12 choice of how we define the bag of districtings. 13 Q. We'll get to those eight runs later on, 14 but for now, let's move on to Step 3 here. 15 Can you tell us how Step 3 works? 16 A. So in Step 3, we have a districting of 17 Pennsylvania, and we evaluate its partisan bias 18 using -- using voting data from 2010 and using a 19 standard metric for evaluating partisan bias called 20 the "median/mean difference." 21 Q. Okay. And what do you do with that 22 measurement? 23 A. So -- so that measurement is used to 24 determine whether this districting encountered at 25 this step is worse or better than the districting at</p>	731	<p>1 3 are done many times. So -- and Steps 2 and 3 2 consist of trying a swap and then taking this map 3 that we have and evaluating its partisan bias. 4 And our tests allowed -- so our paper, 5 in which we give the statistical test, allows this 6 test to be rigorous no matter how many steps that we 7 run it for. In general, when you run it for more 8 steps, you have a better chance of discovering that 9 your thing is an outlier, but the test is rigorous no 10 matter how many steps you run it for. 11 And in this expert report, we take -- 12 we run it for 2 to the 40 steps. 13 Q. When you say 2 to the 40th, that means 14 2 times 2 times 2, 40 times? 15 A. Yes. It's 2 to the power of 40, yeah, 16 which is roughly a trillion. And I should say for 17 two of the runs for the -- we'll get to the specific 18 constraints later, but for two runs, we run them for 19 a mere half-trillion steps, because those runs are 20 slightly slower. 21 Q. Okay. Now, I'd like you to walk us 22 through how one of your runs works. 23 MR. GEFFEN: So if we could please 24 go back to Exhibit 121, Petitioners' 121. 25</p>

732	<p>1 BY MR. GEFFEN:</p> <p>2 Q. What's the map at the top here?</p> <p>3 A. The map at the top is the current</p> <p>4 Congressional districting of Pennsylvania, the 2011</p> <p>5 redistricting.</p> <p>6 Q. Okay. And looking at the smaller maps</p> <p>7 below, what's the next map in the upper left corner?</p> <p>8 A. Right. So these maps below are what</p> <p>9 you get every 20 billion steps of the algorithm.</p> <p>10 So the way this figure is produced, the</p> <p>11 algorithm runs for a trillion steps, and this figure</p> <p>12 is produced by taking a snapshot of just the map that</p> <p>13 it has every 10 times 2 to the power of 32 steps,</p> <p>14 which is -- just think of that as roughly 20 billion</p> <p>15 steps.</p> <p>16 Q. Okay. And so the map in the lower</p> <p>17 right corner, that would be after a bunch of steps?</p> <p>18 A. That's right, that's after a bunch of</p> <p>19 steps.</p> <p>20 And let me just say, I said 2 to the</p> <p>21 power 32. It should have been 2 to the power of 31,</p> <p>22 just to correct the record. Sorry.</p> <p>23 Q. But that's a big number?</p> <p>24 A. But a big -- yeah. The 20 billion was</p> <p>25 the correct approximation, yeah.</p>	734	<p>1 is a member of the bag.</p> <p>2 So somehow, my method accepts as</p> <p>3 given that the mapmakers' taste in squiggly</p> <p>4 districts is the correct taste and shows</p> <p>5 that even against that backdrop, where we</p> <p>6 have weird-looking districts --</p> <p>7 weird-looking districts, still,</p> <p>8 Pennsylvania's districting is an outlier.</p> <p>9 So the method really shows that the</p> <p>10 political geography and the geometric</p> <p>11 features of the current districting can't</p> <p>12 explain the partisan bias. It has partisan</p> <p>13 bias that goes beyond what can be explained</p> <p>14 by those factors.</p> <p>15 So as a result, in answer to your</p> <p>16 question, this is not a good start -- it's</p> <p>17 not even a good starting point for a legal</p> <p>18 map, because I think there's plenty of</p> <p>19 evidence that it's possible to draw much</p> <p>20 better maps with respect to lots of</p> <p>21 constraints than the current map has.</p> <p>22 And by its design, my method is</p> <p>23 generating other similar maps to the current</p> <p>24 map.</p> <p>25</p>
733	<p>1 Q. Okay. Now, just to make sure the</p> <p>2 record is clear, is each of these maps on the screen</p> <p>3 right now meant to be an alternative Congressional</p> <p>4 plan for Pennsylvania that would satisfy all the</p> <p>5 legal requirements for a plan?</p> <p>6 A. No, most definitely not.</p> <p>7 THE COURT: Did you have an</p> <p>8 objection?</p> <p>9 MR. LEWIS: Well, I -- no.</p> <p>10 THE WITNESS: Only if I said yes.</p> <p>11 (Laughter.)</p> <p>12 THE WITNESS: So there are various</p> <p>13 reasons why these should not be taken as</p> <p>14 candidate alternative maps of Pennsylvania.</p> <p>15 So a main reason is that by its nature, the</p> <p>16 intent of my method is to compare the</p> <p>17 current districting of Pennsylvania to other</p> <p>18 districtings of Pennsylvania which are just</p> <p>19 as bad as it with respect to nonpartisan</p> <p>20 factors. Right?</p> <p>21 So we saw all those pictures</p> <p>22 yesterday of the Goofy-looking districts. I</p> <p>23 define the compactness -- the compactness</p> <p>24 requirements on my bag of districtings</p> <p>25 specifically so that the current districting</p>	735	<p>1 BY MR. GEFFEN:</p> <p>2 Q. Okay. So, obviously, you had to make a</p> <p>3 lot of decisions about the details of your analysis,</p> <p>4 and I'd like to ask you some questions about the</p> <p>5 decisions you made and why you made them.</p> <p>6 A. Um-hum.</p> <p>7 Q. So, first, you've used the term -- I</p> <p>8 think you've used the term "partisan bias."</p> <p>9 What do you mean by that term?</p> <p>10 A. Right. So we evaluate the partisan</p> <p>11 bias of districting with a simple classical test</p> <p>12 called the "median versus mean test." And I can tell</p> <p>13 you exactly how this works.</p> <p>14 So one of the reasons that I like this</p> <p>15 test is it's very simple and it's very easy to</p> <p>16 understand how the calculation works.</p> <p>17 So to calculate the median versus mean</p> <p>18 gap for districting, all I do is I take the level of</p> <p>19 Republican support in each of the 18 districts -- so</p> <p>20 this is just 18 numbers between zero and 1, or</p> <p>21 between 0 and 100 percent, as you like -- and I</p> <p>22 compare two numbers: the median of these 18</p> <p>23 numbers -- that's which one comes in the middle when</p> <p>24 you sort them -- and the mean of these 18 numbers.</p> <p>25 That's just the average of them. And so the mean of</p>

736	<p>1 them is just the overall level of Republican support 2 in the state.</p> <p>3 And the gap between these is the median 4 versus mean difference. And, roughly speaking, it 5 respects -- it reflects a skew in the distribution of 6 partisanship in the districting.</p> <p>7 And to give an example of why this 8 should capture -- an intuitive example of why this 9 should capture partisan bias, it's -- think of the 10 situation when the median value is 50 percent. So 11 remember, when the median value is 50 percent, this 12 means that half the Republican districts have support 13 less than 50 percent and half have more, because it 14 is the median --</p> <p>15 Q. Sorry. Half the Republican districts 16 or half the --</p> <p>17 A. Sorry. Half the districts have 18 Republican support less than 50 percent and half have 19 more, which means that the Republicans are winning 20 half the seats in such an election.</p> <p>21 Now, let's say the median versus mean 22 gap is around 6 percent, as it is in Pennsylvania. 23 Then their mean support in the districts would be 24 44 percent, and the mean support in the districts is 25 also their overall support in the State. So it would</p>	738	<p>1 which you can move a piece and still have a precise 2 estimate for how people voted in your new region.</p> <p>3 Q. Another of the steps -- decisions you 4 had to make was how many steps to run your test for. 5 And you said that you ran most of your runs for 2 to 6 the power of 40, or about 1 trillion steps.</p> <p>7 How did you decide to do that many 8 steps?</p> <p>9 A. Right. So that is really just a 10 question of choosing a number large enough to have a 11 really large, impressive number of zeros in my 12 results table that we'll see in a little bit, but 13 small enough that it still runs on my computer.</p> <p>14 So this test -- I said you can download 15 the code and you can run it on your laptop. And with 16 2 to the 40 steps you can -- you'll maybe be able to 17 have it finished before you accidentally turn your 18 laptop off. Right?</p> <p>19 Q. Okay.</p> <p>20 MR. GEFFEN: I'd like to mark and 21 put on the screen a document that's been 22 labeled Petitioners' Exhibit 122. 23 - - - 24 (Petitioners' Exhibit Number 122, 25 marked for identification, as of</p>
737	<p>1 mean that they could win half the seats with only 2 44 percent of the vote.</p> <p>3 So the median versus mean gap captures 4 this disconnect between thresholds to win and -- and 5 the votes required to do so.</p> <p>6 Q. Okay. Now, what -- you must have had 7 to use some methodology to gauge the partisanship of 8 any precinct in your map.</p> <p>9 A. Right. So just now, when I described 10 the median versus mean test, the input was these 18 11 numbers, the level of Republican support. So I need 12 to use some proxy for Republican support, and the 13 proxy I used is the outcome of the Sestak/Toomey 2010 14 Senate race. It's the race that was used for those 15 red/blue figures we saw yesterday in somebody else's 16 testimony.</p> <p>17 Q. Okay. And was that at the 18 Congressional district level or at the precinct 19 level?</p> <p>20 A. So the data -- the smallest unit of 21 data for which you have exact voting outcomes is at 22 the precinct level. So we use precinct-level data. 23 And precincts are also -- this is why this is also 24 the level of which my algorithm operates on the 25 districtings, because it's the smallest unit for</p>	739	<p>1 this date.) 2 - - - 3 BY MR. GEFFEN: 4 Q. Do you recognize this document? 5 A. Yes. This is the results table from my 6 report with one new column on the left, just 7 numbering the rows so that we can refer to them 8 easily right now.</p> <p>9 Q. Okay. And there are eight rows. 10 What does it mean that there are eight 11 rows?</p> <p>12 A. So there's eight rows because, for this 13 expert report, I ran my test eight times. So each 14 row is the results for one run of my test. Each run 15 is done with slightly different constraints.</p> <p>16 Q. Okay. Does one of the rows on this 17 table correspond to the figure we looked at a moment 18 ago, the maps of Pennsylvania?</p> <p>19 A. Yes. That's Row 6.</p> <p>20 Q. Okay. Let's just walk through this row 21 cell by cell so we understand what everything here 22 means.</p> <p>23 So, first of all, what does this mean, 24 Population Threshold, 2 percent?</p> <p>25 A. Right.</p>

740	<p>1 So I would start by saying that</p> <p>2 everything to the left of the thick black bar in the</p> <p>3 middle will be constraints in our bag of districtings</p> <p>4 that we're considering for this run. So, in</p> <p>5 particular, the Population Threshold column tells us</p> <p>6 what population threshold I was allowing for this run</p> <p>7 of my test. So it's 2 percent for this run, which</p> <p>8 means that the districts were allowed to have an</p> <p>9 error of 2 percent from a perfectly equal population.</p> <p>10 Q. Professor Pegden, are you aware of the</p> <p>11 legal requirement that Congressional districts have</p> <p>12 exactly equal population?</p> <p>13 A. Up to one-person error, yes.</p> <p>14 Q. So why did you allow this 2 percent</p> <p>15 deviation in your test?</p> <p>16 A. So there are really two answers -- two</p> <p>17 kinds of answers to this question: first, why it's</p> <p>18 okay that I allow this error; and then, why I do it.</p> <p>19 So the first -- let's answer that first</p> <p>20 one first, why is it okay that I consider comparison</p> <p>21 districtings that aren't perfectly equal in</p> <p>22 population.</p> <p>23 So when I run my test, I observe that</p> <p>24 the median/mean shift shifts by -- shifts from</p> <p>25 something like six points -- so a six-point</p>	742	<p>1 various technical reasons, the -- the algorithm</p> <p>2 depends on having some swap in the population. The</p> <p>3 simplest is that I can't actually have an</p> <p>4 assumption-free prediction for how a given district</p> <p>5 that I create would vote, except if that district is</p> <p>6 composed out of precincts, because, remember,</p> <p>7 precincts are the smallest unit at which voting data</p> <p>8 is collected.</p> <p>9 The Census doesn't ask individual</p> <p>10 citizens for their political preferences. The</p> <p>11 smallest unit at which we know how people vote is a</p> <p>12 precinct, and so my districts have to be composed of</p> <p>13 these precincts.</p> <p>14 Q. Thank you.</p> <p>15 Moving along, Row 6 to the next cell,</p> <p>16 we get -- we have this column Compactness Measure,</p> <p>17 and it says, Average PP.</p> <p>18 What does that mean?</p> <p>19 A. Yeah. So the compactness measure, in</p> <p>20 general, this column tells me how I'm constraining</p> <p>21 the geometry of the districts.</p> <p>22 So if I really just drew up a random</p> <p>23 districting of the state with no constraints on this,</p> <p>24 the districts would look even worse than they do in</p> <p>25 the current districting.</p>
741	<p>1 difference between the median and the mean -- to</p> <p>2 something like 2 points, depending on the precise row</p> <p>3 of the table, okay. And that shift from six points</p> <p>4 to two points can't be accounted for by the slight</p> <p>5 error in population that we're talking about here.</p> <p>6 So what I mean by that precisely is,</p> <p>7 suppose that I took one of the maps, the comparison</p> <p>8 maps that my algorithm produces, okay, and I gave it</p> <p>9 to the defenses' lawyers and I said, Take this map</p> <p>10 that you don't like because it has 2 percent</p> <p>11 population error, and move around people as you see</p> <p>12 fit to fix the population error so that there's</p> <p>13 really just a 1 percent population error; and you're</p> <p>14 not allowed to move around more people than you have</p> <p>15 to, but you can choose who to move.</p> <p>16 It would be impossible for them to</p> <p>17 correct this map to an equal population map with a</p> <p>18 minimal set of changes, which would also correct the</p> <p>19 median/mean gap back up to where it is for the</p> <p>20 current Congressional districting in Pennsylvania.</p> <p>21 So the magnitude of the change that we</p> <p>22 see is not something that can be accounted for by</p> <p>23 this population difference.</p> <p>24 Now, the second kind of answer is, why</p> <p>25 I do have this population threshold at all, and for</p>	743	<p>1 So you need some constraint on the</p> <p>2 geometry of the districts. Maybe let's even start</p> <p>3 with the perimeter example, because the perimeter is</p> <p>4 the easiest to understand -- I see, but we're talking</p> <p>5 about Row 6, yeah, so --</p> <p>6 Q. That's fine, you can talk about</p> <p>7 perimeter, because you use that in some of your other</p> <p>8 runs.</p> <p>9 A. Yeah. So let me just warm up by</p> <p>10 describing what the perimeter constraint is.</p> <p>11 So the perimeter constraint, all that</p> <p>12 does is it takes the sum of the 18 perimeters of the</p> <p>13 18 districts and requires that number to be, at most,</p> <p>14 some threshold, which is set at something like</p> <p>15 2 percent larger than the current districting of</p> <p>16 Pennsylvania. In particular, it's set so that the</p> <p>17 current districting of Pennsylvania satisfies the</p> <p>18 requirement.</p> <p>19 And so this is a constraint which</p> <p>20 prevents districtings from having districts which are</p> <p>21 too ugly or complicated.</p> <p>22 Again, the current districting, by</p> <p>23 design, is allowed in the threshold. It's set high</p> <p>24 enough so that the current districting is considered</p> <p>25 acceptable.</p>

744	<p>1 So average PP is just another way of</p> <p>2 constraining the geometry of the districts. So PP</p> <p>3 stands for Polsby-Popper, which is the ratio of the</p> <p>4 perimeter squared to the area of the district. So</p> <p>5 the idea is that this is -- sorry. It's the ratio of</p> <p>6 the area to the perimeter squared of the district. I</p> <p>7 said it in reverse.</p> <p>8 So the idea is that if I look at the</p> <p>9 ratio of my area to my perimeter squared, I make this</p> <p>10 largest by taking a disk. A disk gets the most area</p> <p>11 with a fixed perimeter -- and so also with the most</p> <p>12 fixed perimeter squared. And for other shapes, we'll</p> <p>13 have less area for the same squared value of their</p> <p>14 perimeter.</p> <p>15 So the uglier the shape, the smaller</p> <p>16 this number is. So a very noncompact district would</p> <p>17 have a number close to zero.</p> <p>18 This Average PP column is calculated by</p> <p>19 taking one over the Polsby-Popper metric for each</p> <p>20 district and just averaging those, the average of the</p> <p>21 18 values.</p> <p>22 Q. Okay. The next column -- the next cell</p> <p>23 says, Preserve Counties.</p> <p>24 A. Yes.</p> <p>25 Q. What does that mean?</p>	746	<p>1 all sorts of other constraints. There are a 9th and</p> <p>2 10th run you can find in the supplement to our paper.</p> <p>3 So two of the runs here I think are</p> <p>4 actually identical to two runs from our paper. There</p> <p>5 are two more, if you're just looking for a 9th and</p> <p>6 10th run, that's part of -- presumably part of</p> <p>7 evidence, because it's part of this supplement, or</p> <p>8 it's at least part of my expert report because it's</p> <p>9 part of this PNAS paper. But, yes, you could try all</p> <p>10 sorts of constraints.</p> <p>11 My goal for this expert report was to</p> <p>12 focus on some manageable, digestible list of</p> <p>13 examples.</p> <p>14 Q. Okay. So now we're getting to that</p> <p>15 thick line up the middle of the table here.</p> <p>16 A. Yes.</p> <p>17 Q. And so we're getting to the results on</p> <p>18 the other side of that line; is that right?</p> <p>19 A. Right.</p> <p>20 Q. So turning to the next couple of</p> <p>21 columns, they -- they have to do with the partisan</p> <p>22 bias.</p> <p>23 Could you just explain in -- in -- you</p> <p>24 know -- spare us the exact mathematical definition of</p> <p>25 "Epsilon Outlier in Significant at P," but can you</p>
745	<p>1 A. Right. So for some of my runs, I had</p> <p>2 the constraint that any county preserved by the</p> <p>3 current 2011 Congressional districting in</p> <p>4 Pennsylvania would have to be preserved in all the</p> <p>5 maps encountered by my algorithm also. And so I did</p> <p>6 some runs that had this constraint, and some didn't.</p> <p>7 So the "yes" in this column indicates that this run</p> <p>8 was preserving counties.</p> <p>9 Q. The next one says, Freeze District 2:</p> <p>10 Yes.</p> <p>11 What does that mean?</p> <p>12 A. So District 2 is this district which</p> <p>13 might be claimed is a majority-minority district</p> <p>14 drawn to comply with the Voting Rights Act in</p> <p>15 potentially complicated ways. And in case that's the</p> <p>16 case, for some of my runs, I just froze District 2</p> <p>17 exactly intact. So no precinct in District 2 is</p> <p>18 allowed to participate in any swaps for runs where</p> <p>19 there's a "yes" in this column.</p> <p>20 Q. Okay. And you did eight runs -- there</p> <p>21 are other ways -- there are other 9th and 10th and</p> <p>22 11th runs you might have done if you had other</p> <p>23 constraints to test or you wanted to test; is that</p> <p>24 right?</p> <p>25 A. Absolutely. You could -- you could try</p>	747	<p>1 just explain in general conceptual terms what those</p> <p>2 two columns mean?</p> <p>3 A. I'll do that, and it will also be</p> <p>4 precise because it's not complicated.</p> <p>5 Q. Right.</p> <p>6 A. So -- so for the Epsilon column, what</p> <p>7 this tells me is simply the fraction of districtings</p> <p>8 encountered in the trillion steps that had as much</p> <p>9 partisan bias, according to our metric, as the</p> <p>10 initial 2011 districting. So here, you see this</p> <p>11 .0000, et cetera, 97. That's saying that only 97 out</p> <p>12 of 100 billion, that fraction of districtings were as</p> <p>13 bad as the 2011 districting among the -- among the</p> <p>14 more than trillion districtings encountered by our</p> <p>15 test.</p> <p>16 Q. When you say "as bad as," you mean?</p> <p>17 A. Exhibited as much partisan bias --</p> <p>18 Q. Okay.</p> <p>19 A. -- with respect to the median/mean</p> <p>20 test.</p> <p>21 Q. And what about this next run,</p> <p>22 Significant at P?</p> <p>23 A. Right. So, so far, like, everything to</p> <p>24 the left of this line, like, everything before the P,</p> <p>25 this table could have been produced without our PNAS</p>

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748	<p>1 paper, because somebody could have designed an 2 algorithm to do these changes to maps; they could 3 have calculated these epsilon values. All of this 4 didn't really require any new theorem in statistics. 5 The p-value, this is what our paper 6 gives us. The p-value tells me rigorously the 7 probability that I could get such a result as I get 8 in this test for a random districting of Pennsylvania 9 from this bag. 10 That is, no matter -- and here's 11 where -- this is where the political geography of the 12 state comes in, because I don't know exactly, right, 13 so I haven't studied carefully the political 14 geography of the state. And, nevertheless, the 15 theorem tells me that no matter what the political 16 geography of Pennsylvania, no matter -- even if you 17 tried to design a state carefully by putting 18 Democrats and Republicans wherever you wanted, for 19 any state that you design, for any political 20 geography in Pennsylvania, the probability that a 21 random districting would have an epsilon value, in 22 our test, as bad as that would be, at most, this 23 p-value, which is .000045. 24 So, in particular, a random districting 25 of Pennsylvania from our bag of districtings would</p>	750	<p>1 changes, the partisanship goes away. And, 2 in particular, it does so dramatically, the 3 overwhelming fraction of districtings that I 4 encounter when I make these changes are 5 fairer than what we have. 6 So somehow, the intuition here is 7 that I started with this districting -- 8 THE COURT: I'm trying to 9 understand by -- I'm -- I don't mean to 10 hijack you -- but math wasn't my strongest 11 suit in school, either. 12 MR. GEFFEN: That's why I went to 13 law school also. 14 THE COURT: I'm trying to 15 understand when you use words like "fairer" 16 or "bad" or "worse." 17 THE WITNESS: Those are all just 18 with respect to the median versus mean. 19 THE COURT: So you're saying 20 that -- that -- so when you're saying that, 21 you're saying the chance it would produce as 22 partisan a shift. 23 THE WITNESS: A partisan shift, 24 yeah. 25 THE COURT: Okay. Okay.</p>
749	<p>1 have probably more than 99.99 percent of passing our 2 test. And this is this rigorous thing that comes 3 from our theorem. 4 So our theorem tells us that -- well, 5 yeah, maybe I've said it enough times. 6 THE COURT: Actually, say it again. 7 THE WITNESS: Okay. Good. 8 So our theorem tells us precisely 9 that if I choose a random districting from 10 the whole bag of alternatives -- and this is 11 remarkable, because I haven't looked at the 12 whole bag -- that it could have probably, at 13 most, 99 -- that it could have probably, 14 rather, at most, .000045 of failing our test 15 as badly as the Congressional districting of 16 Pennsylvania fails it. 17 THE COURT: And that's what I'm 18 trying to understand, you say failing it. 19 You mean it would be as partisan as 20 the current district? 21 THE WITNESS: Right. Well -- or 22 more precisely, having partisanship which 23 evaporates so dramatically, right? 24 So the Epsilon column here captures 25 the extent to which, when I make small</p>	751	<p>1 THE WITNESS: Yeah, exactly. 2 THE COURT: That's what I want to 3 understand: When you're using those terms, 4 that's what you mean. 5 THE WITNESS: "Fairer," "bad," 6 "worse," those are all just about -- yeah, 7 so "fairer" and "bad" are about this 8 partisanship. 9 But I guess when I say the 10 99.99 percent -- so what I'm saying is that 11 99.99 percent of districtings would pass our 12 test in the sense that when I made these 13 random changes, the partisanship wouldn't go 14 away, right? 15 So intuitively what's happening is 16 we start with this map of Pennsylvania and 17 we start making these small changes, right, 18 so Goofy and Donald are getting fuzzier. 19 They're kind of melting away. The 20 districting is changing a little bit, and 21 what we observe is that with those small 22 changes, the districting quickly becomes 23 fairer. Okay? 24 So that's -- that's what this 25 Epsilon column means. When we make these</p>

752	<p>1 small changes, we end up with districtings, 2 an overwhelming fraction of which are fairer 3 than the current districting, according to 4 the median/mean test. 5 And our theorem proves that this is 6 an extremely remarkable property of the 7 current districting, that -- that it's very, 8 very unusual, in a rigorous, quantifiable 9 sense, for a districting to not only have a 10 partisan bias but a partisan bias that goes 11 away when you make small changes to the 12 districting. 13 BY MR. GEFFEN: 14 Q. Professor Pegden, maybe now is a good 15 time to ask you about -- a quick question about a 16 result I see in Row 4 under Partisan Bias, Epsilon 17 Outlier and P-value. I see more zeros after the 18 decimal point there then in the other rows. 19 Can you tell us what those mean? 20 A. Right. So that -- yeah, that row has 21 even more zeros. That row is remarkable because -- 22 right, so remember, the way the test works is that we 23 make this sequence of swaps -- the sequence of moves 24 of precincts into districts. 25 For Row 4, when we did this, after the</p>	754	<p>1 Anticompetitiveness? What does that mean? 2 A. Right. So apart from assessing 3 districtings with respect to partisan bias, we also 4 assess districtings with respect to how 5 anticompetitive they are. And so that works exactly 6 the same way as our partisan bias test, except that 7 we use something else in place of the median/mean 8 test, right, because, remember, the median/mean test 9 was how we evaluate partisan bias. If we replace 10 that with another test, we can evaluate the 11 districting with respect to something else. 12 So for anticompetitiveness, we simply 13 use the variance of those 18 numbers -- remember we 14 had the 18 numbers, which are the level of Republican 15 support in each of the 18 districts? -- and we just 16 look at how widely distributed those numbers are. So 17 it's equivalent to looking at the standard deviation 18 of those numbers. And when that's large, it tells us 19 that -- it tells us that we don't have a lot of close 20 elections; instead, we have a lot of solidly 21 Republican and solidly Democrat districts. 22 And -- right, and so these columns on 23 the right just do our analysis with respect to 24 anticompetitiveness, and you can see that we 25 also have striking numbers, indicating that the</p>
753	<p>1 first -- after the first precinct moves, the 2 districting was a little bit better -- a little bit 3 fairer, that is, and never again was it as unfair as 4 the current districting in Pennsylvania again. So 5 this row represents a case where every districting 6 encountered in the trillion steps of the algorithm 7 exhibited less partisan bias than the current 8 districting. 9 And this is remarkable because it's 10 important to keep in mind that the mechanics of this 11 test involve examining a lot of districtings which 12 are similar in a lot of ways to the current 13 districting. In particular, after a thousand steps, 14 I've only done a thousand little moves, right? You 15 might still see Goofy and Donald there a little bit, 16 but already, it's gotten fairer and -- right. 17 So in that row, the current districting 18 is the only districting that's as bad as what you 19 have. So it really shows that the -- that the 20 districting in Pennsylvania has a very fragile 21 partisan bias which -- yeah, I mean, it has the 22 appearance of something which is extremely carefully 23 crafted. 24 Q. Okay. So looking, again, at Row 6, 25 what about these last two cells in the row under</p>	755	<p>1 districting is very unusual with respect to how 2 anticompetitive it is. 3 Q. So maybe, again, just to reinforce our 4 understanding of what these numbers mean, what would 5 it mean if you ran a row and you got a number with an 6 epsilon value of, say, 0.5? 7 A. So if I ran it for 0.5 -- if I ran -- I 8 got an epsilon value of 0.5, it would mean that when 9 I ran my test and I got these trillions of maps, half 10 of them were more fair and half of them were less 11 fair than the current map. So roughly speaking, that 12 is, I think, what you would expect if you were 13 starting from a really unbiased map. And -- 14 Q. Did you ever observe that in any of 15 your runs for Pennsylvania? 16 A. No, no, never. I have never done a run 17 in Pennsylvania for which you didn't see numbers like 18 this. 19 Q. Okay. Can you draw any overall 20 conclusions from your eight runs? 21 A. Yes. The overall conclusion is that 22 the current Congressional districting in Pennsylvania 23 is really an extreme outlier among the set of all 24 alternatives; it has very, very striking properties 25 with respect to its partisan bias; and political</p>

756	<p>1 geography and traditional districting criteria, as I 2 consider them, cannot explain this phenomenon. 3 Q. And when you say "among the set of all 4 alternatives," what do you mean by that? 5 A. I mean all districtings in these bags 6 that I consider. 7 So for each run, there's a different 8 set of alternatives, and I try all these different 9 alternatives to show that the method is robust to 10 these choices. 11 Q. Can you draw any conclusions about 12 the -- I know you're not a political scientist, but 13 can you, nonetheless, draw any conclusions about 14 Pennsylvania's political geography as an explanation 15 for the partisan bias or anticompetitiveness 16 that -- that you observe in the Congressional 17 plan? 18 A. Right. So -- 19 MR. LEWIS: Objection. 20 THE COURT: What's your objection? 21 MR. LEWIS: It goes beyond the scope 22 of the witness's qualifications as an 23 expert. 24 THE COURT: Response? 25 MR. GEFFEN: I think the witness is</p>	758	<p>1 with a political geography that would favor one party 2 over the other, would you be able to run a test like 3 that -- like yours on a given enacted Congressional 4 Plan for such a state? 5 A. Yeah, you could run the test on such a 6 hypothetical state. And, moreover, these 7 probabilities bounds that my test gives you for the 8 probability that it can give you the wrong answer 9 would be valid for that state or any hypothetical 10 state. Even if somebody tried to create it 11 adversarially -- adversarially to try to somehow mess 12 up my method, they couldn't succeed. 13 That is -- so, remember, the method is 14 very general. Like, I'm not an expert on political 15 science, I'm also not an expert on protein folding, 16 but the method can still be applied in that scenario. 17 You don't have to know something about the landscape 18 of possible protein foldings. 19 In this case, you don't have to know 20 something about the landscape of possible political 21 geographies. There's a theorem that tells you that 22 there's no set of even hypothetical political 23 geographies which could make the theorem lie -- make 24 it be wrong about these answers with probabilities 25 greater than these bounds that I give on the table.</p>
757	<p>1 going to explain why he can use 2 probabilistic tools without needing to know 3 the ins and outs of the, you know, unique 4 political characteristics of different 5 regions of Pennsylvania to, nonetheless, 6 draw a conclusion about whether 7 Pennsylvania's political geography can 8 explain the phenomena that he's observed. 9 THE COURT: I had understood the 10 witness's testimony earlier to say that he 11 didn't know anything about the political 12 geography of Pennsylvania but that it didn't 13 matter for purposes of his report. 14 Did I correctly understand your 15 testimony? 16 THE WITNESS: That's exactly right, 17 yes. 18 THE COURT: So I'm not sure he can 19 answer the question you want to ask him, so 20 I'm going to sustain the objection. 21 BY MR. GEFFEN: 22 Q. Okay. Let me phrase this a little 23 differently. 24 Is it possible that a state -- if you 25 were to set out to construct a hypothetical state</p>	759	<p>1 Q. Thank you. 2 Professor Pegden, how confident are you 3 in the conclusions that you just stated? 4 A. Extremely confident, yes. 5 Q. Is that quantified in your report? 6 A. Yes. So these P columns tell you the 7 probability that what I'm saying could be wrong with 8 respect to the traditional districting criteria that 9 I give you. So I specify very precisely the 10 conditions of the test, and I give you probabilities 11 that I can give the wrong answer with respect to 12 those conditions. 13 Q. Thank you. 14 MR. GEFFEN: Petitioners, at this 15 time, move to admit Petitioners' Exhibits 16 121 and 122 into evidence. 17 THE COURT: Any objection? 18 MR. LEWIS: No objection. 19 THE COURT: Without objection, 20 Petitioners' Exhibits 121 and 122 are 21 admitted. 22 - - - 23 (Whereupon, Petitioners' Exhibit Number 24 121 was admitted into evidence.) 25 - - -</p>

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<p style="text-align: right;">760</p> <p>1 - - - 2 (Whereupon, Petitioners' Exhibit Number 3 122 was admitted into evidence.) 4 - - - 5 MR. GEFFEN: And let's see 6 Petitioners' 117 again, please. 7 BY MR. GEFFEN: 8 Q. Is there material in your expert report 9 that's more technical, mathematical than what you've 10 said on the stand today? 11 A. Yeah, there's some technical 12 descriptions of, for example, the compactness 13 measures; there's details about how to download my 14 code and run it yourselves; things like that. 15 Q. Okay. 16 MR. GEFFEN: Petitioners move to 17 admit Petitioners' Exhibit 117 into 18 evidence. 19 THE COURT: Any objection? 20 Without objection -- do you have an 21 objection? 22 MR. LEWIS: No. I was going to say 23 no. 24 THE COURT: Without objection, 25 Petitioners' 117 is admitted.</p>	<p style="text-align: right;">762</p> <p>1 How did you select voter precincts as 2 the unit that you were swapping in your model? 3 A. Right. So voter precincts are simply 4 the smallest unit which we have precise, nonimputed 5 data for how people voted. So, right, this is the 6 smallest unit of area in which we can say 763 voted 7 for Party A and 322 voted for Party B. 8 Q. Okay. And what is the basis for your 9 belief that that's accurate? 10 A. So my belief is that in elections, when 11 people vote, votes are counted at that level and 12 totaled and are not tracked to individual addresses 13 or individuals, so it's possible to create smaller 14 units in which you have numbers assigned to different 15 parties, but they require some sort of judgment. 16 Like, I could split up a precinct into 17 two smaller parts, but I would have to split the 18 votes then, assuming, for example, that maybe they're 19 distributed proportionally to the area. So while 20 certainly it's possible to create some smaller unit, 21 the precinct is the unit at which I have to make no 22 assumptions at all about how votes split and I have 23 just this perfect count from the elections. 24 Q. Would you agree with me that the 25 composition of what you call your "bag of</p>
<p style="text-align: right;">761</p> <p>1 - - - 2 (Whereupon, Petitioners' Exhibit Number 3 117 was admitted into evidence.) 4 - - - 5 MR. GEFFEN: At this point, 6 Petitioners tender the witness. 7 Thank you. 8 THE COURT: Cross-examination. 9 - - - 10 CROSS-EXAMINATION 11 - - - 12 BY MR. LEWIS: 13 Q. All right. Good morning, Dr. Pegden. 14 Sir, have you ever drawn a 15 Congressional District map before? 16 A. No. 17 Q. Have you ever studied the -- formally 18 the process that a legislature, like Pennsylvania 19 General Assembly, would go through when drawing a 20 district map? 21 A. No. 22 Q. So you've described on Page 4 of your 23 report your Markov chain model as swapping census 24 tracts. Now, I know you've since said that you used 25 voter precincts.</p>	<p style="text-align: right;">763</p> <p>1 districtings" is key to your findings? 2 A. Well, one of my findings is that the 3 particular bag of districting does not appear to have 4 an effect on my results. This is why I choose eight 5 different bags. It's not because I have exactly 6 eight favorites. It's just that I want to show that 7 when I use different choices, I get very similar 8 results. 9 Q. Well, but the point -- I guess where I 10 was going with this is, your test depends upon the -- 11 the factors you use to identify whether your swap in 12 your -- in your Markov chain is valued, correct? 13 A. Yes. 14 Q. Okay. 15 A. I mean, certainly, I'll agree that, in 16 principle, the bag affects the test, which is why I 17 make this robust -- make this robustness check, to 18 show that the bag does not actually seem to have an 19 effect on whether we find the 2011 districting in 20 Pennsylvania, in particular, is an outlier. 21 Q. Okay. Why didn't you run your model 22 with a 0 percent population deviation? 23 I mean, I know you -- you gave your 24 theoretical reasons. 25 Why didn't you just have your computer</p>

764	<p>1 just do it?</p> <p>2 A. So you can't just have the computer</p> <p>3 just do it, because the computer has to have some way</p> <p>4 of estimating -- for example, one thing the computer</p> <p>5 has to be able to do to do the test is have an</p> <p>6 estimate for each district that you draw of the -- of</p> <p>7 the Republican and Democratic affiliation in that</p> <p>8 district. And the way my program -- the way my</p> <p>9 method assigns those affiliations is just by looking</p> <p>10 at vote counts from an actual election, because</p> <p>11 that's a -- seems like a very simple principled way</p> <p>12 of doing this. And I -- there is no data that tells</p> <p>13 me how a particular John Smith voted, so I can't</p> <p>14 break down into smaller units and still do it exactly</p> <p>15 the same way.</p> <p>16 Q. Okay. Now, you did attempt to use</p> <p>17 1 percent population deviation, correct?</p> <p>18 A. Yes.</p> <p>19 Q. Could you have used a half a percent</p> <p>20 population deviation?</p> <p>21 A. I -- I could have run the test with a</p> <p>22 half percent, yes. And, in fact, not just me, but</p> <p>23 anybody could have. This is one of the important</p> <p>24 parts of my method is that the code is on my Web</p> <p>25 site. It's been there for almost a year now, at</p>	766	<p>1 let's run it for two weeks and get a lot of zeros so</p> <p>2 that people are really convinced.</p> <p>3 Q. And you say when you ran the test with</p> <p>4 a 1 percent constraint, that it took -- it was, you</p> <p>5 said, slightly slower.</p> <p>6 I believe I -- hopefully, I got that</p> <p>7 right.</p> <p>8 A. Yeah, absolutely. Yeah, the test runs</p> <p>9 slower with a 1 percent constraint, and that's just</p> <p>10 for the technical reason that fewer swaps succeed,</p> <p>11 right? Intuitively, when I make a swap, it's more</p> <p>12 likely to mess up the population constraint or any</p> <p>13 constraint when the constraint is more restrictive.</p> <p>14 Q. Okay. How much more slowly did -- did</p> <p>15 it run with -- with the 1 percent versus the 2</p> <p>16 percent?</p> <p>17 A. Maybe 40 percent slower. I really</p> <p>18 don't know exactly, but it wasn't dramatic. So I</p> <p>19 think running in the half trillion steps, so</p> <p>20 returning it for half as many steps still took maybe</p> <p>21 roughly as long as the trillion-step runs for the --</p> <p>22 for the others. I -- I -- but I don't remember</p> <p>23 exactly.</p> <p>24 Q. Sure. The 1 trillion were -- were</p> <p>25 steps.</p>
765	<p>1 least, and it includes instructions for how to</p> <p>2 install the program and run it with different</p> <p>3 constraints.</p> <p>4 So, yeah. And people really do that.</p> <p>5 I have received e-mails from people that do that.</p> <p>6 They sometimes ask questions about implementing new</p> <p>7 features. And, absolutely, you can -- you can try</p> <p>8 different population constraints, yeah.</p> <p>9 Q. On Page 4 of your report, you indicated</p> <p>10 that when you ran the report -- I think -- let's get</p> <p>11 the language.</p> <p>12 How long did it take you to -- how long</p> <p>13 did it take your computer to complete each of the</p> <p>14 eight Markov chain runs that you prepared for your</p> <p>15 report?</p> <p>16 A. Yeah, so two of the 40 steps, on my</p> <p>17 computer, takes on the order of maybe 10 to 15 days.</p> <p>18 But I should say, actually, that, you know, maybe as</p> <p>19 a mathematician, I really -- I have an affinity for</p> <p>20 extreme precision, so I really like that my table has</p> <p>21 all these zeros in it.</p> <p>22 You can run the test for 30 minutes or</p> <p>23 an hour and get some level of statistical difference</p> <p>24 that would be good enough in drug trials or in many</p> <p>25 areas of science; but, for me, I -- I say, well,</p>	767	<p>1 Can you explain -- just explaining very</p> <p>2 briefly -- what a step is?</p> <p>3 A. A step is I choose a random precinct on</p> <p>4 the boundary; I attempt to swap -- a move. So I</p> <p>5 attempt to move this precinct from the district it's</p> <p>6 in to the one on the other side of the boundary. And</p> <p>7 the steps -- and the move will happen if it's valid,</p> <p>8 if it doesn't mess up my constraints, and it won't</p> <p>9 happen if it does. So when the step ends, you have</p> <p>10 another map which is -- either has not changed</p> <p>11 because this particular move didn't succeed or it</p> <p>12 changed.</p> <p>13 Q. Okay. So a step is a step regardless</p> <p>14 of whether the step succeeds or not?</p> <p>15 A. It's a step regardless of whether</p> <p>16 the -- the map repeats, right. So there can be</p> <p>17 repetition in maps, absolutely, yeah.</p> <p>18 Q. Okay. Do you have a sense for how many</p> <p>19 actual maps were generated by your -- by your model</p> <p>20 for each one?</p> <p>21 A. Yeah. So is it possible to refer to my</p> <p>22 table when I answer this question?</p> <p>23 Q. Sure.</p> <p>24 Which table do you need?</p> <p>25 A. So it's the only -- I think it's the</p>

<p style="text-align: right;">768</p> <p>1 only table in the report. It's on Page 8 of the 2 report. 3 Q. I'm going to zoom in. 4 A. Zoom in, exactly. 5 Q. Wait. We have this. This is one of 6 the exhibits. It's this one. 7 A. Perfect, exactly. 8 Q. Right. 9 A. Right. So if you maybe make that 10 bigger. 11 Right. So, for example, we can talk 12 about Row 6. This was just -- this is what was used 13 for Figure 2. The Epsilon column tells you that only 14 97 out of 100 billion maps encountered were as bad as 15 the initial map, which, in particular, tells you that 16 a lot of maps were encountered, right? If I only 17 encountered 10,000 maps, then the worst result I 18 could get would be 1 out of 10,000, right? So a lot 19 of maps are certainly generated. 20 So something else I should say maybe 21 more generally is that -- right, so I think I 22 understand that it's natural when thinking about this 23 method to think about different things that it seems 24 might go wrong, like couldn't maps repeat; couldn't 25 this cause a problem. There are all sorts of little</p>	<p style="text-align: right;">770</p> <p>1 A. So let me see exactly what I said in 2 this sentence. You're right that I don't provide 3 this detailed analysis. Let me see exactly what I 4 say. 5 Right. So I think in my report, I do 6 precisely explain my claim, which is that the maps 7 exhibit more partisan bias than could be corrected 8 for in this procedure. And I provide the maps. 9 Moreover, I provide the program that generates the 10 maps. 11 So people can -- I mean, this claim 12 that I've made is publicly verifiable in -- in a very 13 transparent way. 14 Q. But your model is incapable of viewing 15 the detail of a map below the precinct level, 16 correct? 17 A. I'm not sure I understand what that 18 means. 19 Q. Well, you've indicated that your bag of 20 districtings -- that your -- your Markov chain is 21 unable to split a unit smaller than -- I'll use the 22 term "voter tabulation district"; you use the term 23 "precinct" -- because you don't have the partisan 24 data beneath that -- that layer or beneath that 25 level, that precinct level, correct?</p>
<p style="text-align: right;">769</p> <p>1 things like this that you might think could create 2 some weird effect in my method, it -- in -- in the 3 way I use to evaluate districtings. 4 The point of this P column here in this 5 table is that -- it's a probability that any -- any 6 of those things that can go wrong in a way that makes 7 me actually give you the wrong answer. 8 So, in particular, if the general 9 question is, Can't repeated maps somehow lead you to 10 draw an incorrect conclusion about Pennsylvania, the 11 probability that I draw an incorrect conclusion for 12 that reason or any other reason of that type is, at 13 most, .00045 for this run. So my -- my theorem 14 accounts for exactly the situation. 15 Q. Okay. You explained one of your 16 justifications for using a model that has 2 percent 17 -- or in a couple of instances, you use 1 percent -- 18 population deviation by suggesting that if a mapmaker 19 then adjusted at below the precinct level to match 20 population equality, that they could never achieve -- 21 or that that process could never achieve a similar 22 level of mean/median skew as the observed map. 23 Your report and your article don't 24 provide an explanation for how you reach that 25 conclusion, did they?</p>	<p style="text-align: right;">771</p> <p>1 A. Right. So, by design, my Markov chain 2 never splits precincts. Let's put it that way. It's 3 designed to work at the precinct level. 4 Q. All right. I'd like to return now to 5 your -- and it appears on Page 3 of your report. 6 Here, let's pull it up. It's not 7 highlighting. 8 All right. So I've pulled up what's 9 Page 3 of your report, Petitioners' Exhibit 10 Number 117. 11 So do I understand, then, that P1 12 through 3 you ran for all eight of your chains, 13 correct? 14 A. Right, all eight chains require 18 15 contiguous district -- 18 contiguous districts' 16 populations to be roughly equal and to have compact 17 districts according to some metric. 18 Q. Okay. How did you select the -- the 19 upper allowable limit for compactness in your -- in 20 your simulation -- in your Markov chains? 21 A. Right. 22 So, again, the key principle of my 23 method is to compare the current districting to 24 districtings sort of just as bad as it, in non -- in 25 nonpartisan terms. So I simply set the threshold to</p>

772	<p>1 be a few percent higher than the value of the current</p> <p>2 districting, so just barely enough to include the</p> <p>3 current districting in the bag.</p> <p>4 Q. Did you run a -- a test that used</p> <p>5 perhaps a higher allowable limit for compactness?</p> <p>6 A. So that's not in my report. I've run</p> <p>7 those tests, and they give similar results. Somehow,</p> <p>8 like, allowing a higher threshold of compactness, in</p> <p>9 some sense, makes it even more likely that you find</p> <p>10 the districting is gerrymandered. But, yeah, I mean,</p> <p>11 maybe we shouldn't go into the details of that. But</p> <p>12 I've run such things and never seen a nonsignificant</p> <p>13 result.</p> <p>14 Q. Okay. But you didn't do that for</p> <p>15 purposes of your testimony here today?</p> <p>16 A. No, absolutely not. My purpose for</p> <p>17 this report was to give a reasonable accessible list</p> <p>18 of constraints. I tried to not even get into the</p> <p>19 details of thresholds, right, because I felt like</p> <p>20 there's already enough zeros and numbers in this</p> <p>21 report as it is.</p> <p>22 Q. Did you -- why did you not run a set</p> <p>23 of -- or impose a property constraint, one of your P</p> <p>24 subsets here, for avoiding the split of a</p> <p>25 municipality in Pennsylvania?</p>	774	<p>1 current districting would seem -- would -- would --</p> <p>2 which would seem to align with some sort of</p> <p>3 reasonable criteria that the current districting</p> <p>4 would follow. It's a question of what can be</p> <p>5 rigorously defined, yeah.</p> <p>6 Q. But are you aware, sir -- are you</p> <p>7 aware, sir, that a traditional districting criteria</p> <p>8 that actual mapmakers, you know, try to follow is to</p> <p>9 avoid the splitting of municipality -- municipalities</p> <p>10 in Pennsylvania?</p> <p>11 A. So, absolutely, I'm aware generally</p> <p>12 that this is stated as a goal often. I'm also aware</p> <p>13 that it's disputed, the extent to which this is done.</p> <p>14 And remember, so, like, this is an important</p> <p>15 distinction between my method and other methods, is</p> <p>16 that my goal is really to compare Pennsylvania to</p> <p>17 districtings just as bad as the current districting,</p> <p>18 so I can't come up -- I can't work with a</p> <p>19 hypothetical districting criteria for which we can't</p> <p>20 quantify the extent to which the current mapmakers</p> <p>21 succeeded at this goal and just run with that as how</p> <p>22 I do my analysis.</p> <p>23 I mean, I should also say that if</p> <p>24 somebody else has a good idea for how to do that,</p> <p>25 this is part of why I make my code and my software</p>
773	<p>1 A. Yeah, so that's a -- it's a reasonable</p> <p>2 constraint to consider. As I said, I tried to focus</p> <p>3 on a specific natural set of constraints.</p> <p>4 When it comes to splitting</p> <p>5 municipalities, I think it's also not immediately</p> <p>6 clear how to prioritize such splits. So, for</p> <p>7 example, is splitting -- would splitting up</p> <p>8 Pittsburgh be as bad as splitting five small towns or</p> <p>9 10 small towns? It involves some judgments that I'm</p> <p>10 reluctant to make. And, in any case, the current</p> <p>11 districting does not seem to be terrific at avoiding</p> <p>12 splitting towns and cities by any means, so it was</p> <p>13 not clear, to me, that this was a crucial factor in</p> <p>14 the drawing of the current districting.</p> <p>15 Q. Okay. Dr. Pegden, what do you rely</p> <p>16 upon for the conclusion that you -- you just</p> <p>17 gave -- the opinion that you just gave that the</p> <p>18 current map is not great at splitting municipalities</p> <p>19 or counties?</p> <p>20 A. So -- yeah, so what I'm saying there is</p> <p>21 that -- so recall, the basis of this method is that I</p> <p>22 have this list of properties, these are mathematical</p> <p>23 constraints in the bag, okay? So what -- I don't</p> <p>24 know a mathematical way of constraining how I can</p> <p>25 split municipalities in a districting which the</p>	775	<p>1 available with documentation, right? And I've had</p> <p>2 questions from people, How do I implement new</p> <p>3 features? I think I'm fairly responsive. I haven't</p> <p>4 heard ideas for how to do this.</p> <p>5 THE COURT: Counsel, may I ask a</p> <p>6 question?</p> <p>7 MR. LEWIS: Yes.</p> <p>8 THE COURT: I just want to</p> <p>9 understand your answer.</p> <p>10 THE WITNESS: Yeah.</p> <p>11 THE COURT: As I understood your</p> <p>12 answer with regard to compactness, you set a</p> <p>13 measure that would allow the current map to</p> <p>14 satisfy.</p> <p>15 THE WITNESS: Yes, absolutely.</p> <p>16 THE COURT: I would assume it would</p> <p>17 be the outer measure of compactness of the</p> <p>18 current map?</p> <p>19 THE WITNESS: Exactly, yeah.</p> <p>20 THE COURT: Explain in your last</p> <p>21 answer how could you not do that with the</p> <p>22 municipal splits by setting the outer number</p> <p>23 at what the current map has.</p> <p>24 THE WITNESS: So you're absolutely</p> <p>25 right that if you just cared about the</p>

776	<p>1 number of splits, you could -- you could</p> <p>2 just set a threshold like that. But it's</p> <p>3 actually not clear, to me, that just the</p> <p>4 number of splits is what you should care</p> <p>5 about, right?</p> <p>6 I mean, Philadelphia is --</p> <p>7 splitting Pittsburgh is not the same as</p> <p>8 splitting Scranton, for example, and --</p> <p>9 THE COURT: Okay.</p> <p>10 THE WITNESS: Well, it's just not</p> <p>11 clear, to me, as -- I mean, from where I</p> <p>12 sit, it's not clear, to me, that splitting a</p> <p>13 large center is the same as splitting a</p> <p>14 small center. I don't know. So --</p> <p>15 MR. LEWIS: Your Honor, I didn't</p> <p>16 want to interrupt Your Honor's colloquy with</p> <p>17 the witness, but I would actually move to</p> <p>18 strike that answer on the basis that this</p> <p>19 witness has not been proffered as an expert</p> <p>20 in the field of political science.</p> <p>21 THE COURT: Overruled.</p> <p>22 MR. LEWIS: Okay.</p> <p>23 THE COURT: He's answering my</p> <p>24 question.</p> <p>25 MR. LEWIS: Fair enough.</p>	778	<p>1 an avoidance of municipal splits in your model, would</p> <p>2 that have affected what you call the "bag of</p> <p>3 districts" that you're using to compare the candidate</p> <p>4 district, i.e., Act 131?</p> <p>5 A. Absolutely. And I can say that in</p> <p>6 general, for -- I think what should be clear is it</p> <p>7 that for any list of constraints I could have, even</p> <p>8 in principle, put in this report, we can always</p> <p>9 imagine an 11th constraint that I didn't try. And</p> <p>10 it's always true that in principle, that 11th</p> <p>11 constraint does change the bag. Right?</p> <p>12 So my way of addressing this is both to</p> <p>13 try many different constraints and to provide the</p> <p>14 tools to do so to anybody that wants to use them.</p> <p>15 Q. Okay. Sir, just to -- I just want to</p> <p>16 return very, very briefly to the -- to the population</p> <p>17 deviation issue on Pages 3 and 4 of your report.</p> <p>18 If you need me to scroll here -- I</p> <p>19 think I've got the section I need. If you need me to</p> <p>20 scroll, I will do it.</p> <p>21 A. I'm going to look at my report.</p> <p>22 Q. Okay. So you assert -- oh, right</p> <p>23 here.</p> <p>24 The second bullet point, you assert</p> <p>25 that you would expect to see warning signs --</p>
777	<p>1 THE COURT: I'd have to strike my</p> <p>2 question.</p> <p>3 MR. LEWIS: I had to try,</p> <p>4 Your Honor.</p> <p>5 THE COURT: You're welcome to</p> <p>6 follow up on my question if you would like.</p> <p>7 MR. LEWIS: Thank you.</p> <p>8 BY MR. LEWIS:</p> <p>9 Q. Dr. Pegden, what is the basis for your</p> <p>10 opinion that splitting Pittsburgh is not the same as</p> <p>11 splitting Philadelphia?</p> <p>12 A. I think the exact three words I used</p> <p>13 were "I don't know," right? So I don't have a basis</p> <p>14 for an opinion that they're different so much as it's</p> <p>15 not clear, to me, that I should consider -- like,</p> <p>16 making this judgment that I just consider them equal,</p> <p>17 I consider that a value judgment which I don't really</p> <p>18 have a basis to make. I haven't been given the</p> <p>19 criteria that was -- that were used to draw the</p> <p>20 current map --</p> <p>21 Q. Absolutely.</p> <p>22 A. -- and so I don't have a basis for</p> <p>23 saying I will consider all towns and city splits</p> <p>24 equal and set a threshold.</p> <p>25 Q. Okay. So, sir, if you had considered</p>	779	<p>1 A. This is the third bullet point.</p> <p>2 There's one on the previous page.</p> <p>3 Q. True.</p> <p>4 A. Yes.</p> <p>5 Q. It serves me right for scrolling.</p> <p>6 So you assert as one of your</p> <p>7 explanations for not using -- or for why using</p> <p>8 something greater than 0 percent population deviation</p> <p>9 is appropriate, because you would expect to see</p> <p>10 warning signs when you went from 2 percent to</p> <p>11 1 percent.</p> <p>12 What's the basis for your opinion that</p> <p>13 you would see warning signs from 2 percent to</p> <p>14 1 percent?</p> <p>15 A. Yeah. So let me explain -- yeah, the</p> <p>16 relationship between these bullet points.</p> <p>17 For me, as a mathematician who feels</p> <p>18 very comfortable with my understanding of my method,</p> <p>19 the second bullet point -- so the first one on this</p> <p>20 page -- is really the reason why I am confident that</p> <p>21 the population difference cannot account for my</p> <p>22 findings.</p> <p>23 However, I realize that not every</p> <p>24 person that has to interact with this method may be</p> <p>25 completely comfortable with all of the details that</p>

780	<p>1 it entails. And so, for that reason, I carry out 2 this -- let's call it a "sanity check" on the method. 3 I've claimed to you that I have a -- 4 a -- a good, principled, technical reason that 5 population -- the population deviation I consider of 6 2 percent does not -- does not undermine my 7 conclusion. 8 Without knowing the details of my 9 method, I think a reasonable question for you to ask 10 would be, Well, have you tried changing the 11 population threshold to see if it affects it? And so 12 I do this as -- this sort of demonstration to some, 13 you know, person who doesn't want to have to interact 14 with the technical details of my method or my 15 reasoning in this bullet point for why the population 16 difference doesn't matter, that it does pass the 17 sanity check. When I change my population threshold 18 from 2 percent to 1 percent, I don't see a 19 degradation in my results. 20 Q. Sir, does your model take into account 21 incubency protection? 22 A. No, I don't do any analysis of 23 incubency protection in this report. 24 Q. Okay. Does your model also take into 25 account a hypothetical districting goal of the</p>	782	<p>1 the one used in my report, where you make small 2 changes to the districting. 3 But I will admit that it was not an 4 explicit goal to do this; however, I think that it is 5 actually the case that the comparisons I'm making are 6 largely to districtings that share the cores. 7 Now -- I mean -- but you're right. Let 8 me -- maybe just to satisfy you, let me say I have 9 not presented explicit data in this report about this 10 question. 11 Q. Okay. Let's talk a little bit about 12 the measurement of -- of partisan bias. 13 How did you select the measurement of 14 partisan bias that you rely upon in your report? 15 A. So what I really like about the median 16 versus mean test is that it's simple, transparent. I 17 can explain to anybody what the calculation is, and I 18 didn't make it up. It's been used for more than 19 100 years to measure partisan bias in districting, so 20 it's a standard, simple, transparent metric. 21 Q. How did you determine that it's a 22 standard metric? 23 A. It's, I mean, used in a lot of 24 publications. I mean, it literally has more than a 25 100-year history in -- in use in evaluating partisan</p>
781	<p>1 preservation of the cores of prior districts? 2 A. So it doesn't explicitly take this into 3 account; however, the nature of my method, where I 4 make small changes to districtings and then observe 5 them -- observe that things change quickly, the 6 nature of that mentioned means that, actually, a lot 7 of my comparisons are to districts that share their 8 cores with the initial districting. 9 So although it's not an explicit goal 10 of my analysis, a side effect of the way do I things 11 is that I do -- is that a lot of the comparisons I'm 12 making are actually comparisons of that type. 13 Q. Okay. But you haven't done that 14 analysis rigorously in your report, have you? 15 A. I mean, I've done a rigorous analysis 16 in my report, and I'm telling you that the nature of 17 the analysis does mean that it does compare the 18 districting to other districtings with the same core. 19 So I don't actually know a 20 well-agreed-upon notion of what it means to share a 21 core. So when this is -- when people -- so in the 22 literature, when I've seen people talk about methods 23 to evaluate districtings in ways that respect this 24 notion of sharing a core of -- of a district, the 25 method that people are using are exactly methods like</p>	783	<p>1 bias. 2 Q. Okay. Did you consider any other 3 measurements of partisan bias? 4 A. I have -- for Pennsylvania, I didn't 5 use any metrics other than the median versus mean 6 test and then the anticompetitiveness test, which is 7 the variance. So, specifically, I want -- it would 8 be bad if I sort of shopped around for a partisan 9 bias metric until I found one that worked. And 10 that's not what -- and I did not do that. 11 So I tried to make principled, simple, 12 transparent choices of metrics and then apply those. 13 Q. How did you select the data that you 14 used to draw your comparison -- or -- or to -- to 15 perform the median/mean measurement? You indicated 16 it was one midterm Senate race in 2010, correct? 17 A. Right. I used the Sestak/Toomey 2010 18 race, yes. 19 Q. And how did you select that race? 20 A. That was simply because it was a 21 statewide race, and it was among the most recent data 22 available to the mapmakers who drew the current map. 23 Q. And did you make that decision based on 24 any expertise in the field of political science? 25 A. I don't have expertise in the field of</p>

784	<p>1 political science, if that's what you mean, but I did 2 discuss the choice with people that work in this 3 field. So I don't -- I'm not sure where that places 4 the answer to your question. 5 Q. You indicated that another expert in 6 this case provided you with the partisan data that 7 you relied upon, correct? 8 If I misstated, please let me know. 9 A. Yeah. So what happened is we 10 downloaded the data from a public Harvard election 11 data archive. So I never communicated -- there was 12 no back-and-forth. There's a public data archive of 13 prepared data in which people have, you know, taken 14 the voting data, done the assignments of the 15 appropriate precinct shapefiles, worked through 16 problems in the precincts and problems in the data, 17 and then provided the final product. 18 Q. Okay. No. I thank you for that 19 clarification. I wasn't sure where -- your answer 20 was a bit unclear on direct, so thank you for that. 21 Did you run your model with, perhaps, 22 other statewide election results in the relevant time 23 period? 24 A. For Pennsylvania, we didn't run our 25 method with any other results. And, again, that</p>	786	<p>1 draw districtings, as we talked about before. 2 Really, the key application of the 3 method is in detecting that a particular districting 4 is an extreme outlier with respect to partisan bias. 5 So I can -- I can detect that you have a problem, but 6 I can't tell you ahead of time sort of what the right 7 seat split is. 8 Q. They told me when I went to law school 9 there wouldn't be math involved, and now I think we 10 may have to get some -- and I think I may have 11 discovered this morning that statement was false. 12 A. Okay. I'm very happy to hear that. 13 Q. When you talk about the bag of 14 districtings, is it your contention that all possible 15 districtings that would satisfy your criteria exist 16 in the bag that you're measuring? 17 A. Yes, right. So it's not a question of 18 what I'm measuring. Like, the bag is an abstract 19 object, right? So in my report, I define a bag of 20 districtings. It's exactly the set of all 21 districtings satisfying the criteria I lay out. 22 So any time I talk about a "bag of 23 districtings," I'm talking about the set of all 24 possibilities. 25 Q. So we've talked a little bit about a</p>
785	<p>1 should be important to you, because it should be 2 important that I didn't shop around for -- for data 3 that worked well for what I wanted. 4 Q. Okay. And, Dr. Pegden, in fact, your 5 model can't really tell us how many -- and this goes 6 to -- you've made some comments this morning that -- 7 you know, describing Act 131 in terms of fairness, 8 correct? 9 A. Sure. 10 Q. You said that you think a map is more 11 fair or -- or less fair? 12 A. In fair, there was always just a 13 standard for the mean/median test. So that was 14 always just an informal way for me summarizing the 15 outcome of the mean/median test for particular 16 districting. 17 Q. Okay. So, Dr. Pegden, is it not true 18 that your model is not able to, for example, predict 19 how many seats Republicans or Democrats, you know, 20 should win, correct? 21 A. Absolutely, that's true. So there are 22 a couple of things that my model should not be used 23 for. It shouldn't be used to tell you the correct 24 number of seats in a Republican -- in a districting 25 of Pennsylvania, and it should also not be used to</p>	787	<p>1 Markov chain. 2 How does a Markov -- how does a Markov 3 chain work? 4 A. So a Markov chain is a sequence of 5 random observations where each observation can depend 6 on the previous observation but, beyond that, not on 7 things that came before it. So it's often described 8 as a -- as a memory -- memory list random process. 9 So the standard example might be a 10 person randomly walking around a city. So at each 11 time point, they're at a different street corner. 12 They make a random choice of where to go next. Okay? 13 So at any time, when you observe where 14 they are, the -- their location is a random 15 observation. And, of course, it depends on where 16 they were on the previous time step. 17 But the Markov property -- the Markov 18 chain means that suppose I tell you where they were 19 at time 10. Telling where they were at time 5 gives 20 you no extra information about where they might be at 21 time 11. Time 10 is as much information as you can 22 really use. 23 So maybe I should just, for -- for 24 clarity, in the case of redistricting or a Markov 25 chain, it's acting on the districting. So somehow</p>

788	<p>1 the person walking around the city is the</p> <p>2 districtings walking around the bag.</p> <p>3 So this is -- so it's -- it's kind of</p> <p>4 weird, but it's -- so, in general, a Markov chain</p> <p>5 is -- it's a sequence of random changes being made to</p> <p>6 something, and that something can be any of a number</p> <p>7 of diverse things.</p> <p>8 Q. Okay. And you have a figure -- and I'm</p> <p>9 referring now to Petitioners' Exhibit 119, which is</p> <p>10 your article in the Proceedings of the National</p> <p>11 Academy of Sciences.</p> <p>12 Let me zoom in here --</p> <p>13 A. Yes.</p> <p>14 Q. -- referring to Figure 1. And this is</p> <p>15 on Page 2861 of that -- that report.</p> <p>16 Okay.</p> <p>17 Sir, do I understand correctly that</p> <p>18 this figure -- the green dot surrounded by a lot of</p> <p>19 pink dots surrounded by more green dots, correct?</p> <p>20 A. That is an accurate graphical</p> <p>21 description of the picture, yes.</p> <p>22 Q. We're good there.</p> <p>23 Can you explain with this figure what</p> <p>24 the Markov chain is actually doing?</p> <p>25 A. Yeah. I should emphasize, first off --</p>	790	<p>1 A. -- possibly astronomically. We don't</p> <p>2 really have a good idea of how many there are.</p> <p>3 Anyone that gives you a precise number -- they say</p> <p>4 it's at least this or, at most this -- I would be</p> <p>5 skeptical of. But it's probably quite large, yeah.</p> <p>6 Q. Okay. Does your -- but the specific</p> <p>7 model that you used was slightly different than a</p> <p>8 traditional Markov chain analysis; is that correct?</p> <p>9 A. So our whole paper is about a new kind</p> <p>10 of Markov chain analysis --</p> <p>11 Q. Right.</p> <p>12 A. -- and that's what we do.</p> <p>13 Q. Okay.</p> <p>14 A. Does that answer your question?</p> <p>15 Q. Yes.</p> <p>16 A. Okay.</p> <p>17 Q. Can you describe what -- let me ask</p> <p>18 this a different way.</p> <p>19 You describe on Page 4 of your</p> <p>20 report -- and, again, if you need me to scroll, I'm</p> <p>21 happy to do it for you.</p> <p>22 A. Would you like me to describe the</p> <p>23 difference between a traditional Markov chain</p> <p>24 analysis and what I do --</p> <p>25 Q. Sure --</p>
789	<p>1 so this picture is about an abstract Markov chain --</p> <p>2 Q. Sure.</p> <p>3 A. -- so one can imagine that the dots</p> <p>4 here represent configurations in your Markov chain.</p> <p>5 So, for example, they might represent the city street</p> <p>6 corners and -- in the example where somebody is</p> <p>7 walking around the city --</p> <p>8 Q. Sure.</p> <p>9 A. -- so each step that the person takes,</p> <p>10 they -- they pick one of their four random</p> <p>11 neighboring locations and take a step to that</p> <p>12 location --</p> <p>13 Q. Okay.</p> <p>14 A. -- and the point of this picture is</p> <p>15 somehow that -- like, this is just supposed to be one</p> <p>16 small part of the Markov chain. Possibly, the Markov</p> <p>17 chain extends out way beyond this figure, and you</p> <p>18 have, potentially, no idea what's there, the way we</p> <p>19 apply our test.</p> <p>20 Q. Okay.</p> <p>21 Okay. Now, you got -- you've mentioned</p> <p>22 before the astronomically large number of possible</p> <p>23 districtings --</p> <p>24 A. Yes --</p> <p>25 Q. -- that could be in --</p>	791	<p>1 A. -- is that what you're looking for?</p> <p>2 Q. -- we'll make that easy. Go ahead.</p> <p>3 A. Okay. Right. So a traditional -- so</p> <p>4 remember I talked about there are these -- these</p> <p>5 naive and classical methods for detecting that</p> <p>6 something is an outlier; Method 1 is looking at</p> <p>7 everything in the bag; Method 2 is drawing random</p> <p>8 samples from the bag. Okay?</p> <p>9 One way that Markov chains are</p> <p>10 sometimes used is as a way to actually try to draw</p> <p>11 random samples from the bag. Okay?</p> <p>12 So this person that's walking randomly</p> <p>13 around the city, okay, suppose I start him, you know,</p> <p>14 at the embassy, okay, and he starts walking randomly</p> <p>15 around the city. Maybe in the first 100 steps he</p> <p>16 takes, he's still maybe kind of close to the embassy.</p> <p>17 His location still has a lot of dependence on where</p> <p>18 he started. Okay. But, actually, if I let him walk</p> <p>19 for long enough, eventually, he really will be at a</p> <p>20 random point in the city in a way that can be</p> <p>21 quantified.</p> <p>22 So you can -- you can quantifiably say</p> <p>23 that he is almost equally likely to be anywhere in</p> <p>24 the city.</p> <p>25 And this is the way Markov chains are</p>

CROSS-EXAMINATION - WESLEY PEGDEN, PH.D.

792	<p>1 often used in statistics. This is -- Markov 2 chain/Monte Carlo methods are running Markov chains 3 for a really long time so that, actually, now, you 4 get a random sample from the bag. And then -- so you 5 run the chain for a long time, you get a sample, and 6 now you maybe do that a thousand times, and you have 7 a thousand samples. 8 So there's this problem -- if you're a 9 mathematician, there's a problem. If you're a 10 scientist, there's no problem. 11 If you're a mathematician, there's a 12 problem with this method, which is that -- remember I 13 said that if you run the Markov chains for long 14 enough, you'll be getting actually random points in 15 the city. Okay? 16 And, actually, there are general 17 theorems that tell you that's the case in very 18 general settings. The problem is the theorems don't 19 tell you how long you have to run the Markov chain 20 for. Okay? 21 So in principle, you may have -- you 22 don't know how long you have to run the Markov chain 23 for, and so you can't really just run it for long 24 enough and then assert you have a good sample. 25 Now, like I said, this is only a</p>	794	<p>1 But, I mean, as -- as a mathematician 2 and probabilist, I'm interested in what I can do with 3 a -- with a proof behind me. 4 And our third way of doing this kind of 5 statistical analysis allows you to show that 6 something is an outlier using a Markov chain without 7 knowing the mixing time. 8 So that's why the title of the paper is 9 Assessing significance in a Markov chain without 10 mixing. So the idea is I can get a rigorous p-value 11 telling you the probability that the method is giving 12 incorrect answers. That's assessing significance 13 using Markov chain but without knowing anything about 14 how fast the Markov chain is mixing. 15 Q. Okay. And how does your test -- how 16 does your test accomplish that goal of allowing you 17 to draw random sample without knowing the -- 18 A. Okay. 19 So we don't draw random sample -- 20 Q. You don't draw a random sample? 21 A. Right, we do not draw a random sample. 22 That's Method 2. Method 2, you draw random samples. 23 The way our method works is by -- so, 24 okay, here's an analogy. Okay. So -- 25 THE COURT: Because I'm lost on the</p>
793	<p>1 problem if you're a mathematician. 2 Across fields of science, people do use 3 Markov chains in all sorts of crucial fields that we 4 rely on in all aspects of our life, and they're 5 just -- they make reasonable assumptions about how 6 long they have to run the chain before they know 7 they're getting a random sample. 8 As a mathematician, I want to say I 9 have a proof that what I'm doing has a certain 10 property. In this case, the probability that I'm 11 wrong is, at most, this. 12 So in the case of the redistricting 13 Markov chain, in particular, nobody knows how long 14 you have to run -- nobody has the proof that says, If 15 I run the chain for this long, now I'm getting random 16 samples. So this is called the mixing time of the 17 Markov chain, how long you have to run the chain 18 before you're really getting random samples. 19 And nobody rigorously, from a 20 mathematician's point of view, knows the mixing time 21 of redistricting Markov chain. I think it's -- 22 honestly, I think it's still reasonable to do 23 analyses with Markov chains in this 24 not-quite-mathematically rigorous way. And people do 25 them, and I think it's a reasonable analysis.</p>	795	<p>1 embassy analogy. 2 THE WITNESS: So let's go back to 3 the embassy analogy -- 4 THE COURT: Okay. 5 THE WITNESS: -- and let's really 6 just work it. Okay? 7 THE COURT: Okay. 8 THE WITNESS: Okay. So suppose you 9 show up in -- 10 THE COURT: You heard my 11 Etch A Sketch thing yesterday? 12 THE WITNESS: I liked that a lot, 13 actually. That's good, yeah. 14 BY MR. LEWIS: 15 Q. I was going to suggest PAC-MAN to 16 follow in the same thing. Let's stick with the city. 17 A. Okay. 18 Q. So we can try to figure out how to 19 adjust it to PAC-MAN afterwards. 20 Suppose you show up in the city, you 21 fly in, it's your first time you're ever there, you 22 know nothing about the city. And what you tell the 23 taxi driver is, I'm hungry. I just want you to take 24 me to a random restaurant in the city, something 25 really representative. Just pick one randomly, take</p>

796	<p>1 me there.</p> <p>2 Suppose the taxi driver drives you to</p> <p>3 the restaurant, you say, That's great, thanks a lot,</p> <p>4 you give him a big tip, you go into the restaurant,</p> <p>5 and now the restaurant is the worst restaurant you've</p> <p>6 ever been in.</p> <p>7 Okay. Now, the question you're trying</p> <p>8 to answer is, Did the taxi driver intentionally sort</p> <p>9 of do this bad thing to me, or is this really just</p> <p>10 he -- did he really take me to a random restaurant.</p> <p>11 Okay? Because, remember, I don't know anything about</p> <p>12 the city.</p> <p>13 Now, Method 2 -- so Method 1 would be I</p> <p>14 would go and catalog all the restaurants and write</p> <p>15 reviews of them and figure out whether this one was</p> <p>16 usually bad. Okay.</p> <p>17 Method 2 is I would really draw random</p> <p>18 restaurants from the city, okay, for my comparison.</p> <p>19 But the city is big. I don't know how to draw random</p> <p>20 restaurants from it.</p> <p>21 Method 3 is I'm just going to explore</p> <p>22 the restaurants around me. And, technically, the way</p> <p>23 you do this is by walking randomly around your</p> <p>24 restaurant, but ignore that technicality for a</p> <p>25 minute. You're just going to look at the restaurants</p>	798	<p>1 restaurants --</p> <p>2 THE COURT REPORTER: Can you slow</p> <p>3 down a little?</p> <p>4 THE WITNESS: Sorry.</p> <p>5 (Laughter.)</p> <p>6 THE WITNESS: Okay. I can -- right.</p> <p>7 So --</p> <p>8 THE COURT: He's excited.</p> <p>9 THE COURT REPORTER: I know.</p> <p>10 THE WITNESS: I'm so sorry.</p> <p>11 So you can try to put down a bad</p> <p>12 restaurant surrounded by good restaurants,</p> <p>13 and then you can put down another</p> <p>14 restaurant -- bad restaurant surrounded by</p> <p>15 good restaurants. But you'll -- no matter</p> <p>16 what you do, you can't create a situation</p> <p>17 where most restaurants are bad restaurants</p> <p>18 surrounded by good restaurants.</p> <p>19 And so locally exploring this space</p> <p>20 can rigorously tell you that the taxi driver</p> <p>21 is -- didn't deserve that tip.</p> <p>22 BY MR. LEWIS:</p> <p>23 Q. Okay. And that latter analysis is --</p> <p>24 is what you have asserted to have done in this case,</p> <p>25 right?</p>
797	<p>1 around your restaurant.</p> <p>2 And suppose that you observe that not</p> <p>3 only is your restaurant that he took you to terrible,</p> <p>4 but it's surrounded by great restaurants. All the</p> <p>5 other restaurants are terrific.</p> <p>6 So the analogy here, the bad restaurant</p> <p>7 is the district with a lot of partisan bias for</p> <p>8 Republicans, and it's surrounded by all these</p> <p>9 restaurants that have less partisan bias. Okay?</p> <p>10 Now, the question is, Could this have</p> <p>11 happened to you? You're at a bad restaurant</p> <p>12 surrounded by good restaurants just by chance with</p> <p>13 the taxi driver's random choice. Now, you're not a</p> <p>14 city planner, so you don't have expertise in how</p> <p>15 restaurants are laid out in cities. But it turns out</p> <p>16 it doesn't matter, because it's impossible, even in</p> <p>17 principle, to design a city where when you throw a</p> <p>18 dart at the restaurants in the city, it lands at a</p> <p>19 bad restaurant surrounded by good restaurants.</p> <p>20 And that -- I mean, just think about</p> <p>21 trying to do it for a minute. How would you do it?</p> <p>22 You would put a bad restaurant surrounded by good</p> <p>23 restaurants. Oh, no, but now I have all these good</p> <p>24 restaurants where the dart might land. Now I can try</p> <p>25 to put a bad restaurant surrounded by good</p>	799	<p>1 A. That is exactly -- I mean, up to the</p> <p>2 analogy, that is what we do for redistricting, yes.</p> <p>3 Q. And in your -- in your published work,</p> <p>4 you refer to -- to that as -- the term is "local</p> <p>5 outlier," correct?</p> <p>6 A. Yes -- well -- yes -- I believe you,</p> <p>7 let's say, yeah.</p> <p>8 Q. Well, we can look --</p> <p>9 A. I'm sure you're right. I don't have an</p> <p>10 objection to that term at all.</p> <p>11 Q. Okay. Got it.</p> <p>12 Okay. And doesn't your analysis --</p> <p>13 we'll return to our example with the restaurant -- at</p> <p>14 some level, doesn't your analysis depend on how big</p> <p>15 the universe is around that local area?</p> <p>16 A. It really doesn't. So, actually -- I</p> <p>17 mean, maybe it's helpful to turn to our theorem --</p> <p>18 maybe it's not helpful. I'll just tell you. Our</p> <p>19 theorem --</p> <p>20 Q. Okay.</p> <p>21 A. -- makes no assumption on the total</p> <p>22 possible -- they're called "states" in the Markov</p> <p>23 chain, but it's confusing, because the state in the</p> <p>24 Markov chain is, in our case, a districting. So it's</p> <p>25 one city corner or one restaurant. Our -- there's no</p>

800	<p>1 input to our theorem, which is the -- the number of</p> <p>2 possibilities.</p> <p>3 And, actually, this is also true for</p> <p>4 Method 2, by the way. Like, when I gave this</p> <p>5 example, if I draw a thousand purely random samples,</p> <p>6 and they're all better than the thing I'm studying, I</p> <p>7 said that has probability, at most, 1 over 1,001 of</p> <p>8 happening by chance. And notice that the size of the</p> <p>9 bag doesn't figure into that calculation. Right?</p> <p>10 So that's why when people do polls in</p> <p>11 different states, the sample size that they use</p> <p>12 doesn't depend on the size of the state or anything</p> <p>13 like that. So basic statistics, you know, things</p> <p>14 depend on your sample, not the size of the universe.</p> <p>15 Q. But doesn't a statistically significant</p> <p>16 sample require a -- a uniform distribution underneath</p> <p>17 it, or at least an observable distribution?</p> <p>18 A. This is the basis for Method 2 --</p> <p>19 Q. Right.</p> <p>20 A. -- so there's different ways of</p> <p>21 asserting statistical significance. Method 2, which</p> <p>22 is, like, the simplest example of a statistical</p> <p>23 analysis, is one way of getting a p-value, and that</p> <p>24 is by having a uniform distribution and drawing</p> <p>25 samples from it.</p>	802	<p>1 And to get epsilon values, which are</p> <p>2 very small, like we observe, like, 97 over 100</p> <p>3 billion, I have to explore enough of the space just</p> <p>4 so that there are at least -- I've seen enough</p> <p>5 alternatives to get those small numbers.</p> <p>6 For example, if I only observe -- if I</p> <p>7 only observe, let's say, 200 other maps, then the</p> <p>8 most extreme result I could get would be that I'm an</p> <p>9 outlier at -- I'm a local outlier at epsilon at 1</p> <p>10 over 200, let's say. Okay?</p> <p>11 And then the p-value that I would get</p> <p>12 from this would just be .1, 1/10. Because I took 1</p> <p>13 over 200 times 2 -- that's 1 over 100 -- and then I</p> <p>14 took the square root that's 1 over 10, and so I have</p> <p>15 a p-value that's only 1/10th.</p> <p>16 So you're right. If I don't run my</p> <p>17 test for very long, it's unlikely to work. But the</p> <p>18 test tells you whether or not it worked, right? The</p> <p>19 p-value that it gives is not something which you</p> <p>20 should only trust if you ran it for a long time. The</p> <p>21 p-value really tells you everything you need to know</p> <p>22 about the extent to which you should trust the</p> <p>23 theorem or the result.</p> <p>24 Q. So to return to the concept of the</p> <p>25 local outlier in districting, your model works by</p>
801	<p>1 It's not the only way of getting</p> <p>2 p-values in a particular -- our method is another way</p> <p>3 of getting p-values, and there's a proof of our</p> <p>4 theorem. So the p-values that we get are valid.</p> <p>5 They're not, like, hinging on some philosophical</p> <p>6 perspective that I have on p-values or something like</p> <p>7 that.</p> <p>8 Q. Okay. But isn't there some</p> <p>9 obligation -- not obligation -- isn't there some</p> <p>10 minimum threshold that your -- that -- where your</p> <p>11 chain has to traverse the space in order to be able</p> <p>12 to draw a broader conclusion about -- or to draw</p> <p>13 those significant results?</p> <p>14 A. So -- right. I can tell you exactly</p> <p>15 what it requires. The conclusion -- right. So in</p> <p>16 that table with the epsilons and Ps -- it's probably</p> <p>17 not even necessary to put it back up -- so the</p> <p>18 conclusion of the theorem is that p-value. There's a</p> <p>19 simple formula. The formula -- the theorem tells you</p> <p>20 that you calculate that p-value by taking your</p> <p>21 epsilon value, multiplying it by 2 and taking the</p> <p>22 square root. Okay?</p> <p>23 So, in particular, the theorem will</p> <p>24 only give you a small p-value, which is what you</p> <p>25 want, when the epsilon value is very small.</p>	803	<p>1 taking the existing map and perturbing the edges of</p> <p>2 the map, right? You're swapping, swapping, swapping?</p> <p>3 A. Right.</p> <p>4 Q. And even after a trillion steps,</p> <p>5 haven't you only explored some infinitesimal</p> <p>6 percentage of the possible districtings in the State?</p> <p>7 A. So, honestly, nobody has any idea</p> <p>8 exactly how big this bag is. So for all I know, it's</p> <p>9 a very small percentage of the bag. That's the</p> <p>10 reason that I'm using a method which doesn't depend</p> <p>11 on the size of the bag.</p> <p>12 So this method -- right. So, like,</p> <p>13 getting back to the restaurant analogy, I know the</p> <p>14 taxi driver doesn't deserve his tip no matter how</p> <p>15 large the city is. Right? If he puts me at a bad</p> <p>16 restaurant in the middle of a thousand or a million</p> <p>17 or a billion better restaurants, then no matter how</p> <p>18 large the city is, this is something that he was</p> <p>19 trying to do on purpose.</p> <p>20 Q. Okay.</p> <p>21 MR. LEWIS: Nothing further for this</p> <p>22 witness. Thank you, Your Honor.</p> <p>23 THE COURT: Any other</p> <p>24 cross-examination?</p> <p>25 MR. LEVINE: Yes, Your Honor.</p>

804	<p>1 BY MR. LEVINE:</p> <p>2 Q. I'm Clifford Levine on behalf of the</p> <p>3 Lieutenant Governor.</p> <p>4 You're from Pittsburgh, so I trust you</p> <p>5 know a little bit about football.</p> <p>6 A. Maybe --</p> <p>7 Q. All right.</p> <p>8 A. -- don't give me any questions about</p> <p>9 sports.</p> <p>10 Q. Let me just ask you this -- and this is</p> <p>11 not a trick question. This is the most basic, basic,</p> <p>12 first-grade probability.</p> <p>13 A. Okay.</p> <p>14 Q. If we are to flip a coin and -- heads</p> <p>15 or tails, there's a 50 percent probability if you're</p> <p>16 picking tails --</p> <p>17 A. Hopefully.</p> <p>18 Q. -- let's assume there's 50 percent</p> <p>19 probability, all right?</p> <p>20 A. Yeah.</p> <p>21 Q. A really simple question: If I were to</p> <p>22 give you two chances to get tails, in other words,</p> <p>23 you --</p> <p>24 A. I can flip it twice, and if I have at</p> <p>25 least one tail, now I have a 3/4 chance of winning.</p>	806	<p>1 of Democrats and Republicans, and that one would</p> <p>2 expect, with 18 Congressional districts, for</p> <p>3 instance, that there would be nine Democrats and nine</p> <p>4 Republicans.</p> <p>5 THE COURT: Mr. Levine, can you</p> <p>6 clarify your question for me? Equal</p> <p>7 Democrats and Republicans in terms of</p> <p>8 registered voters or --</p> <p>9 MR. LEVINE: No; in terms of this</p> <p>10 preference, based on the voter preference</p> <p>11 that we've discussed.</p> <p>12 THE COURT: Meaning -- meaning</p> <p>13 votes cast for a generic Republican and a</p> <p>14 generic Democrat?</p> <p>15 MR. LEVINE: That's right, in the</p> <p>16 statewide races.</p> <p>17 BY MR. LEVINE:</p> <p>18 Q. Again, this is a hypothetical. I'm</p> <p>19 just trying to understand.</p> <p>20 So assuming that the outcome that one</p> <p>21 would expect would be 9 to 9, because it's a 50/50</p> <p>22 state, what is partisan bias measuring?</p> <p>23 A. So partisan bias is measuring the</p> <p>24 disconnect -- so, roughly speaking, since we already</p> <p>25 discussed a precise definition, my metric measures a</p>
805	<p>1 Q. Right. And if I gave you three</p> <p>2 chances, what is the probability?</p> <p>3 A. 7/8.</p> <p>4 Q. Okay. I told you that was simple in</p> <p>5 answer to the question.</p> <p>6 A. Yeah, that's great.</p> <p>7 THE COURT: I didn't follow it, but</p> <p>8 I'm just a judge.</p> <p>9 BY MR. LEVINE:</p> <p>10 Q. If I give you two chances from one, it</p> <p>11 would go from 50 percent to 75 percent --</p> <p>12 THE COURT: You can move along on</p> <p>13 the coin-flip thing.</p> <p>14 MR. LEVINE: Thank you.</p> <p>15 BY MR. LEVINE:</p> <p>16 Q. And I just had another just question on</p> <p>17 Exhibit 122.</p> <p>18 You have partisan bias and</p> <p>19 anticompetitiveness?</p> <p>20 A. Yes.</p> <p>21 Q. And I'm just trying to understand the</p> <p>22 difference.</p> <p>23 A. Right.</p> <p>24 Q. Is it -- let's assume -- again, a</p> <p>25 hypothetical -- assume we had an equal state in terms</p>	807	<p>1 disconnect between the number of seats somebody can</p> <p>2 win and the fraction of votes they need to win it.</p> <p>3 So that's, roughly speaking, what the median versus</p> <p>4 mean captures.</p> <p>5 Q. Okay. So, for instance, you could</p> <p>6 have -- let's say, of our 18 districts, let's say</p> <p>7 nine districts had 75 percent voters who generally</p> <p>8 voted Democratic, 25 percent who generally voted</p> <p>9 Republican --</p> <p>10 A. Right.</p> <p>11 Q. -- and we had nine voters that</p> <p>12 generally -- 75 percent that generally voted</p> <p>13 Republican and 25 percent that generally voted</p> <p>14 Democratic.</p> <p>15 A. Right. In this case, both the mean and</p> <p>16 the median would be the same, and you would have no</p> <p>17 gap. So this is -- because what you just described</p> <p>18 is a situation which is symmetric with respect to the</p> <p>19 Republicans and Democrats. They -- you have nine</p> <p>20 districts that are heavily Democratic, nine districts</p> <p>21 that are heavily Republican. The median versus mean</p> <p>22 will be zero. It will be -- it will have no partisan</p> <p>23 bias compared to my -- according to my metric.</p> <p>24 Q. So would that be a .5 on your</p> <p>25 calculation?</p>

808	<p>1 A. So that's -- so the .5 -- you mean if I</p> <p>2 ran the test starting from this districting?</p> <p>3 Q. Yes.</p> <p>4 A. This is -- this is some hypothetical</p> <p>5 thing.</p> <p>6 Q. Let me withdraw. Let me withdraw.</p> <p>7 A. Yeah, yeah.</p> <p>8 Q. So -- so that's one example.</p> <p>9 Then -- and would your partisan bias be</p> <p>10 generally measuring the outcomes of how many</p> <p>11 Democratic Congressmen we ended up with versus</p> <p>12 Republican Congressmen in the various iterations?</p> <p>13 A. The partisan bias measures how easy it</p> <p>14 is for one side to win a lot of seats with few votes,</p> <p>15 right. That's how -- so, in particular -- in your</p> <p>16 example, there's no difference between how easy it is</p> <p>17 for the Republicans and the Democrats, so there's no</p> <p>18 partisan bias.</p> <p>19 Q. Okay. Now, does -- if we change my</p> <p>20 example and basically have nine districts with 49</p> <p>21 percent Republican-leaning voters and 51 percent</p> <p>22 Democratic-leaning voters, and then the opposite,</p> <p>23 51 percent Republican -- whatever it was, 51/49</p> <p>24 equally --</p> <p>25 A. Right.</p>	810	<p>1 the table.</p> <p>2 And Column 6, you said --</p> <p>3 BY MR. LEVINE:</p> <p>4 Q. Was that the map -- did I understand</p> <p>5 that that was the -- do you mean Row 6?</p> <p>6 A. Row 6?</p> <p>7 Q. Row 6.</p> <p>8 A. Row 6 was run -- so each of these rows</p> <p>9 is just a run of the algorithms. So each one starts</p> <p>10 from the current map and generates trillions of other</p> <p>11 maps. And Row 6 is just the run for which Figure 2</p> <p>12 indicates some of the maps encountered.</p> <p>13 Q. Oh, I see. I misunderstood you.</p> <p>14 That was not the map?</p> <p>15 A. No, no, no.</p> <p>16 Q. Okay. Thank you.</p> <p>17 MR. LEVINE: Thank you. I have no</p> <p>18 further questions. Thank you for your time.</p> <p>19 THE COURT: Any further</p> <p>20 cross-examination?</p> <p>21 MS. MCKENZIE: None, Your Honor.</p> <p>22 THE COURT: Redirect.</p> <p>23</p> <p>24</p> <p>25</p>
809	<p>1 Q. -- would that reflect</p> <p>2 anticompetitiveness at all? Would that be relevant?</p> <p>3 A. Right. So -- right. These -- these</p> <p>4 two examples are identical with respect to the</p> <p>5 partisan bias metric. They're both symmetric with</p> <p>6 respect to the Democrats and Republicans, so both</p> <p>7 will have a zero gap for median and mean.</p> <p>8 With respect to anticompetitiveness,</p> <p>9 the 75/25 example, this is an example where there's a</p> <p>10 greater variation in the partisan makeup of the</p> <p>11 districts. In particular, the partisan makeup of a</p> <p>12 typical district is far from 50/50. So the</p> <p>13 anticompetitiveness metric calls the 75/25 example</p> <p>14 more anticompetitive; whereas the case where the vote</p> <p>15 is close would be more competitive.</p> <p>16 Q. Looking at Exhibit 122, you indicated</p> <p>17 Column 6 was the current map?</p> <p>18 A. Sorry. Which is Exhibit --</p> <p>19 Q. Exhibit 122.</p> <p>20 MR. LEVINE: Could you just put that</p> <p>21 up?</p> <p>22 THE COURT: Again, we have paper.</p> <p>23 If you look at the big binders over there to</p> <p>24 your left, 122 is in Volume 2.</p> <p>25 THE WITNESS: Okay. So it's just</p>	811	<p>1 - - -</p> <p>2 REDIRECT EXAMINATION</p> <p>3 - - -</p> <p>4 BY MR. GEFFEN:</p> <p>5 Q. Professor Pegden, you were asked about</p> <p>6 the rows of your results table in which you had run a</p> <p>7 test with smaller population deviation thresholds.</p> <p>8 And I think you said that those runs</p> <p>9 took your computer longer to process?</p> <p>10 A. Yeah. They just run a little bit</p> <p>11 slower. It's not dramatic. It's -- it's the same</p> <p>12 order of magnitude, but they run a little bit slower.</p> <p>13 Q. And so in the report where you list</p> <p>14 results for the -- those runs, you're listing your</p> <p>15 results after 2 to the power of 39 steps instead of 2</p> <p>16 to the power of 40 steps, as did you for the other</p> <p>17 runs; is that right?</p> <p>18 A. Right. And that's really just because</p> <p>19 those runs didn't finish in time for the report</p> <p>20 decline. So, yeah.</p> <p>21 Q. Did you halt the program once it got to</p> <p>22 2 to the 39?</p> <p>23 A. No. It kept running until I made 2 to</p> <p>24 the 40 steps.</p> <p>25 Q. And what was different, if anything,</p>

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<p style="text-align: right;">812</p> <p>1 about the results after 2 to the 40 steps? 2 MR. LEWIS: Objection. I think that 3 goes beyond -- that goes beyond the expert 4 reports. 5 THE COURT: Sustained. 6 BY MR. GEFFEN: 7 Q. You were also asked about the 8 possibility of using your test to analyze the 9 hypothetical scenario in which it were sought to 10 avoid pairing incumbents? 11 A. Right. 12 Q. Could someone use the code on your 13 Web site to do that? 14 A. I think it would take changing five 15 lines of code, perhaps, to do this. It would be very 16 easy to do. 17 So, yeah, there's two things: First, 18 this would be very easy to do. Again, I provide the 19 code -- all you would have to do is freeze the 19 20 precincts of the incumbents that were -- that were 21 present when the map was drawn. 22 Keep in mind that when we freeze the 23 counties that are preserved by the current map, we're 24 preserving some giant portion of the State. It's 25 thousands and thousands of precincts are frozen in</p>	<p style="text-align: right;">814</p> <p>1 A. Um-hum. 2 Q. Have you checked that data set against 3 the -- the real-life outcomes in the House races from 4 2012, 2014, and 2016? 5 A. Yeah. So using that as your proxy for 6 voter preference gives the correct election outcomes 7 in those years. 8 Q. Thanks. 9 And also, was that the same election 10 data set that you used for your PNAS paper? 11 A. It is. 12 Q. The restaurant analogy. What if the 13 city that your airplane landed in had billions of 14 restaurants? 15 A. It doesn't matter. Even if it had 2 to 16 the power of billions of restaurants, the logic of 17 the test is unaffected. It really does not depend on 18 the size of the universe at all. 19 Q. Would wandering around the neighborhood 20 more, after you leave the terrible restaurant -- 21 would wandering around more of that neighborhood help 22 you become more certain about your -- your ultimate 23 conclusions in that analogy? 24 A. Yeah. So it could well be that when 25 you wander around for longer, your epsilon value,</p>
<p style="text-align: right;">813</p> <p>1 the algorithm and not allowed to swap. 2 So this would just require freezing 19 3 precincts. It would be very easy to do. And 4 moreover, it's very far-fetched to imagine that this 5 would have any significant effect on the results 6 because, like I said, freezing counties -- I mean, 7 honestly, when I decided let's see what happens when 8 I freeze counties, there was really some suspense. 9 I didn't know exactly what would 10 happen. This is constraining a large part of the 11 State from moving. It was not clear, to me, that the 12 algorithm would still have enough room to discover 13 that the current districting is an outlier. 14 Freezing the 19 precincts containing 15 the incumbents addresses, there's no suspense there. 16 When I -- when I go to make a random swap, there's a 17 really good chance it's not allowed to be made 18 because it's an accounting. It's very rare that the 19 swap would be forbidden because of an incumbent's 20 address. So most of the algorithm -- most of the 21 algorithm steps will be unconstrained by this sort of 22 consideration. 23 Q. Okay. You were asked also about your 24 choice of the 2010 U.S. Senate race for your 25 partisan -- as your partisanship data set.</p>	<p style="text-align: right;">815</p> <p>1 that is, the fraction of things that are as bad as 2 you, can get -- could get even smaller. And then you 3 would get a better p-value. 4 Q. Okay. So, in other words, if you -- 5 you wandered around a neighborhood a trillion times, 6 you would have more certainty than if you wandered 7 around 100 times in terms of -- you have a -- a -- 8 well, you tell me what would change. 9 A. Yes, sir. When you -- the longer you 10 run around for, the greater potential for certainty 11 there is. But I want to emphasize exactly how 12 certain you should be about any test just comes from 13 that p-value. The theorem does all the work for you. 14 So it's -- so one way of thinking about 15 this, again, is if I only walk around for 200 steps, 16 I can only get epsilon as 1 over 200. And so there's 17 an upper limit to how good a result the theorem can 18 give. 19 But what I want to really emphasize is, 20 sort of as a consumer of the test result, you don't 21 need to worry about how many steps I ran it for. The 22 p-value gives you the confidence level accounting for 23 all of these factors. 24 Q. Okay. And you were asked questions 25 about the theorem that you proved in your PNAS paper.</p>

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816	<p>1 MR. GEFFEN: Could we look at 2 Petitioners' Exhibit 123, please? 3 BY MR. GEFFEN: 4 Q. I don't want to get into all the gory 5 math here, but is this the theorem that you proved in 6 your paper? 7 A. Yes, this is the theorem. 8 Q. Is there any aspect of this theorem 9 that depends on how many districtings are in the bag 10 that you're analyzing? 11 A. No. And let me even try to take a stab 12 at just walking through a few things that do appear, 13 because it's not as scary as it looks. 14 So X0, X1, et cetera, so this is -- it 15 says it's a reversible Markov chain. So in the City 16 example, these Xs are the locations that you're at at 17 a certain time. In the Redistricting example, 18 they're a redistricting that you have at a certain 19 step. And so notice that there's one -- there's 20 essentially, like, one hypothesis of this theorem, 21 which is that the Markov chain that you apply to has 22 to be reversible. And all that means in the case 23 of -- all that means is essentially that, like, steps 24 that you made can -- can be reversed. 25 So in the City example, it's really</p>	818	<p>1 right, so the p-value that you calculate the route to 2 epsilon does not depend on K; it only depends on 3 epsilon. 4 Q. Thank you. 5 MR. GEFFEN: Petitioners would move 6 Petitioners' Exhibit 123 into evidence. 7 THE COURT: Any objection? 8 MR. LEWIS: Counsel, did this -- was 9 this in the report? 10 THE WITNESS: It's in the supplement 11 as part of the report. 12 MR. GEFFEN: This is in the PNAS 13 paper, which is attached in the report as an 14 exhibit. 15 THE WITNESS: It's on Page 2, left 16 column of the PNAS paper. 17 MR. LEWIS: I guess no objection, 18 although, it's duplicative of the article. 19 THE COURT: It's admitted without 20 objection. 21 - - - 22 (Whereupon, Petitioners' Exhibit Number 23 123 was admitted into evidence.) 24 - - - 25 THE COURT: Professor, I have a</p>
817	<p>1 just that all streets are two-way streets; there are 2 no one-way streets. So it's just a -- a -- it's just 3 a property of Markov chains that is -- yeah, it's 4 very standard and -- and almost always the case in 5 Monte Carlo/Markov chain methods. 6 And what this says is that if I have 7 any such Markov chain -- and then it says this weird 8 thing about some stationary distribution pi. All 9 that is talking about, in layman's terms, is you 10 think about pi as, if I were able to randomly select 11 an element in my -- an element in my space, and it 12 says -- the theorem says that if X naught is 13 distributed as pi, so the way of reading that is, if 14 this districting that we have really was just chosen 15 randomly from the set of possibilities, then it says, 16 for any fixed K -- and K is how many steps I run the 17 algorithm for -- any fixed K -- so notice it does not 18 depend on K -- the probability that I have an epsilon 19 outlier is that most route to epsilon. 20 So notice that the theorem doesn't even 21 mention the number of possible configurations. The 22 size of the bag literally does not appear in the 23 theorem. And it says that the test works no matter 24 how many steps you run it for; that's K. So K does 25 not matter. And notice K is not in the formula,</p>	819	<p>1 question, though, about the theorem. 2 THE WITNESS: Okay. 3 THE COURT: M is the current map? 4 THE WITNESS: No, no. Yeah, so M is 5 just the Markov chain. So, like, the Markov 6 chain is this procedure that you have for, 7 you know, randomly perturbing something. In 8 this case, the Markov chain -- so M is this 9 Markov chain, and it is like the seat -- it 10 is the sequence of maps -- it's really just 11 a random process that you're going to do. 12 So, yeah, I mean -- right, so this 13 is really -- so this is the theorem about 14 general Markov chains, not about maps. 15 So M, here, stands for Markov, not 16 for map, yeah, but . . . 17 So the way of thinking about this is 18 M -- it says, M equals that sequence. So M 19 is, like, this random process that you're 20 going to do of random changes. Then it says 21 things like suppose the states of M have 22 reevaluated label. So that says suppose 23 that you have some way of assigning values 24 to these configurations in your Markov 25 chain.</p>

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<p style="text-align: right;">820</p> <p>1 So M is the -- is, like, you have 2 all these configurations you're going to 3 make random changes to, and your labels, in 4 our case, in the median versus mean metric. 5 And then it says that if -- if what you 6 started with was really random, then no -- 7 for any length of time that you ran it for, 8 observing that it was an epsilon outlier, 9 would happen with the probability at most 10 route to epsilon. 11 THE COURT: So the Xs are the -- 12 THE WITNESS: The maps. 13 THE COURT: -- the various stages of 14 the maps that are produced by -- 15 THE WITNESS: Exactly, the Xs are 16 the maps, yeah. Just kind of, like, 17 think -- here, think about M as the bag, 18 really. 19 THE COURT: Okay. But the Xs -- so 20 let's compare X0, which is the first map 21 that is generated -- 22 THE WITNESS: Exactly. 23 THE COURT: -- to X1. 24 Is X0 subsumed in X1? 25 THE WITNESS: What we do is we</p>	<p style="text-align: right;">822</p> <p>1 THE COURT: So there's a 2 possibility you could undo something that 3 was done in the chain. 4 THE WITNESS: Right. That's an 5 important part of the hypothesis of the 6 theorem, because, remember, it does 7 require -- it's a reversible Markov chain. 8 THE COURT: Okay. Thank you. 9 MR. GEFFEN: Thank you. 10 BY MR. GEFFEN: 11 Q. I don't have any more mathy questions, 12 but a couple more questions. 13 You were asked about certain 14 hypothetical criteria that might be used in 15 districtings such as avoiding splitting 16 municipalities or avoiding pairing incumbents. 17 If you had been informed what criteria 18 were actually used by the drafters of the 2011 Plan 19 for Pennsylvania, could you have incorporated those 20 criteria into your code as constraints on your bag of 21 districtings? 22 A. Certainly, it's possible to incorporate 23 all sorts of extra constraints, and given a list of 24 explicit constraints, I think that would have been a 25 very reasonable thing to do, yes.</p>
<p style="text-align: right;">821</p> <p>1 compare X0 to the whole list of X0 up to XK. 2 THE COURT: I'm trying to compare 3 Map X0 to Map X01. So does X1 derive from 4 X0? 5 THE WITNESS: Yes, absolutely. It's 6 one small change away. 7 THE COURT: But the change that was 8 made in -- to get to X0 -- X0 is the 9 2011 Map. 10 THE WITNESS: Yeah. 11 THE COURT: So X1 is a small change 12 to the 2011 Map? 13 THE WITNESS: Yes. 14 THE COURT: Does X2 incorporate the 15 change in X1 and make an additional change? 16 THE WITNESS: Yes, exactly. 17 THE COURT: And all the way down 18 the chain, so they're never going back and 19 undoing a prior change? 20 THE WITNESS: That could happen by 21 chance, because, remember, you randomly 22 select which thing to do. So just like in 23 the City, since it's two-way streets, you 24 might just by chance walk backwards 25 occasionally. But, yeah.</p>	<p style="text-align: right;">823</p> <p>1 Q. And were you able to get the list of 2 constraints that the mapmakers in Pennsylvania 3 actually did use to make the 2011 Plan? 4 A. I was not given any such list. 5 THE COURT: They're all shaking 6 their head in agreement that you're done. 7 MR. GEFFEN: I have no further 8 questions. Thank you. 9 THE COURT: Okay. 10 Professor, thank you very much 11 for -- 12 MR. LEWIS: Your Honor, I have very, 13 very brief recross. 14 THE COURT: I'm sorry. What? 15 MR. LEWIS: Very brief recross, 16 Your Honor, based on the redirect? 17 THE COURT: Unusual. 18 I'll give you very brief, but then I 19 have to give them very brief re-redirect. 20 In other words, you don't get the last word; 21 they do. 22 MR. LEWIS: We'll withdraw the 23 request, Your Honor. 24 THE COURT: Okay. Thank you. 25 Professor, thank you for your</p>

824	<p>1 testimony. You may step down. 2 (The witness is excused.) 3 THE COURT: Can we go off the 4 record for a minute? 5 - - - 6 (Whereupon, a recess was taken from 7 11:47 a.m. to 11:51 a.m.) 8 - - - 9 MS. MCKENZIE: Petitioners call 10 their next witness, please. Call 11 Dr. Warsaw. 12 THE COURT: I'm sorry. Petitioners 13 call -- 14 MS. MCKENZIE: Dr. Warsaw. 15 - - - 16 CHRISTOPHER WARSHAW, PH.D., 17 after having been first duly sworn, was 18 examined and testified as follows: 19 - - - 20 VOIR DIRE 21 - - - 22 BY MS. MCKENZIE: 23 Q. Good morning, Dr. Warsaw. 24 Could you state your full name, please? 25 A. Sure. It's Christopher Warsaw.</p>	826	<p>1 A. My wife got a job with the 2 Federal Government, so we decided that it made sense 3 to move our family to Washington, D.C. 4 Q. What are your academic specialties 5 within the field of political science? 6 A. I focus on the study of representation, 7 broadly put; and I also focus on the study of public 8 opinion polarization in elections. 9 Q. And what do you mean when you say 10 "representation"? 11 A. Representation is the study of the 12 Democratic process, in particular, the study of the 13 effect of public opinion in elections on the 14 political process. And typically, when we focus on 15 the political process, we look at the policies the 16 governments produce and the actions of elected 17 officials, such as the roll call votes in 18 legislatures. 19 Q. And when did you begin developing your 20 expertise in these subjects? 21 A. It probably would have been -- I 22 started graduate school in 2006, but I ramped up -- 23 really ramped up my dissertation work in about 2010, 24 so I think my expertise start -- really started to 25 form in around 2010.</p>
825	<p>1 Q. Where did you grow up, Doctor? 2 A. I grew up in Pennsylvania. It's my 3 childhood in Mechanicsburg, Pennsylvania. And I 4 attended Mechanicsburg schools, including 5 Mechanicsburg Area Senior High School. 6 Q. And what's your educational background? 7 A. After high school, I went to college in 8 Western Massachusetts at Williams College. After 9 college, I received my graduate education at 10 Stanford University. I received a Ph.D. in political 11 science, focusing on American politics and 12 statistics, and a law degree from Stanford Law 13 School. 14 Q. And how are you currently employed? 15 A. I'm currently an assistant professor of 16 political science at George Washington University. 17 Q. Have you held any other academic 18 positions? 19 A. I was -- I have. I was an assistant 20 professor at the Massachusetts Institute of 21 Technology in Cambridge, Massachusetts from 2012 to 22 '16 and an associate professor from 2016 to '17. 23 Q. Was that also in political science? 24 A. It was. 25 Q. And why did you move from MIT to GW?</p>	827	<p>1 My dissertation in graduate school for 2 my PDF focused on representation in Congress; that 3 is, the effect -- the relationship between public 4 opinion on individual issues and the votes of Members 5 of Congress. 6 Q. And can you describe some of the recent 7 courses that you've taught? 8 A. Yes. I taught courses on public 9 opinion in elections; I taught a graduate course in 10 statistics, a graduate course on political 11 methodology; and I taught several undergraduate 12 courses on representation. 13 MS. MCKENZIE: If we could pull up 14 Petitioners' Exhibit 36. 15 BY MS. MCKENZIE: 16 Q. Is that a copy of your CV? 17 A. Yes. 18 Q. And does that CV list all the 19 publications you've authored in the last 10 years? 20 A. Yes. 21 MS. MCKENZIE: Petitioners move to 22 admit Exhibit 36 into evidence. 23 THE COURT: Any objection? 24 Without objection, 25 Petitioners' Exhibit 36 is admitted.</p>

828	<p>1 - - -</p> <p>2 (Whereupon, Petitioners' Exhibit Number</p> <p>3 36 was admitted into evidence.)</p> <p>4 - - -</p> <p>5 BY MS. MCKENZIE:</p> <p>6 Q. Do any of the articles on your CV</p> <p>7 relate to your academic work on representation?</p> <p>8 A. They do. A number do.</p> <p>9 Q. Which ones?</p> <p>10 A. So Article 14, titled Policy</p> <p>11 Preferences and Policy Change: Dynamic Responsiveness</p> <p>12 in the American States, which is forthcoming in the</p> <p>13 American Political Science Review, focuses on the</p> <p>14 effect of public opinion in elections on the policies</p> <p>15 that states produce over the last three-quarters of a</p> <p>16 century.</p> <p>17 Q. Great.</p> <p>18 MS. MCKENZIE: If we could just flip</p> <p>19 to the second page of the CV.</p> <p>20 BY MS. MCKENZIE:</p> <p>21 Q. What --</p> <p>22 A. Article 2 -- sorry.</p> <p>23 Article 3 here, entitled Representation</p> <p>24 of Municipal Government, also published in the</p> <p>25 American Political Science Review, looks at the</p>	830	<p>1 Q. Thank you.</p> <p>2 MS. MCKENZIE: If we can just flip</p> <p>3 back to the second page.</p> <p>4 Great.</p> <p>5 BY MS. MCKENZIE:</p> <p>6 Q. Do any of the articles on the CV relate</p> <p>7 to your academic work in analyzing public opinion?</p> <p>8 A. Yes, a number do.</p> <p>9 First, Article 1 looks at how should we</p> <p>10 measure district-level public opinion on individual</p> <p>11 issues. So this -- this article examines how we can</p> <p>12 use large-scale surveys to estimate the preferences</p> <p>13 of the mass public at the level of Congressional</p> <p>14 districts and other legislative districts.</p> <p>15 Article 2 which is called Measuring</p> <p>16 Constituent Policy Preferences in Congress, State</p> <p>17 Legislatures and Cities, actually provides estimates</p> <p>18 of the ideological preferences of the mass public.</p> <p>19 And On the Representativeness of Primary Electorates</p> <p>20 looks at the public opinion of primary electorates in</p> <p>21 presidential and Congressional elections, with</p> <p>22 Article 12.</p> <p>23 And then a number of articles of</p> <p>24 mine -- actually, Article 4 also looks at how can we</p> <p>25 measure public opinion at the state level. This</p>
829	<p>1 relationship between public opinion in cities across</p> <p>2 America and the policies that cities produce.</p> <p>3 Also, Mayoral partisanship and</p> <p>4 Municipal Fiscal Policy looks at the effect of</p> <p>5 partisan -- the partisan identity of a mayor, so, in</p> <p>6 other words, the way we elect a Democrat or a</p> <p>7 Republican mayor on the fiscal policies the</p> <p>8 governments produce.</p> <p>9 And Incremental Democracy: The Policy</p> <p>10 Effects of Partisan Control of State Government</p> <p>11 examines how much it matters whether you elect a</p> <p>12 Democrat or a Republican as a governor or state</p> <p>13 legislature for the policies that states produce over</p> <p>14 the last three-quarters of a century.</p> <p>15 Q. Were all of those articles published,</p> <p>16 or are going to be published, in peer-reviewed</p> <p>17 journals?</p> <p>18 A. Yes.</p> <p>19 Q. And did any of those papers win awards?</p> <p>20 A. Yes. The -- Article 14, if you go back</p> <p>21 up, Policy Preferences and Policy Change: Dynamic</p> <p>22 Responsiveness in the American States -- this article</p> <p>23 won the Best Paper on State Politics presented at the</p> <p>24 American Political Science Association conference in</p> <p>25 2014.</p>	831	<p>1 article is called Dynamic Estimation of Latent</p> <p>2 Opinion Using a Hierarchical Group-Level IRT Model.</p> <p>3 And then a number of my articles use</p> <p>4 the public opinion -- opinion measures that I develop</p> <p>5 to examine representation, as we talked about a</p> <p>6 few minutes ago.</p> <p>7 Q. Okay. And all the articles that you</p> <p>8 just mentioned, are they published in peer-reviewed</p> <p>9 journals or forthcoming?</p> <p>10 A. Yes, absolutely.</p> <p>11 Q. Okay. Do any of the articles on your</p> <p>12 CV relate to your academic work on polarization in</p> <p>13 Congressional elections?</p> <p>14 A. They do. Article 12 that I mentioned a</p> <p>15 second ago, in the representation -- On the</p> <p>16 Representativeness of Primary Electorates, looks at</p> <p>17 the role of primary elections in polarization in</p> <p>18 Congress.</p> <p>19 The Estimating Candidates' Political</p> <p>20 Orientation in a Polarized Congress, Article 7,</p> <p>21 measures the ideological preferences of Congressional</p> <p>22 candidates using a wide variety of different metrics</p> <p>23 and shows that, across a wide variety of metrics,</p> <p>24 polarization in Congress is increasing dramatically.</p> <p>25 And, also, in Article 10, Geography,</p>

832	<p>1 Uncertainty, and Polarization, looks at some of the</p> <p>2 factors underlying polarization, the link between the</p> <p>3 mass public and polarization in both Congressional</p> <p>4 districts as well as state legislative districts.</p> <p>5 And that article is called Geography, Uncertainty,</p> <p>6 and Polarization.</p> <p>7 Q. What about Article 13?</p> <p>8 A. Article 13 focuses on Congressional</p> <p>9 elections, so it does speak to polarization. This</p> <p>10 article is called Does the Ideological Proximity</p> <p>11 Between Candidates and Voters Affect Voting in U.S.</p> <p>12 House Elections? And this article examines whether</p> <p>13 members of the public hold -- hold Members of</p> <p>14 Congress accountable for their policy positions. So</p> <p>15 it's about the link between the accountability</p> <p>16 process in elections and the polarization that we see</p> <p>17 in Congress.</p> <p>18 Q. And have all those articles been</p> <p>19 published or are forthcoming in peer-reviewed</p> <p>20 journals?</p> <p>21 A. Yes, they have been.</p> <p>22 Q. Okay. Have you also published about</p> <p>23 partisan bias in elections?</p> <p>24 A. I have. Article 11, entitled Partisan</p> <p>25 Gerrymandering and the Political Process: Effects on</p>	834	<p>1 pro-Republican efficiency gap can expect to have</p> <p>2 the -- their state legislators take much more</p> <p>3 conservative roll call positions than states without</p> <p>4 a partisan bias in their efficiency gap. Moreover,</p> <p>5 they can expect states to have much more conservative</p> <p>6 policies than you would have if you had no partisan</p> <p>7 advantage in the districting policy.</p> <p>8 Q. Did you find the same thing if you have</p> <p>9 a Democratic bias in the redistricting process?</p> <p>10 A. We did. It was broadly systematic.</p> <p>11 Q. And was this paper written before you</p> <p>12 were approached about serving as an expert in this</p> <p>13 litigation?</p> <p>14 A. It was.</p> <p>15 Q. Okay. Have any of your papers been</p> <p>16 cited in gerrymandering matters before?</p> <p>17 A. It is -- I believe that several of my</p> <p>18 papers were cited by both sides -- by briefs from</p> <p>19 both sides in Whitford v. Gill, which is the current</p> <p>20 case in gerrymandering before the Supreme Court.</p> <p>21 Q. Dr. Warsaw, have you ever served as an</p> <p>22 expert witness before?</p> <p>23 A. I have not. This is my first time as</p> <p>24 an expert witness.</p> <p>25 MS. MCKENZIE: At this time,</p>
833	<p>1 Roll Call Voting and State Policies, examines just</p> <p>2 this question.</p> <p>3 Q. Okay. And is that article going to be</p> <p>4 published in a peer-reviewed journal?</p> <p>5 A. It is. It's forthcoming and online in</p> <p>6 the Election Law Journal, which is a peer-reviewed</p> <p>7 journal.</p> <p>8 Q. What is that article about?</p> <p>9 A. This article is about the effect of the</p> <p>10 efficiency gap on the political process in the</p> <p>11 American states and specifically examines the effect</p> <p>12 of the efficiency gap on the roll call votes of state</p> <p>13 legislatures/state legislators and on the policies</p> <p>14 that states actually produce.</p> <p>15 Q. Okay. And we'll talk about the</p> <p>16 efficiency gap in detail, but for now, just broadly</p> <p>17 speaking, what is the efficiency gap?</p> <p>18 A. The efficiency gap is a measure of the</p> <p>19 partisan advantage in the districting process.</p> <p>20 Q. Okay. And can you describe the</p> <p>21 findings in that paper about the relationship between</p> <p>22 a larger efficiency gap and political representation?</p> <p>23 A. Yes. Broadly speaking, we find that</p> <p>24 the magnitude of a state's efficiency gap has a large</p> <p>25 effect on representation. States with a large</p>	835	<p>1 Petitioners tender Dr. Warsaw as an expert</p> <p>2 in American politics and, in particular,</p> <p>3 political representation, public opinion.</p> <p>4 THE COURT: Hold on for a second.</p> <p>5 MS. MCKENZIE: Sure.</p> <p>6 THE COURT: American politics. Now</p> <p>7 you're into your subset, which is what?</p> <p>8 MS. MCKENZIE: Political</p> <p>9 representation --</p> <p>10 THE COURT: Political</p> <p>11 representation.</p> <p>12 MS. MCKENZIE: -- public opinion --</p> <p>13 THE COURT: Okay.</p> <p>14 MS. MCKENZIE: -- elections --</p> <p>15 THE COURT: Okay.</p> <p>16 MS. MCKENZIE: -- and polarization.</p> <p>17 THE COURT: Dr. Warsaw has been</p> <p>18 offered as an expert in American politics</p> <p>19 with the following subsets: political</p> <p>20 representation, public opinion, elections</p> <p>21 and polarization.</p> <p>22 Are there any objections?</p> <p>23 MR. TUCKER: No.</p> <p>24 THE COURT: Hearing none, we will</p> <p>25 accept Dr. Warsaw as an expert in those</p>

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1 areas, or that area with subareas.
 2 MS. MCKENZIE: Thank you,
 3 Your Honor.
 4 - - -
 5 DIRECT EXAMINATION
 6 - - -
 7 BY MS. MCKENZIE:
 8 **Q. So, Dr. Warshaw, before we get into the**
 9 **details, just broadly speaking, what was the first**
 10 **thing that Petitioners asked you to evaluate in this**
 11 **case?**
 12 A. I was asked to evaluate the partisan
 13 bias or the degree of partisan bias in Pennsylvania's
 14 redistricting plan and to place this partisan bias,
 15 if it exists, into historical perspective.
 16 **Q. And just broadly speaking, what did you**
 17 **find?**
 18 A. I found that there is a large and
 19 durable Republican advantage in the districting
 20 process in Pennsylvania that spiked dramatically
 21 after the 2011 Plan went into place. In fact, I find
 22 that the Republican advantage in the districting
 23 process, as measured through the efficiency gap in
 24 Pennsylvania, was the largest in the country in 2012;
 25 and, indeed, it was the second largest in

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1 history -- that we've ever seen in 2012 Pennsylvania
 2 Plan.
 3 **Q. What was the second thing that you were**
 4 **asked to evaluate?**
 5 A. I was asked to evaluate the
 6 consequences for the 2011 Redistricting Plan for the
 7 representation that citizens of Pennsylvania receive
 8 in Congress, the context of the growing polarization
 9 that we've observed in Congress over the past four
 10 decades.
 11 **Q. And what did you find, also broadly**
 12 **speaking?**
 13 A. Broadly speaking, I found that there's
 14 -- polarization is increasing dramatically in
 15 Congress, so when you put together the fact that the
 16 growth in the part -- of the Republican advantage in
 17 the districting process means that there's a large --
 18 a much larger number of Republicans elected in
 19 Pennsylvania than you would expect based on the votes
 20 in Pennsylvania.
 21 And you put this together with the fact
 22 that there's a huge gulf between the way that
 23 Democrats and Republicans in Congress vote, so what
 24 that means is that Democrats from Pennsylvania whose
 25 votes are wasted have little or no voice in

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1 Washington in their -- in their representatives.
 2 **Q. What was the third thing that you**
 3 **looked at?**
 4 A. The third thing I was asked to evaluate
 5 was the effect of the partisan advantage in the
 6 districting process on citizens trusting government.
 7 **Q. And what did you find, again, broadly**
 8 **speaking?**
 9 A. Once again, what I found was that when
 10 there's a large partisan bias in the districting
 11 process, this degrades -- this really degrades
 12 citizens' trust in their representatives. In places
 13 where one party has a large advantage in the
 14 districting process, citizens whose votes are wasted
 15 are much less likely to trust their representatives
 16 than in places with a neutral districting process.
 17 So by this, my takeaway is that the
 18 gerrymandering that we've observed in Pennsylvania
 19 and across the country really is degrading our
 20 democracy and it's eroding citizens' faith in our
 21 democracy.
 22 **Q. All right. Now that we've heard about**
 23 **your broad findings, I'd like to go back and drill**
 24 **down about each one.**
 25 **So the first thing that you said you**

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1 **did was look at the level of partisan bias in**
 2 **Pennsylvania by analyzing Pennsylvania's efficiency**
 3 **gap.**
 4 A. Yes.
 5 **Q. How does a gerrymander work?**
 6 A. Well, a gerrymander, at its core, is
 7 about efficiently translating your votes into seats
 8 as efficiently as possible. In practice, the way you
 9 do this is by having some districts where you pack
 10 your -- the other party's supporters into as few
 11 districts as possible where they have a very large
 12 margin in those districts, so they might win, like,
 13 70/30 or 80/20. So this is called "packing."
 14 And then the other mechanism for
 15 gerrymandering is called "cracking." So in cracking,
 16 we see that the party that's trying to bias the
 17 districting process in their favor will spread the
 18 other party's voters across a large number of
 19 districts, so the disadvantaged party wins or
 20 loses -- sorry -- loses the large number of districts
 21 by relatively narrow margins.
 22 So in this way, the advantaged party is
 23 winning as many seats as possible, given their number
 24 of votes.
 25 **Q. What's the efficiency gap?**

840	<p>1 A. The efficiency gap is just a way of</p> <p>2 translating this intuition that what gerrymandering</p> <p>3 is ultimately about is efficiently translating votes</p> <p>4 into seats by wasting as many of your opponent's</p> <p>5 supporters as possible and as few as possible -- as</p> <p>6 possible of your own. So it's really just a formula</p> <p>7 that captures this intuition that that's what</p> <p>8 gerrymandering is at its core.</p> <p>9 MS. MCKENZIE: All right.</p> <p>10 Can we pull up the equation at the</p> <p>11 top of Page 6 of Dr. Warshaw's report?</p> <p>12 BY MS. MCKENZIE:</p> <p>13 Q. Can you explain just -- just walk us</p> <p>14 through this equation and how the efficiency gap is</p> <p>15 calculated.</p> <p>16 A. Sure.</p> <p>17 So, again, the way -- just to, you</p> <p>18 know, remind you what I just said a second ago, the</p> <p>19 way gerrymandering proceeds is by wasting as many of</p> <p>20 your opponent's voters as possible. And you do this</p> <p>21 by packing them into a small number of districts so</p> <p>22 that you win by overwhelming margins or -- or you</p> <p>23 crack them across a large number of districts that</p> <p>24 the advantaged party wins by narrow margins.</p> <p>25 So here, we're just -- we're</p>	842	<p>1 A. So the polarity of the scale is</p> <p>2 arbitrary, so we could have selected -- we could have</p> <p>3 done it the other way and get exactly the same</p> <p>4 results. I chose it this way because it's what some</p> <p>5 of the papers do in the field.</p> <p>6 Q. And when you do it this way, what is</p> <p>7 it -- is a Republican advantage a positive number or</p> <p>8 a negative number?</p> <p>9 A. So here, a Republican advantage is a</p> <p>10 negative number, and we can see that because a</p> <p>11 Democratic advantage would come when Republicans are</p> <p>12 wasting more votes than Democrats. So that would</p> <p>13 suggest a positive number implies the Democratic</p> <p>14 advantage in the districting process.</p> <p>15 Q. Okay. And why do you do it as a</p> <p>16 percentage, meaning why are you dividing the number</p> <p>17 of wasted votes by the total number of votes?</p> <p>18 A. Well, it's important to do it as a</p> <p>19 percentage because we want a metric -- whenever we're</p> <p>20 trying to quantify the partisan advantage in the</p> <p>21 districting plan, we wanted a metric that's</p> <p>22 comparable both over time -- so we want a measure</p> <p>23 that's comparable in Pennsylvania between 1972 and</p> <p>24 2016, regardless of how the number of voters or</p> <p>25 districts has changed in Pennsylvania over this time</p>
841	<p>1 calculating the efficiency gap based on these wasted</p> <p>2 votes. So a wasted vote is a vote in excess of those</p> <p>3 needed to win in a packed district and those that you</p> <p>4 didn't need to win in -- sorry -- all the votes in a</p> <p>5 cracked district where you lose.</p> <p>6 So the efficiency gap calculation is</p> <p>7 simply summing up all of the wasted votes for each</p> <p>8 party. And we see, in relative terms, which party</p> <p>9 wastes more seat -- wastes more votes, and that party</p> <p>10 has an advantage in the districting process.</p> <p>11 Q. So in that equation, what does the EG</p> <p>12 stand for?</p> <p>13 A. So the EG here is the efficiency gap.</p> <p>14 Q. And what is W sub R?</p> <p>15 A. So W sub R is the total number of</p> <p>16 wasted votes by Republicans.</p> <p>17 Q. And how about W sub D?</p> <p>18 A. That's the total number of wasted votes</p> <p>19 by deferred Democratic voters.</p> <p>20 Q. And what's N?</p> <p>21 A. So N is just the total number of votes</p> <p>22 in the election; so this means we're creating a</p> <p>23 relative metric rather than, like, a metric on the</p> <p>24 scale of a million votes, or something.</p> <p>25 Q. Why is it Rs minus Ds in this equation?</p>	843	<p>1 span. We also want a metric that's comparable across</p> <p>2 states.</p> <p>3 So we want something where you can</p> <p>4 compare both the efficiency gaps, or, in other words,</p> <p>5 the degree of partisan advantage in the districting</p> <p>6 process, between a state like Pennsylvania and a</p> <p>7 larger state, like California, as well as a smaller</p> <p>8 state, like Maryland. If we didn't have a relative</p> <p>9 metric where we divided -- the total -- the relative</p> <p>10 difference in wasted votes by the total number of</p> <p>11 votes, then it would be impossible to compare the</p> <p>12 efficiency gap either over time within Pennsylvania</p> <p>13 or across states.</p> <p>14 Q. Okay. And I think it would be helpful</p> <p>15 to just walk the Court through how to calculate the</p> <p>16 efficiency gap. We have a demonstrative on this.</p> <p>17 A. Sure.</p> <p>18 MS. MCKENZIE: Your Honor, this</p> <p>19 isn't an exhibit; it's just a hypothetical</p> <p>20 demonstrative.</p> <p>21 BY MS. MCKENZIE:</p> <p>22 Q. So -- that --</p> <p>23 THE COURT: Just consistent with</p> <p>24 past practice, can we at least give it a</p> <p>25 number for the record?</p>

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844	<p>1 MS. MCKENZIE: Absolutely. I'm 2 happy to give it a number for the record. 3 Do we know -- can we mark it as 200? 4 - - - 5 (Petitioners' Exhibit Number 200 was 6 marked for identification, as of 7 this date.) 8 - - - 9 THE COURT: 200. You're skipping a 10 bunch, but okay. 11 200. 12 MS. MCKENZIE: All right. John, if 13 you wouldn't mind just putting up the 14 equation that we looked at from Page 6 on 15 the side there. 16 Okay. Thanks. 17 BY MS. MCKENZIE: 18 Q. So, Dr. Warshaw, can you walk us 19 through how to calculate the efficiency gap based on 20 this hypothetical example? 21 A. Yes, absolutely. 22 So this hypothetical example shows a 23 hypothetical districting plan, three districts. In 24 each district, there were 100 voters. There are 300 25 voters across this entire state plan.</p>	846	<p>1 district that you win, a wasted vote is every vote 2 that is more than you needed to actually win the 3 district; so it's more than 50 percent plus one. 4 So in the first district, the Democrats 5 wasted 29 votes, because they only actually needed 51 6 votes to win this district. 7 In a district that you lose, such as -- 8 Q. Just stop for a second there. 9 So -- and you get 29 by subtracting 51 10 from 80? 11 A. Yes, exactly. Sorry. Yeah, they 12 needed 51 votes to win this district, and they 13 received 80 votes. So in this hypothetical district, 14 they wasted 29 votes. 15 And in the second district, here, the 16 Democrats received 40 votes; but in this district, 17 they lost. So in this district, none of those 40 18 votes actually translated into a seat in the 19 legislature. So in this district, all 40 of those 20 votes were wasted. 21 Likewise, in the Third District, the 22 Democrats here, too, wasted all of the 40 votes 23 because none of those 40 votes translated into a seat 24 in the legislature or -- or were part of winning a 25 seat.</p>
845	<p>1 In the first district, the Democratic 2 candidate won 80 votes to 20, so they received 3 80 percent of the vote in the first district; in the 4 second district, the Republican candidate won 60 5 votes to 40; likewise, in the third district, here, 6 too, the Republican candidate won 60 votes to 40. 7 So one thing to notice about this plan, 8 before we move on to the calculation of the 9 efficiency gap, is that in this hypothetical plan, 10 Democrats received 160 voters -- votes across the 11 entire plan, whereas Republicans only received 140. 12 So in this plan, Democrats received 53 percent of the 13 statewide vote, yet they only received one out of the 14 three seats, or a third of the seats. 15 So this would be -- before we even move 16 on to the technical calculation of the efficiency 17 gap, this would clearly be a districting plan where 18 there was a Republican advantage in this districting 19 plan because they have many more -- they have a much 20 higher percentage of the seats here than they do of 21 the votes. 22 Q. All right. And can you walk us through 23 how you calculate that Democratic-wasted votes? 24 A. So the Democratic-wasted votes -- to 25 remind everyone, a wasted vote is one in a -- in a</p>	847	<p>1 So if we sum -- if we sum across all 2 three districts, the Democrats wasted 29 votes in the 3 first district, 40 votes in the second district, and 4 30 votes -- or sorry -- 40 votes in the 5 third district. So across all three districts, the 6 Democrats wasted 109 votes. 7 Q. Great. 8 And how do you calculate the 9 Republican-wasted votes? 10 A. For the Republicans, we're going to use 11 the same idea. So in the first district, where they 12 lost, all 20 of the Republican votes were wasted 13 because in this district, none of those 20 Republican 14 votes were necessary to win the seat. Whereas, in 15 the second and third districts -- once again, 16 remember, that in a district you win, every vote 17 that's in addition to the 50 percent plus one that 18 you need to win the district is wasted. So here, the 19 Republicans wasted nine votes in each of these two 20 districts. 21 So we sum across the three districts: 22 The Republicans wasted 20 votes in the 23 first district, nine votes in the second district and 24 nine votes in the third district, for a total of 38 25 wasted votes.</p>

848	<p>1 Q. And how do you use those numbers to</p> <p>2 calculate the actual efficiency gap?</p> <p>3 A. Sure. I want to pause before we get to</p> <p>4 the formula. You know, it's just worth noting this</p> <p>5 is, you know, a different way of just -- you don't</p> <p>6 have to stare at a formula very hard to notice that</p> <p>7 in this hypothetical districting plan, Democrats</p> <p>8 waste far more votes than Republicans do.</p> <p>9 And turning to the districting plan --</p> <p>10 sorry. Turning to the efficiency gap calculation, in</p> <p>11 order to calculate the efficiency gap, look -- if you</p> <p>12 look at the formula on the right, first, we put the</p> <p>13 total number of wasted Republican votes over the</p> <p>14 total votes, and we subtract the wasted -- the total</p> <p>15 number of wasted Democratic votes over the total</p> <p>16 votes. So when you do that, you get -- you get an</p> <p>17 estimate of the efficiency gap for this hypothetical</p> <p>18 districting plan of about negative 24 percent. In</p> <p>19 other words, the efficiency gap has a -- shows a</p> <p>20 pro-Republican advantage of 24 percent.</p> <p>21 Q. And if --</p> <p>22 A. As we'll talk about later on, probably,</p> <p>23 that's exactly the same efficiency gap that we saw in</p> <p>24 Pennsylvania in 2012.</p> <p>25 Q. And in this hypothetical example, if</p>	850	<p>1 intuition?</p> <p>2 A. It does.</p> <p>3 Q. Okay. And when you calculate the</p> <p>4 efficiency gap for, say, the 2012 Congressional</p> <p>5 election or any other Congressional election, what</p> <p>6 actual election returns are you using?</p> <p>7 A. I use the official election returns</p> <p>8 that -- I use ones that have been collected by a</p> <p>9 group of scholars, but it's based on the official</p> <p>10 election returns that are posted on the House of</p> <p>11 Representatives' Web site.</p> <p>12 Q. What elections are you -- are you --</p> <p>13 what -- what -- are you using --</p> <p>14 A. I'm sorry. I used --</p> <p>15 THE COURT: Hold on for a second.</p> <p>16 Posted on the House and Senate</p> <p>17 Web site; what's that mean?</p> <p>18 THE WITNESS: I can't actually --</p> <p>19 they're -- they're collected by the Clerk of</p> <p>20 the House. I can't remember if they're</p> <p>21 posted --</p> <p>22 THE COURT: Which House?</p> <p>23 THE WITNESS: Sorry.</p> <p>24 The House of Representatives.</p> <p>25 THE COURT: Which House of</p>
849	<p>1 you reversed the districts so that the Democrats won</p> <p>2 60 to 40 in two districts and the Republicans won 80</p> <p>3 to 20 in one district, how would that change the</p> <p>4 analysis?</p> <p>5 A. It would just reverse all the numbers.</p> <p>6 In that case, you would see a Democratic advantage of</p> <p>7 24 percent in the efficiency gap. There's nothing</p> <p>8 particular about the partisan labels that affects the</p> <p>9 calculation of the efficiency gap.</p> <p>10 Q. And when political scientists</p> <p>11 actually calculate the efficiency gap in real-life</p> <p>12 elections, are there any other steps, things that you</p> <p>13 have to account for?</p> <p>14 A. Yes. You have to account for unequal</p> <p>15 turnout across races, or if it was a districting plan</p> <p>16 that was not equal populace, we would have to account</p> <p>17 for that. And you also have to account for</p> <p>18 uncontested races. It's very important.</p> <p>19 Q. And we'll get back to that a little bit</p> <p>20 later, but the technical details are in your report</p> <p>21 at Page 6 and in the appendix; is that right?</p> <p>22 A. Yes, absolutely.</p> <p>23 Q. Okay. But do you think this</p> <p>24 demonstrative in that equation -- that basic equation</p> <p>25 calculates -- captures the basic calculation or</p>	851	<p>1 Representatives?</p> <p>2 THE WITNESS: The U.S. House of</p> <p>3 Representatives.</p> <p>4 THE COURT: Okay.</p> <p>5 THE WITNESS: Yeah. Yeah.</p> <p>6 I used the official election</p> <p>7 returns, which have been then collated by</p> <p>8 scholars, but they're -- they're based</p> <p>9 directly on the official election returns</p> <p>10 that are collected by the Clerk of the</p> <p>11 House.</p> <p>12 BY MS. MCKENZIE:</p> <p>13 Q. I think my question was unclear.</p> <p>14 A. Your question might have been more</p> <p>15 general.</p> <p>16 So you were asking which type of</p> <p>17 election I use.</p> <p>18 Q. That's right.</p> <p>19 A. Yes.</p> <p>20 In that case -- sorry -- I use U.S.</p> <p>21 House elections. I don't use, you know, governors'</p> <p>22 elections or Senate elections. And the reason for</p> <p>23 that is that in a case where we have the districting</p> <p>24 plan in front of us, at the end of the day, what a</p> <p>25 gerrymander's trying to do is translate votes in</p>

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852	<p>1 House elections in the seats as efficiently as 2 possible.</p> <p>3 So where we have votes available, it 4 makes sense to measure the efficiency gap using the 5 results of -- of the election that's at stake in the 6 gerrymander. So that's what I do here.</p> <p>7 Q. Okay. Where does the efficiency gap 8 measure come from?</p> <p>9 A. The efficiency gap was a measure that 10 was developed by a scholar named Eric McGhee in 2014, 11 who's a political scientist. And it was published in 12 a peer-reviewed journal called Legislative Studies 13 Quarterly, which is a top field journal for the study 14 of Congress and other legislatures around the world.</p> <p>15 Q. And why did you choose to use the 16 efficiency gap to measure the effects of a 17 gerrymander or as a measure of partisan bias?</p> <p>18 A. I think there's two reasons: One is 19 theoretical, and one is more practical.</p> <p>20 So I think in a theoretical -- at a 21 theoretical level, the efficiency gap, at its heart, 22 is really capturing the intuition that what a 23 gerrymander is all about is translating votes into 24 seats as efficiently as possible. And the way you do 25 that is by wasting more of your opponent's voters</p>	854	<p>1 useful measure of partisan bias?</p> <p>2 A. I did.</p> <p>3 So one way to know that it's a useful 4 measure of partisan bias is if it captures what 5 happens when a party -- what we think happens when a 6 party controls redistricting process. And what we 7 think happens, based on a wide array of previous 8 purchase, is that when a party controls redistricting 9 process, on average, we would expect the districts 10 that are drawn to be more biased -- to be biased in 11 their favor, or to get more biased in their favor 12 through -- via the districting process. This is a 13 result that's been confirmed by a wide range of 14 political science studies.</p> <p>15 So the efficiency gap is capturing 16 this -- this effect. In other words, if, when 17 Republicans control the redistricting process, the 18 efficiency gap moves in a more pro-Republican 19 advantage, then that would suggest, to me, that the 20 efficiency gap is capturing something important about 21 intentional gerrymandering in the redistricting 22 process.</p> <p>23 Q. What did you find when you did that 24 analysis?</p> <p>25 A. What I found when I looked at the 2011</p>
853	<p>1 than your own through packing and cracking.</p> <p>2 And this is exactly -- unlike the other 3 metrics that are out there to measure -- trying to 4 measure partisan advantage in the districting 5 process, that's exactly what the efficiency gap 6 captures.</p> <p>7 And in a more practical level, the 8 efficiency gap can be measured for a wide range of 9 different election results. So, for instance, it 10 could be calculated in -- in an election where the 11 Republican or the Democrat, you know, had 75 percent 12 of the statewide vote or in a place where they had 13 30 percent; whereas many of the other metrics rely on 14 a hypothetical tied election, which in a case like 15 Pennsylvania might be a reasonable assumption, but if 16 we're trying to make a metric that is comparable 17 between Pennsylvania and other states both in 2012 or 18 '14, as well as past states, it makes sense to have a 19 metric that's comparable across time and across 20 states.</p> <p>21 Q. And are you calculating this directly 22 from observed election results?</p> <p>23 A. Yes.</p> <p>24 Q. Okay. Did you conduct any analysis of 25 your own to confirm that the efficiency gap is a</p>	855	<p>1 Redistricting Plans not just in Pennsylvania, but 2 around the country was, you know, exactly what we 3 would expect, both based on, I think, our own 4 intuitions, but also based on the many published 5 studies that have been done on redistricting in the 6 political science literature, in places where 7 Republicans controlled the redistricting process, the 8 efficiency gaps were both larger, more -- they had a 9 more Republican bias in absolute terms than in places 10 where Democrats controlled the redistricting process. 11 But not just that, they actually moved substantially 12 in a pro-Republican advantage.</p> <p>13 So between 2010 and 2012, in the places 14 where Republicans controlled the redistricting plan, 15 the efficiency gap moved, I think, 10 or 11 points in 16 a pro-Republican direction. And in places where the 17 Democrats controlled the redistricting process -- 18 which, you know, frankly, there weren't as many of 19 those, because 2010 was obviously a big year for 20 Republicans -- but in the places where Democrats 21 controlled the districting process, the efficiency 22 gap moved in a pro-Democratic direction.</p> <p>23 Q. Was that difference statistically 24 significant?</p> <p>25 A. It was.</p>

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1 **Q. Okay.**

2 THE COURT: Was what -- was what

3 difference statistically significant?

4 THE WITNESS: I'm sorry, Your Honor.

5 The difference between the changes in the

6 efficiency gap when Democrats and

7 Republicans controlled the -- the -- the

8 redistricting process. So it -- that

9 wouldn't have occurred by chance. It was --

10 THE COURT: You had indicated where

11 states -- where Republicans controlled it in

12 one state, it moved pro-Republican --

13 THE WITNESS: Exactly.

14 THE COURT: -- when Democrats

15 controlled it in a state, it moved

16 pro-Democrat --

17 THE WITNESS: Exactly.

18 THE COURT: -- she asked you for

19 some kind of a statistical significant

20 comparison. That's what I don't understand.

21 THE WITNESS: I conducted a

22 regression which confirmed that the

23 difference between the effect of a

24 pro-Democratic and pro-Republican -- the

25 difference between the efficiency -- the

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1 changes in the efficiency gap when Democrats

2 and Republicans controlled the efficiency --

3 controlled the redistricting process was

4 statistically significant at conventional

5 levels of significance.

6 THE COURT: Significant in what

7 respect? I'm trying to understand.

8 Are you saying -- are you saying --

9 let me ask -- are you saying that when

10 Democrats controlled it, they moved less

11 favorable toward Democrats than where states

12 were controlled by Republicans, and they

13 moved it more favorable toward -- in other

14 words, were Republicans more egregious in

15 gerrymandering than Democrats?

16 THE WITNESS: Sorry for

17 interrupting, Your Honor.

18 I found modest differences, but I'm

19 not sure that the -- I can't remember

20 whether the differences between the changes

21 in the efficiency gap, like, whether -- I

22 can't say whether Republicans -- the -- the

23 Republican advantage gained when Republicans

24 controlled it was, like, different than the

25 Democratic advantage when they controlled it

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1 was -- was significant.

2 THE COURT: Okay. So that's not

3 what you're talking about in the differences

4 being statistically significant?

5 THE WITNESS: Right. I'm saying

6 that -- that the -- we wouldn't observe by

7 chance the difference -- the -- the

8 difference in the efficiency gap that we --

9 and the changes in the efficiency gap that

10 we observed when Democrats and Republicans

11 controlled the efficiency -- the

12 redistricting process.

13 THE COURT: I'm still not sure I

14 understand the statistically significant

15 question.

16 Could you --

17 MS. MCKENZIE: Can you give me a

18 moment, Your Honor?

19 THE COURT: Okay.

20 (Counsel confer.)

21 BY MS. MCKENZIE:

22 **Q. Dr. Warsaw, so let's suppose there was**

23 **one state that was controlled by Republicans and one**

24 **state that was controlled by Democrats, and you**

25 **observed a difference in the efficiency gap -- a**

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1 **pro-Republican difference, for example, in the**

2 **efficiency gap in the Republican-controlled state and**

3 **a pro-Democratic advantage in the efficiency gap in a**

4 **Democratic-controlled state --**

5 A. Yes.

6 **Q. -- what would that tell you?**

7 A. Well, that might tell us something.

8 There's no way to know whether any difference --

9 differences we observed if there was just, you know,

10 one state and there -- if there are only, say, small

11 differences between those two plans, then, of course,

12 those differences could just occur by chance.

13 **Q. So what you're saying is what's -- in**

14 **that hypothetical example, you wouldn't know whether**

15 **the relationship that you observed between the**

16 **Republican or Democratic control of redistricting and**

17 **the efficiency gap was random?**

18 A. Exactly. Exactly. What we observe in

19 the actual data is that every single time -- when --

20 in every single state that I looked at where

21 Republicans controlled the redistricting process in

22 the states with more than six Congressional

23 districts, the efficiency gap moves substantially in

24 a pro-Republican direction.

25 And in the cases where Democrats

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<p style="text-align: right;">860</p> <p>1 controlled redistricting, I believe, in every case, 2 it moved in a pro-Democratic direction. 3 THE COURT: Substantially or -- 4 that's -- I'm still struggling with your 5 question about statistical significance. 6 THE WITNESS: I think the key is the 7 difference between the changes under 8 Democrats and Republicans -- 9 THE COURT: You -- basically, the 10 point is both gerrymander, in your view? 11 THE WITNESS: Yeah. I think, 12 when -- when -- you know, I'm not making a 13 claim -- there's nothing in my report that 14 purports to demonstrate that Republican 15 gerrymanderers are systematically worse in 16 Congressional districts than Democratic 17 gerrymanderers. 18 THE COURT: That explains my 19 statistically significance question. 20 THE WITNESS: I'm not making that 21 claim, Your Honor. 22 MS. MCKENZIE: And, Your Honor, 23 we're just -- Dr. Warshaw was just analyzing 24 a very -- a very simple point about whether 25 what you expect --</p>	<p style="text-align: right;">862</p> <p>1 but it wouldn't be that meaningful for the balance of 2 Congress or the representation that citizens are 3 likely to receive in Congress in subsequent 4 elections. 5 Q. All right. We'll return to the 6 durability point a little bit later. 7 A. Yeah. 8 Q. Do you -- do you think that the 9 efficiency gap is the only way to measure whether a 10 Congressional districting plan is biased or 11 gerrymandered? 12 A. No, of course not. I think -- I think 13 what we care about here is an underlying concept of 14 partisan advantage in the districting process. And I 15 think the efficiency gap is one metric of that that I 16 think is extremely good on both theoretical grounds 17 as well as empirical grounds. 18 But I think there's a range of metrics 19 that you could use, particularly in states like 20 Pennsylvania with relatively -- where the vote -- the 21 percentage of votes that one party received was 22 pretty close to 50 percent. 23 Q. All right. So let's turn to what you 24 actually found about the efficiency gap. 25 MS. MCKENZIE: Can we call up</p>
<p style="text-align: right;">861</p> <p>1 BY MS. MCKENZIE: 2 Q. And you can tell me if I'm right or 3 wrong. 4 MS. MCKENZIE: -- that whether what 5 you would expect if the efficiency gap is a 6 useful measure of partisan bias is a 7 relationship between an efficiency gap that 8 favors one party and who controlled the 9 districting process. 10 THE WITNESS: Exactly. 11 THE COURT: Okay. Thank you for -- 12 I apologize for hijacking your examination. 13 MS. MCKENZIE: No problem at all, 14 Your Honor. I appreciate the clarification. 15 BY MS. MCKENZIE: 16 Q. All right. Did you conduct any other 17 analysis to confirm that the efficiency gap is a 18 useful measure of partisan bias? 19 A. I did. I also examined the durability 20 of the efficiency gap. So if the efficiency gaps in 21 2012 were just ephemeral, and they changed rapidly in 22 subsequent years, then it's possible that whatever 23 measure of partisan advantage that we use immediately 24 after the redistricting, you know, might be important 25 for -- for the balance of Congress in 2013 and '14,</p>	<p style="text-align: right;">863</p> <p>1 Petitioners' Exhibit 37? 2 BY MS. MCKENZIE: 3 Q. Which is Figure 1 of your report. 4 A. Yes. 5 Q. Can you tell us what this is, 6 Dr. Warshaw? 7 A. So in this exhibit -- you know, to 8 repeat what I said earlier, what I calculated in my 9 analysis was the efficiency gap in every state 10 Congressional election between 1972 and 2016. So, in 11 other words, across the past 44 years, I calculated 12 the efficiency gap in every Congressional election. 13 And this graph shows one way of plotting the rows -- 14 of visualizing the results. 15 Q. Can you explain what's shown on the 16 horizontal axis from left to right? 17 A. So the horizontal axis here shows the 18 degree of partisan advantage in the districting plan. 19 So moving from left to right, on the left part of the 20 graph, we see plans where there's a large 21 pro-Republican advantage of 20 percentage points or 22 more. 23 In the middle of the graph, where we 24 have the vertical line and we see the zero percent on 25 the horizontal axis, these are plans with no partisan</p>

864	<p>1 advantage for either party in the districting 2 process.</p> <p>3 And in -- on the far right, in places 4 where you have -- this shows state Congressional 5 elections where you have a large pro-Democratic 6 advantage in the efficiency gap of 20 or 30 percent 7 or more.</p> <p>8 Q. Okay. And that zero figure, what does 9 it mean if you have an efficiency gap of zero?</p> <p>10 A. It means that each party is wasting the 11 same number of votes. In other words, neither party 12 has an advantage via the districting process in the 13 translation of votes in defeats.</p> <p>14 Q. Can you explain what's shown on the 15 vertical axis?</p> <p>16 A. So the vertical axis simply shows the 17 percentage of -- let's label density -- it simply 18 shows the percentage of Congressional elections with 19 various values of the efficiency gap.</p> <p>20 Q. And does this graph contain the 21 efficiency gap in every election year in states with 22 more than six Congressional seats between 1972 and 23 2012 --</p> <p>24 A. It does.</p> <p>25 Q. -- or 2016? I apologize.</p>	866	<p>1 tails of the distribution, as we might call it, so 2 the tails of the graph around where there's a 3 20 percent pro-Democratic advantage or a 20 percent 4 pro-Republican advantage, there's -- the graph there 5 is, like, very small. The tails of the distribution 6 have a very small number of Congressional elections 7 in them.</p> <p>8 So if you highlight right on the tails, 9 as we're doing now, what you can see is there's just 10 a very small area under the curve there.</p> <p>11 Q. Okay. And if you look at the top of 12 the -- the top of the curve there, you notice 13 that the top is slightly to the right of that 14 vertical line; is that right?</p> <p>15 A. It is.</p> <p>16 Q. And what does that tell you?</p> <p>17 A. So the second thing this graph tells me 18 is that we might be concerned about the -- certainly 19 concerned about concluding anything about a 20 pro-Republican advantage in the districting process 21 if there was, like, a very large partisan bias over 22 time in favor of either party, but especially if 23 there was a large and persistent pro-Republican bias 24 in the efficiency gap that was consistently true over 25 time.</p>
865	<p>1 A. It does.</p> <p>2 Q. Okay. And what does this graph tell us 3 about the efficiency gap in Congressional elections 4 across the country during this period?</p> <p>5 A. Yeah, I think it shows us two important 6 things: One is that most efficiency gaps lie 7 relatively close to zero. And we might be concerned 8 about the efficiency gap as a metric of partisan 9 advantage or a metric of gerrymandering if, in fact, 10 you had lots of, like, extreme values of it. So then 11 it would be hard to tell whether, like, you know, the 12 efficiency gap in a particular state was so large as 13 to be abnormal.</p> <p>14 But instead, we see that most of the 15 efficiency gaps here lie very close to zero. And, in 16 fact, 75 percent lie between 10 percent and negative 17 10 percent, and less than 4 percent have more than a 18 20 percent advantage for either party. So 96 percent 19 of the efficiency gaps over the last 44 years lie 20 between negative 20 percent and 20 percent.</p> <p>21 Q. And how do you see that visually on 22 this graph?</p> <p>23 A. What you can see is that -- visually is 24 that the -- by far, the largest area under the curve 25 is right around zero. And if you look out at the</p>	867	<p>1 But instead, what we see is, again, the 2 average efficiency gap lies very close to zero. And 3 if anything, the average efficiency gap over the last 4 44 years suggests a slight Democratic advantage in 5 the districting process.</p> <p>6 So I think that we really can't 7 conclude here that either party has some, like, 8 persistent long-term advantage in the efficiency gap 9 for the last 44 years, and we certainly can't 10 conclude that Republicans have a substantial 11 long-term advantage in the efficiency gap due to 12 political geography or some other factor.</p> <p>13 Q. So does the efficiency gap naturally -- 14 as a measure of partisan bias, does the efficiency 15 gap naturally favor one party over another?</p> <p>16 A. No. Clearly, if you look at this data 17 over the past 44 years, it doesn't consistently favor 18 one party or the other.</p> <p>19 Q. Okay.</p> <p>20 MS. MCKENZIE: Petitioners move 21 Exhibit 37 into evidence. 22 THE COURT: Any objection? 23 MR. TUCKER: No. 24 THE COURT: Without objection, 25 Petitioners' Exhibit 37 is admitted.</p>

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<p style="text-align: right;">868</p> <p>1 - - - 2 (Whereupon, Petitioners' Exhibit Number 3 37 was admitted into evidence.) 4 - - - 5 BY MS. MCKENZIE: 6 Q. Dr. Warshaw, did you also analyze the 7 efficiency gap in Pennsylvania, specifically? 8 A. I did. 9 MS. MCKENZIE: And can we please 10 pull up Petitioners' Exhibit 40? 11 BY MS. MCKENZIE: 12 Q. Which is Figure 4 of your report. 13 What is this graph about, generally 14 speaking? 15 A. So this graph shows the trajectory of 16 the efficiency gap in Pennsylvania over the past 17 44 years, between 1972 and 2016. 18 Q. And what's the horizontal axis showing? 19 A. So the horizontal axis here shows the 20 timespan. So you can see that in the far left of the 21 graph, we start in 1970. And as you move to the 22 right in the graph, we see there's a -- a tick for 23 1980, then 1990 and so on until we get to the 2010. 24 And then you'll see that there's also 25 some vertical lines going up the graph from top to</p>	<p style="text-align: right;">870</p> <p>1 little bit from the individual elections so we can 2 get a sense of how the efficiency gap is changing 3 over time. 4 Q. So have there been any years in 5 Pennsylvania's history in which there was an 6 efficiency gap that hovered right around zero? 7 A. Yes, there were many years. In fact, 8 the historical norm in Pennsylvania is to be 9 relatively close to zero. So if we start from the 10 left of the graph in the 1970s and '80s, what you can 11 see is that in the 1970s, there was a very modest, 12 perhaps, Democratic advantage in the efficiency gap, 13 but all of the values were relatively close to zero. 14 So, in other words, they were close to the horizontal 15 line that goes -- that goes left to right from the 16 0 percent mark. 17 The 1980s and '90s, there was clearly 18 no -- no partisan advantage for either party in the 19 efficiency gap. You know, in some years, it would be 20 slightly positive, in some years, slightly negative, 21 but they all hovered very close to zero. 22 If we move to the 2000s, in the 2000s, 23 it appears that perhaps a very modest Republican 24 advantage opened up in the efficiency gap, but 25 whatever that advantage was was very modest. Over</p>
<p style="text-align: right;">869</p> <p>1 bottom. So you'll notice there's one right to the 2 right of 2010. And these signify the breaking point 3 between the decennial redistricting plans. 4 So this is when the -- so dots to the 5 right of that are when the 2011 Redistricting Plan in 6 Pennsylvania went into place. 7 Q. And what's the vertical axis in this 8 graph showing? 9 A. The vertical axis is showing the 10 partisan advantage in the efficiency gap. So dot -- 11 so it would be -- closer to the bottom of the graph 12 would be -- would be elections where there's a 13 pro-Republican advantage in the efficiency gap, and 14 dots near the top of the graph would be elections 15 with a pro-Democratic advantage in the efficiency 16 gap. 17 Q. And what do the dots represent exactly? 18 A. So the dots represent the results in 19 every single Congressional election year in 20 Pennsylvania over the past 44 years. So they show 21 the efficiency gap that occurred in every single 22 Congressional election. 23 Q. Okay. And what's the blue line? 24 A. So the blue line is simply showing the 25 moving average over this time, trying to extract a</p>	<p style="text-align: right;">871</p> <p>1 the course of the decade, the efficiency gaps were 2 never very far from zero. 3 Q. What did you -- what did you calculate 4 as Pennsylvania's efficiency gap in 2012? 5 A. So in 2012, we see an efficiency gap in 6 Pennsylvania that really doesn't look anything like 7 the efficiency gaps that we saw in prior years. 8 So, remember, that what I just told you 9 based on my historical analysis is that, 10 historically, the efficiency gaps in Pennsylvania 11 have hovered, generally, relatively close to 12 0 percent. So in 2012, we saw an efficiency gap in 13 Pennsylvania of negative 24 percent, that is, the 14 efficiency gap indicated that Republicans had a 15 24-percentage-point advantage in the districting 16 process. 17 Q. What about in 2014? 18 A. So in 2014, Republicans continued to 19 have a large advantage in the districting process 20 with negative 15 percent. 21 Q. How about in 2016? 22 A. In 2016, the efficiency gap, again, 23 continued to have a very large and robust Republican 24 advantage. So they had a negative 19 percent 25 Republican advantage in the efficiency gap.</p>

872	<p>1 Q. Okay. Had Pennsylvania ever had an 2 efficiency gap of 15 percent in favor of either party 3 before the 2011 Plan? 4 A. No, it had not. 5 Q. And how many times had Pennsylvania had 6 an efficiency gap of even 10 percent before the 7 2011 Plan? 8 A. Only once before the 2011 Plan went 9 into place that it had an efficiency gap larger than 10 10 percent. 11 Q. Okay. So you said Pennsylvania's 12 efficiency gaps in 2012, 2014 and 2016 ranged from a 13 15 percent pro-Republican gap to 24 percent? 14 A. Yes, they did. 15 Q. So what can you conclude about those 16 gaps in relation to historical gaps throughout 17 Pennsylvania's history? 18 A. I would conclude that the efficiency 19 gaps that we've seen after the 2011 Redistricting 20 plan went into place are extreme relative to the 21 previous redistricting plans that we've seen in 22 Pennsylvania. 23 MS. MCKENZIE: Petitioners move to 24 admit Exhibit 40 into evidence. 25 THE COURT: Any objection?</p>	874	<p>1 A. I did. 2 Q. All right. So we'll get into the 3 details in a minute, but broadly, what did your 4 comparison find? 5 A. So just to remind you once again, I 6 calculated the efficiency gap in every Congressional 7 election over the past 44 years, which enabled me to 8 make comparisons like this, where I could put 9 Pennsylvania's efficiency gap into historical 10 perspective, which I think is enormously important. 11 What I found is that the efficiency gap 12 in 2012 in Pennsylvania was the largest in the 13 country in 2012. And, in fact, it was the second 14 largest efficiency gap that we've seen in modern 15 history since one-person, one-vote went into effect 16 in 1972. 17 MS. MCKENZIE: All right. Can we 18 please call up Petitioners' Exhibit 42? 19 BY MS. MCKENZIE: 20 Q. Which is Figure 5 of your report. 21 What were you trying to measure with 22 this chart? 23 A. So this -- this plot is a different way 24 of seeing the results of my analysis of the 25 efficiency gap. So on the horizontal axis here at</p>
873	<p>1 MR. TUCKER: No, Your Honor. 2 THE COURT: Without objection, 3 Petitioners' Exhibit 40 is admitted. 4 - - - 5 (Whereupon, Petitioners' Exhibit Number 6 40 was admitted into evidence.) 7 - - - 8 BY MS. MCKENZIE: 9 Q. Dr. Warshaw, has there been any 10 analysis in the academic literature of what an 11 efficiency gap of between 15 and 24 percent means in 12 terms of Congressional seats? 13 A. Yes, there has. 14 Q. And what -- what does the analysis 15 show? 16 A. So two studies have found that in 17 Pennsylvania, an efficiency gap of this size, of 18 between negative 15 and 24 percent in the 19 Republican -- in -- in the Republicans' favor, 20 implies that Republicans won an average of three to 21 four extra Congressional seats each year over this 22 timespan. 23 Q. Okay. Did you also analyze how 24 Pennsylvania's efficiency gaps compared to efficiency 25 gaps in other states?</p>	875	<p>1 the bottom of the chart, it shows the degree of 2 partisan advantage in the efficiency gap so that to 3 the left, we have places with a pro-Republican 4 efficiency gap of 20 percent or more, and on the far 5 right of the plot, we have places with a large 6 pro-Democratic efficiency gap. 7 And the vertical axis in this plot 8 shows the time periods. We start in 1972, and we 9 proceed through 2016. So every dot on this chart 10 shows the efficiency gap in states with more than six 11 Congressional seats in a given election year. 12 Q. And just to pause for a sec, so the 13 horizontal lines of dots, does that represent a year? 14 A. They do. So if you start at the 15 bottom, the -- the line of dots right above, just 16 sort of, 1970 shows the efficiency gaps in the 1972 17 Congressional election, whereas at the very top of 18 the plot, we have the efficiency gaps in every state 19 in the country in the 2012, '14 and '16 elections. 20 Q. Okay. So you said earlier, when we 21 were looking at your density chart, that only 22 4 percent of efficiency gaps across the country since 23 1972 were above 20 percent in favor of either party. 24 A. Yes. 25 Q. So how does Pennsylvania's 24 percent</p>

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1 **efficiency gap in 2012 compare to other states?**
 2 A. So it was the largest in the country in
 3 2012. In other words, it was the largest
 4 pro-Republican efficiency gap out of all the states
 5 in 2012.
 6 **Q. And how about in history?**
 7 A. It was the second largest in all of
 8 history.
 9 **Q. And what about if you look at the other**
 10 **two elections following the 2011 redistricting, so**
 11 **2014 and 2016?**
 12 A. Sure.
 13 As you can see from the chart -- so,
 14 again, on the chart, the dots represent the elections
 15 in every election year, and the PA abbreviations --
 16 **Q. The dots represent the efficiency gaps?**
 17 A. Sorry, the efficiency gap in every
 18 Congressional election, and the PA represents the
 19 efficiency gaps in Pennsylvania.
 20 So we can see that Pennsylvania
 21 continued to have a very large pro-Republican
 22 efficiency gap over the course of the 2014 and 2016
 23 elections. And if you average across those three
 24 elections, there's an average efficiency gap of
 25 negative 19 percent, which was the second largest in

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1 the country, narrowly, after North Carolina.
 2 **Q. When you say "second largest in the**
 3 **country," you mean second largest on average over the**
 4 **three elections?**
 5 A. Yes --
 6 **Q. Okay.**
 7 A. -- the average across those three
 8 elections -- it was the second largest averaging
 9 across those three elections.
 10 **Q. Okay. So you said it was the second**
 11 **largest to North Carolina.**
 12 **Do you know the magnitude of the**
 13 **difference?**
 14 A. It was around 1 percent was the
 15 difference. The difference was very small between
 16 them.
 17 MS. MCKENZIE: Petitioners move to
 18 admit Exhibit 42 into evidence.
 19 THE COURT: Any objection?
 20 Without objection.
 21 - - -
 22 (Whereupon, Petitioners' Exhibit Number
 23 42 was admitted into evidence.)
 24 - - -
 25 THE COURT: Counsel, is this a good

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1 point to break, or are you in the middle of
 2 a line of thought?
 3 MS. MCKENZIE: If I could just have
 4 a few more minutes -- I think if -- if we
 5 look at one more figure, that will be a
 6 good -- at a good breaking place.
 7 THE COURT: Okay. Very well.
 8 MS. MCKENZIE: Thank you.
 9 BY MS. MCKENZIE:
 10 **Q. Is it -- is it possible that**
 11 **Pennsylvania's large efficiency gap could be caused**
 12 **by geography or some other neutral factor?**
 13 A. In my judgment, no. I think,
 14 certainly, geography can contribute to differences in
 15 the efficiency gap across states, but in
 16 Pennsylvania, the efficiency gap -- if you pull up
 17 the figure from my report that shows the change in
 18 Pennsylvania.
 19 **Q. I believe it's Exhibit 40.**
 20 MS. MCKENZIE: If we can pull that
 21 up.
 22 THE WITNESS: Yes.
 23 So what this figure shows is that
 24 the efficiency gap in Pennsylvania moved
 25 sharply in a pro-Republican direction when

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1 the 2011 Redistricting Plan went into place.
 2 So, in other words, between the 2010 and
 3 2012 elections, the efficiency gap grew
 4 about 15 percentage points more
 5 pro-Republican, a change that's far larger
 6 than anything we observed before in previous
 7 Congressional elections.
 8 So I think what this suggests, to
 9 me, is it's very unlikely that some change
 10 in political geography or some other aspect
 11 of voting behavior would have driven this
 12 change. This change was likely only due to
 13 the districts that were put in place.
 14 BY MS. MCKENZIE:
 15 **Q. How fast does political geography**
 16 **generally change?**
 17 A. So we know from a wide variety of
 18 studies that, certainly, political geography changes
 19 over time, but it doesn't change this fast. Over the
 20 course of a two-year period, there's no possible
 21 change in political geography that would lead to such
 22 a dramatic shift in the efficiency gap, in my
 23 judgment.
 24 **Q. And you're talking about a dramatic**
 25 **shift between the 2000s decade and the current**

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<p>1 decade?</p> <p>2 A. Not just between the decades, but a</p> <p>3 dramatic shift between the 2010 and 2012 elections.</p> <p>4 So that's where we would have to have an extremely</p> <p>5 large shift in political geography that would have</p> <p>6 caused the change we observed here.</p> <p>7 And it's hard for me to think, either</p> <p>8 at a theoretical level or an empirical level, like,</p> <p>9 any change in political geography that could have</p> <p>10 caused that.</p> <p>11 MS. MCKENZIE: Your Honor, I think</p> <p>12 this is a good place to break.</p> <p>13 THE COURT: Okay. Thank you.</p> <p>14 Professor, you can step down for a</p> <p>15 moment, but after the break, I'm sure you're</p> <p>16 going to be back up here.</p> <p>17 Before we break, what does the rest</p> <p>18 of the day -- well, first of all, let's stay</p> <p>19 on the record for this part.</p> <p>20 And, again, I don't mean to beat a</p> <p>21 dead horse, but I want to make sure we're on</p> <p>22 the record so this is clear.</p> <p>23 As we indicated at the beginning of</p> <p>24 the day, the Court had requests, from all</p> <p>25 side, Word versions of their stipulations --</p>	<p>1 - - -</p> <p>2 THE CLERK: The Court is now in</p> <p>3 recess.</p> <p>4 (Whereupon, at 12:48 p.m., a</p> <p>5 luncheon recess was taken.)</p> <p>6</p> <p>7</p> <p>8</p> <p>9</p> <p>10</p> <p>11</p> <p>12</p> <p>13</p> <p>14</p> <p>15</p> <p>16</p> <p>17</p> <p>18</p> <p>19</p> <p>20</p> <p>21</p> <p>22</p> <p>23</p> <p>24</p> <p>25</p>
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<p>1 the stipulation of facts and their exhibit</p> <p>2 lists. The request was made to all parties.</p> <p>3 Petitioners, did you have any</p> <p>4 objection to that request?</p> <p>5 MR. JONES: No, Your Honor, we had</p> <p>6 no objection to the request.</p> <p>7 THE COURT: Did any of the</p> <p>8 Respondents have any objection to the</p> <p>9 request?</p> <p>10 MR. TUCKER: No, Your Honor.</p> <p>11 THE COURT: Petitioner, do you</p> <p>12 believe that there was any ex parte</p> <p>13 communication by the Court with respect to</p> <p>14 that request?</p> <p>15 MS. GALLAGHER: Absolutely not, Your</p> <p>16 Honor.</p> <p>17 THE COURT: Do any of the</p> <p>18 Respondents believe that to be the case?</p> <p>19 MR. TUCKER: Absolutely not,</p> <p>20 Your Honor.</p> <p>21 THE COURT: Thank you.</p> <p>22 We'll stand in recess until 1:30.</p> <p>23 - - -</p> <p>24 (Whereupon, a discussion was held off</p> <p>25 the record.)</p>	<p>1 AFTERNOON SESSION</p> <p>2 (1:39 p.m.)</p> <p>3 - - -</p> <p>4 CHRISTOPHER WARSHAW, PH.D.,</p> <p>5 was called for continued examination and, after having</p> <p>6 been previously duly sworn, was examined and</p> <p>7 testified further as follows:</p> <p>8 - - -</p> <p>9 THE CLERK: All rise. The</p> <p>10 Commonwealth Court session is back in</p> <p>11 session.</p> <p>12 THE COURT: Please be seated,</p> <p>13 everyone.</p> <p>14 Counsel, you can continue your</p> <p>15 direct examination of Dr. Warsaw.</p> <p>16 MS. MCKENZIE: Thank you.</p> <p>17 Let me just hand the laser pointer</p> <p>18 to Dr. Warsaw.</p> <p>19 THE COURT: I'm sorry. What?</p> <p>20 MS. MCKENZIE: I was just going to</p> <p>21 hand the laser pointer.</p> <p>22 THE COURT: Oh, the laser pointer.</p> <p>23 Yes, please.</p> <p>24 THE WITNESS: Thank you.</p> <p>25 MS. MCKENZIE: Could we call back up</p>

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<p style="text-align: right;">884</p> <p>1 Petitioners' Exhibit 42? 2 - - - 3 DIRECT EXAMINATION (RESUMED) 4 - - - 5 BY MS. MCKENZIE: 6 Q. And, Dr. Warshaw, we were looking at 7 this -- this graph a little bit earlier. 8 And just to reorient, what -- what do 9 the dots signify in this graph? 10 A. The dots show the efficiency gap in 11 every -- in every Congressional election over the 12 past 44 years. 13 Q. So in every state? 14 A. In every state. 15 Q. What does each dot represent? 16 A. The dot represents the efficiency gap 17 in that particular election in each state. 18 Q. Okay. And what do the little PA 19 markers represent? 20 A. They show the -- they show the 21 efficiency gaps in Pennsylvania. So I wanted to make 22 it easy to see the efficiency gaps in Pennsylvania. 23 Q. So what does this graph tell you about 24 the efficiency gap in Pennsylvania relative to other 25 states over time?</p>	<p style="text-align: right;">886</p> <p>1 1988 election here, there's a range of dots across 2 the axis. And you can see that Pennsylvania is right 3 in the middle of those dots. And indeed, that's 4 where it's typically been in past elections. 5 Q. So does this finding tell you anything 6 about the likelihood that political geography could 7 be the cause of Pennsylvania's extreme efficiency 8 gaps in post-2011? 9 A. It does. I think what this tells us is 10 that to the extent political geography influences the 11 efficiency gap in Pennsylvania, historically, it's 12 led to a relatively neutral efficiency gap with no 13 party having a persistent advantage in the 14 districting process. 15 In fact, the large Republican bias in 16 the districting process that we observe in the last 17 three elections only occurred after the 18 2011 Redistricting Plan went into place. We hadn't 19 seen anything like this in prior elections in 20 Pennsylvania, which, again, suggests that political 21 geography can't be the explanation for the large 22 pro-Republican efficiency gaps we've seen in recent 23 elections. 24 Q. Okay. And we talked about this a 25 little bit earlier.</p>
<p style="text-align: right;">885</p> <p>1 A. What it tells us is that the efficiency 2 gaps in Pennsylvania today -- so, for instance, the 3 2012 -- the efficiency gap in 2012, which was a 4 24 percentage-point pro-Republican efficiency gap -- 5 are extremely large, both relative to Pennsylvania's 6 historical efficiency gaps, as we saw earlier, but 7 also relative to the efficiency gaps in other states. 8 You can easily see this by looking at 9 the PA abbreviations in the upper -- upper left 10 quadrant of the graph -- are far to the left of -- of 11 almost any other efficiency gap over this entire 12 period, which means they have a larger pro-Republican 13 efficiency gap compared -- relative to all the other 14 redistricting plans over this entire period. 15 Q. Was it always true in prior decades 16 that Pennsylvania's efficiency gap was large relative 17 to other states? 18 A. No. In past elections, Pennsylvania's 19 efficiency gap has look -- has generally been, you 20 know, roughly in the middle of the distribution of 21 other states. 22 Q. And can you tell us how -- how you see 23 that from that graph? 24 A. Well, you can see, for instance, if we 25 look at the -- let's see -- if we look at, like, the</p>	<p style="text-align: right;">887</p> <p>1 Did you also analyze the durability of 2 the efficiency gap after the 2011 redistrictings? 3 A. I did. 4 Q. And can you tell us what you mean by 5 "durable"? 6 A. What I wanted to look at is, when an 7 efficiency gap -- when a redistricting plan is put 8 into place, how persistent is the efficiency gap that 9 occurred in 2012 over the remainder of the decennial 10 redistricting cycle. 11 In particular, I wanted to look -- if 12 we fast-forward four years from when the 13 redistricting occurred, how similar are the 14 efficiency gaps we observe in 2016 to the efficiency 15 gaps that we observe in 2012? And the more similar 16 they are, probably the better metric the efficiency 17 gap -- or the -- the more politically meaningful 18 differences in the efficiency gap in 2012 are. 19 Because it suggests that they're unlikely to be 20 remedied through normal electoral politics if they're 21 extremely persistent. 22 MS. MCKENZIE: Okay. Can we please 23 pull up Petitioners' Exhibit 339? 24 BY MS. MCKENZIE: 25 Q. Which is Exhibit 3 of your report.</p>

888	<p>1 Tell us what this graph is showing,</p> <p>2 just generally.</p> <p>3 A. So this -- this compares the efficiency</p> <p>4 gaps in 2012 to the efficiency gaps in 2016. So the</p> <p>5 X-axis, in other words, the horizontal axis, we can</p> <p>6 see a state's efficiency gap in 2012. And then the</p> <p>7 vertical axis, so the -- where the state falls sort</p> <p>8 of up and down the graph, shows their efficiency gap</p> <p>9 in 2016.</p> <p>10 Q. And what's the blue line?</p> <p>11 A. The blue line is just the moving</p> <p>12 average. It shows the average relationship between</p> <p>13 efficiency gaps in 2012 and '16.</p> <p>14 Q. Okay. And what are the -- the</p> <p>15 little -- the little letters, like GA and NY and TN?</p> <p>16 A. So these -- these are all just the</p> <p>17 state abbreviations. I wanted to make it very easy</p> <p>18 to see where states fell so we could compare directly</p> <p>19 their efficiency gaps for each state with more than</p> <p>20 six districts in 2012 and 2016.</p> <p>21 Q. Okay. So, for instance, if you wanted</p> <p>22 to find Wisconsin's efficiency gap, how -- how would</p> <p>23 you find that on that graph?</p> <p>24 A. Right. So Wisconsin is sort of in the</p> <p>25 left lower quadrant of the graph. We can see it.</p>	890	<p>1 So the efficiency gaps in 2012 are extremely</p> <p>2 predictive of the efficiency gaps in 2016.</p> <p>3 Q. Is -- do you see that relationship for</p> <p>4 Pennsylvania?</p> <p>5 A. I do. So turning to -- turning to</p> <p>6 Pennsylvania, we can see, once again, is that in</p> <p>7 2012, Pennsylvania had an efficiency gap of negative</p> <p>8 24 percent, which is the largest pro-Republican</p> <p>9 efficiency gap in the country. In 2016, Pennsylvania</p> <p>10 still had a very large pro-Republican efficiency gap</p> <p>11 of negative 19 percent, which, in 2016, was the</p> <p>12 second largest in the country, narrowly, after</p> <p>13 North Carolina.</p> <p>14 Q. All right. So you said that the 2012</p> <p>15 efficiency gaps predict 67 percent of the variation</p> <p>16 in efficiency gaps four years later?</p> <p>17 A. Yes.</p> <p>18 Q. Did you draw any conclusions from that</p> <p>19 about the ability of the electoral process to remedy</p> <p>20 partisan bias in the 2011 redistricting of</p> <p>21 Pennsylvania?</p> <p>22 A. I did. The conclusion I drew is that</p> <p>23 the efficiency gaps that occur immediately after the</p> <p>24 2011 Redistricting Plans went into place are</p> <p>25 extremely persistent and predict the vast majority of</p>
889	<p>1 It's right about here. And we can see that the</p> <p>2 efficiency gaps in 2012 and 2016 were almost</p> <p>3 identical in Wisconsin. And you can see that because</p> <p>4 it falls in the same place on the axis here that it</p> <p>5 does here.</p> <p>6 And I think, to make this more precise,</p> <p>7 the efficiency gap in Wisconsin in 2012 is negative</p> <p>8 13 percent, while the efficiency gap in Wisconsin in</p> <p>9 2016 was negative 14 percent. So you can see that</p> <p>10 the efficiency gaps were almost identical in 2012 and</p> <p>11 2016.</p> <p>12 Q. So what does the R equals .82 on that</p> <p>13 graph mean?</p> <p>14 A. So R equals .82 is the correlation</p> <p>15 between the efficiency gaps in 2012 and 2016. And</p> <p>16 what this shows is that the efficiency gaps in 2012</p> <p>17 are extremely predictive of the efficiency gaps in</p> <p>18 2016. In other words, the variance in the efficiency</p> <p>19 gaps in 2012 predicts about 67 percent of the</p> <p>20 variation in the efficiency gaps in 2016.</p> <p>21 Q. And is that across the entire country?</p> <p>22 A. That's across the entire country.</p> <p>23 Q. And is that -- that's a high -- is that</p> <p>24 a high level of correlation?</p> <p>25 A. Yeah, that's a very high correlation.</p>	891	<p>1 variation in efficiency gaps four years later. So</p> <p>2 this tells me that the normal electoral process is</p> <p>3 unlikely to remedy the efficiency gaps we've observed</p> <p>4 unless the courts step in to change them.</p> <p>5 MS. MCKENZIE: Petitioners move</p> <p>6 Exhibit 39 into evidence.</p> <p>7 THE COURT: Any objection?</p> <p>8 MR. TUCKER: No.</p> <p>9 MS. HANGLEY: No objection.</p> <p>10 THE COURT: Petitioners' Exhibit 39</p> <p>11 is admitted without objection.</p> <p>12 - - -</p> <p>13 (Whereupon, Petitioners' Exhibit Number</p> <p>14 39 was admitted into evidence.)</p> <p>15 - - -</p> <p>16 BY MS. MCKENZIE:</p> <p>17 Q. Dr. Warshaw, you mentioned earlier that</p> <p>18 you focused your analysis on comparing Pennsylvania's</p> <p>19 efficiency gap to states with more than six</p> <p>20 Congressional seats.</p> <p>21 Why did you do that?</p> <p>22 A. I did it primarily because the</p> <p>23 efficiency gaps in states with a smaller number of</p> <p>24 seats were more volatile year to year. So I didn't</p> <p>25 want to focus on those small states with more</p>

892	<p>1 volatile efficiency gaps.</p> <p>2 And they're volatile for the very</p> <p>3 simple reason that in a place with only, say, three</p> <p>4 or four Congressional elections, a close result in</p> <p>5 one election where the Democrat or the Republican</p> <p>6 narrowly wins could obviously substantially change</p> <p>7 the efficiency gap.</p> <p>8 So sort of small-volatility election</p> <p>9 results can lead to big swings in the efficiency gap</p> <p>10 from year to year, so I didn't want that volatility</p> <p>11 to affect my analysis.</p> <p>12 And I think from the point of view of</p> <p>13 thinking about Congress as a whole, I think the</p> <p>14 consequences of this are relatively small, because</p> <p>15 the states with more than six Congressional seats</p> <p>16 constitute more than 80 percent of the seats in the</p> <p>17 current Congress. So my analysis encompasses the</p> <p>18 vast majority of the seats in Congress.</p> <p>19 From a representational perspective,</p> <p>20 I'm focusing on the states that constitute the</p> <p>21 majority of the representation that citizens receive</p> <p>22 in Congress.</p> <p>23 Q. Did you still look at states with</p> <p>24 fewer -- with six or fewer Congressional seats as --</p> <p>25 as a check?</p>	894	<p>1 A. So the bulk of my analysis focuses on</p> <p>2 Congressional election results since those are</p> <p>3 ultimately the -- the object of a gerrymander is to</p> <p>4 maximize the number of seats in Congress relative to</p> <p>5 your votes in Congressional elections.</p> <p>6 I also compared my results with other</p> <p>7 measures of the efficiency gap as well as with</p> <p>8 efficiency gap measures derived from presidential</p> <p>9 election results.</p> <p>10 Q. And did you find that it change your</p> <p>11 analysis?</p> <p>12 A. I did not.</p> <p>13 Q. So in one of the tables in</p> <p>14 Professor Gimpel's report, Table 7, which we'll take</p> <p>15 a look at more later, he does a calculation of an</p> <p>16 efficiency gap in Pennsylvania's Congressional</p> <p>17 elections but he uses party registration figures.</p> <p>18 Did you look at that?</p> <p>19 A. I did.</p> <p>20 Q. Do you think that's a useful or valid</p> <p>21 way of measuring the efficiency gap?</p> <p>22 A. I do not.</p> <p>23 Q. Why not?</p> <p>24 A. Well, I think that, in general, party</p> <p>25 registration, in Pennsylvania, particularly, is not a</p>
893	<p>1 A. I did.</p> <p>2 Q. And what did you find?</p> <p>3 A. What I found is that in 2012,</p> <p>4 Pennsylvania had the largest efficiency gap in the</p> <p>5 country among states with more than four</p> <p>6 Congressional seats. Even if we lower our threshold</p> <p>7 from six seats to four seats, Pennsylvania continues</p> <p>8 to have the largest efficiency gap in the country.</p> <p>9 And if we lower the threshold still</p> <p>10 more to states with more than two Congressional</p> <p>11 seats, Pennsylvania's efficiency gap is the second</p> <p>12 largest in the country after Arkansas.</p> <p>13 Q. Okay. Dr. Warshaw, did you take a look</p> <p>14 at Professor Gimpel's expert report in this case?</p> <p>15 A. I did.</p> <p>16 Q. And he criticized the efficiency gap on</p> <p>17 the ground that it is purportedly, quote, sensitive</p> <p>18 to the political data used to calculate it.</p> <p>19 A. He did.</p> <p>20 Q. Do you agree with that criticism?</p> <p>21 A. I don't. I think the central</p> <p>22 conclusion is very similar regardless of the data</p> <p>23 that you calculate -- that you use to calculate it.</p> <p>24 Q. And what -- what political data did you</p> <p>25 use to calculate it? What elections?</p>	895	<p>1 good predictor of how people vote in Congressional</p> <p>2 elections, which I think is something that</p> <p>3 Professor Gimpel actually noted in his report.</p> <p>4 So given that, we have election results</p> <p>5 in Congressional elections, where we can measure</p> <p>6 directly people's preferences in those elections, and</p> <p>7 we also have a suite of other election results if</p> <p>8 wanted to use sort of other election --</p> <p>9 election-based metrics to measure people's</p> <p>10 preferences.</p> <p>11 So given the availability of much</p> <p>12 better sources of information on people's electoral</p> <p>13 preferences, I don't see the relevance of party</p> <p>14 registration.</p> <p>15 Q. All right. Beyond the efficiency gap,</p> <p>16 did you look at any other measure of partisan bias in</p> <p>17 Pennsylvania for your report?</p> <p>18 A. I did.</p> <p>19 MS. MCKENZIE: All right. And let's</p> <p>20 call up Petitioners' Exhibit 41, which is</p> <p>21 Table 1.</p> <p>22 BY MS. MCKENZIE:</p> <p>23 Q. Can you explain what this table is</p> <p>24 showing?</p> <p>25 A. Sure. So this table is showing the</p>

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896	<p>1 results of the 2012 Congressional elections in 2 Pennsylvania. And we can see, starting to the -- to 3 the left column with the title District shows the 4 Congressional districts and the right column with the 5 title Democratic Vote Share shows the Democrats' 6 percentage of the two-party vote in each of these 7 districts.</p> <p>8 Q. And what does the line in the middle 9 there show?</p> <p>10 A. The line in the middle shows the cutoff 11 between districts where Democrats won and Republicans 12 won; so all the districts below this cutoff were won 13 by Democrats, generally by overwhelming margins, and 14 the districts above this cutoff were won by 15 Republicans.</p> <p>16 Q. Did the Democrats win a majority of the 17 statewide Congressional vote in Pennsylvania in 2012?</p> <p>18 A. It did. Democrats won approximately 19 51 percent of the statewide Congressional vote in 20 2012.</p> <p>21 Q. What kind of vote percentage would it 22 have taken for the Democrats to win a majority of the 23 seats in Pennsylvania's delegation in 2012?</p> <p>24 A. Well, in order to win a majority of the 25 seats, Democrats would have had to have won 10 out of</p>	898	<p>1 to be sure. So they would have gotten six of the 18 2 districts, but they still wouldn't have won the 3 Eighth District, the 15th District, the 4 Sixth District or the Third District.</p> <p>5 So even though in your counterfactual 6 scenario Democrats would have won 57 percent of the 7 statewide vote, they still would have only won a 8 third of the seats across the state.</p> <p>9 Q. Okay. So I just want to pause on this 10 for a second because I think it's important.</p> <p>11 You're saying if the Democrats had won 12 56 percent of the statewide Congressional vote in 13 2012 and the Republicans had won 44 percent, so that 14 the Democrats won 12 percent more votes, they still 15 would have only one-third of the seats?</p> <p>16 A. Correct.</p> <p>17 MS. MCKENZIE: Petitioners move to 18 admit Exhibit 41 into evidence.</p> <p>19 THE COURT: Any objection?</p> <p>20 MR. TUCKER: No, Your Honor.</p> <p>21 MS. HANGLEY: No objection.</p> <p>22 THE COURT: Petitioners' Exhibit 41 23 is admitted without objection. 24 - - - 25 (Whereupon, Petitioners' Exhibit Number</p>
897	<p>1 the 18 districts. Now, in -- in the real election, 2 they only won five districts. So in order to win a 3 majority of seats, Democrats would have had to have 4 won five more districts than they actually won in the 5 real election.</p> <p>6 So they would have had to have won 7 District 3, 6, 15, 8 and 12. And in the case of 8 Districts 3 through 8 -- or sorry -- 3, 6, 15 and 8, 9 they would have had to win those districts by about 10 7 percentage points; they would have had to receive 11 7 percentage points more of the vote in those 12 districts than they actually received.</p> <p>13 Q. So -- and just to be clear, you said 14 earlier that the Democrats won about 51 percent of 15 the statewide Congressional vote already in 2012?</p> <p>16 A. Yes.</p> <p>17 Q. So Democrats would have won a majority 18 of the seats in 2012 if they had won 57 percent of 19 the vote across the state?</p> <p>20 A. No. If we assume, as political 21 scientists typically do, that there's a uniform swing 22 across districts, where 57 percent of the vote 23 statewide implies that Democrats would have won about 24 6 percentage points more of the vote in each 25 district, then they would have won the 12th District,</p>	899	<p>1 41 was admitted into evidence.) 2 - - - 3 BY MS. MCKENZIE:</p> <p>4 Q. Dr. Warsaw, we're about to move on to 5 the next thing you analyzed, but before we do that, 6 can you just summarize your conclusions for us about 7 partisan bias in Pennsylvania's Congressional map?</p> <p>8 A. Yes. Looking across the Congressional 9 elections both in Pennsylvania and the nation as a 10 whole, the efficiency gap in Pennsylvania is 11 extremely large relative both to historical 12 efficiency gaps in Pennsylvania, which have typically 13 lied close to 0 percent. In other words, typically, 14 Pennsylvania has had no partisan advantage for either 15 party.</p> <p>16 And it's also large -- it's also 17 extremely large relative to efficiency gaps that 18 we've observed in other states historically, where 19 the 2012 efficiency gap in Pennsylvania was not only 20 the largest in 2012, the most pro-Republican in 2012, 21 but it is also the second-most pro-Republican 22 efficiency gap in history.</p> <p>23 Q. All right. Thanks, Dr. Warsaw. 24 So let's now return to the second thing 25 that you said that you looked at, which was the</p>

900	<p>1 effect of partisan bias in Pennsylvania on the 2 representation that Pennsylvanians receive in 3 Congress. 4 Did you evaluate that question in the 5 context of the polarization in Congress? 6 A. I did. 7 Q. Can you give us some background on 8 polarization in Congress in general? 9 A. I can. So there's a consensus among 10 political scientists, which I think probably matches 11 with the common-sense intuition of most of us, that 12 polarization in Congress is not only extremely large 13 today, but it's much larger today than it used to be. 14 In fact, polarization in Congress increased 15 dramatically over the past 40 years. 16 Q. And what do political scientists 17 generally look at when they're analyzing 18 polarization? 19 A. Typically, political scientists focus 20 on roll call data. In other words, they focus on the 21 votes that Members of Congress pass on pieces of 22 legislation. And the reason for this is that roll 23 call voting is ultimately the way that -- the primary 24 way that Members of Congress influence the laws that 25 are passed, and they ultimately could be signed by</p>	902	<p>1 A. Yes. 2 Q. Okay. 3 A. And this data came from -- was 4 developed by -- in a published paper by two political 5 scientists, so I didn't come up with this data. 6 Q. On the vertical axis, when it says 7 Partisan Divergence and Conservative Vote 8 Probability, that's the roll call votes? 9 A. Yes. 10 Q. And you just said that someone other 11 than you assigned a conservative or liberal label to 12 each particular roll call vote? 13 A. Yeah, I believe it was based on whether 14 more Republicans or Democrats voted in a particular 15 direction. That's how they figured out whether it 16 was a more conservative roll call vote. 17 Q. So what do the dots on this chart show? 18 A. So the dots on this chart show, in 19 every Congress, the difference in the percentage of 20 time that Democrats and Republicans vote in a 21 conservative direction. And what you can see is that 22 in the far lower left of the graph, in the 1970s, 23 there was about a 30 percentage-point difference in 24 the percentage of time that Democrats and Republicans 25 voted conservatively, which surely is not -- you</p>
901	<p>1 the president into -- into law. And it's also the 2 primary way that Members of Congress influence the 3 policies passed by our nation. 4 Q. Did you conduct your own analysis of 5 polarization for this case? 6 A. I did. 7 MS. MCKENZIE: Can we please call up 8 Petitioners' 43? 9 BY MS. MCKENZIE: 10 Q. Which is Figure 6 of your report. 11 So what is this figure showing, 12 generally? 13 A. So this figure is showing on the Y 14 axis -- it shows the difference in the percentage of 15 people -- 16 Q. The Y is the vertical. 17 A. I'm sorry. 18 On the vertical axis on the left, it 19 shows the difference in the percentage of people in 20 each party that vote in a conservative direction. 21 And the X axis -- in other words, the horizontal 22 axis -- it shows the time -- the time period. So the 23 data here goes from the early 1970s up to 2014. 24 Q. And by "people in each party," you mean 25 Members of Congress?</p>	903	<p>1 know, that's no small difference, but it's a much 2 smaller difference than the difference we observe 3 today. 4 So as you move up the plot, you can see 5 that, over time, the difference between Democrats and 6 Republicans in Congress, which is typically called 7 "polarization" by political scientists, is increased 8 dramatically. 9 So that in -- as we move into the more 10 recent Congresses after the -- in the far, far right 11 of the plot, we can see that in these Congresses, 12 Democrats and Republicans -- there was about a 13 65 percentage-point difference in the percentage of 14 time -- of the time that Democrats and Republicans 15 voted in a conservative direction. 16 So, in other words, it was about twice 17 as large a difference between the -- the proportion 18 of the time that Democrats and Republicans voted 19 conservatively on roll call votes today as there was 20 in the early 1970s. 21 Q. Okay. 22 MS. MCKENZIE: Petitioners move to 23 admit Exhibit 43 into evidence. 24 THE COURT: Any objection? 25 Without objection, Petitioners'</p>

904	<p>1 Exhibit 43 is admitted. 2 - - - 3 (Whereupon, Petitioners' Exhibit Number 4 43 was admitted into evidence.) 5 - - - 6 MS. MCKENZIE: Can we call up 7 Petitioners' Exhibit 44? 8 BY MS. MCKENZIE: 9 Q. And this is a -- Figure 7 of 10 Dr. Warsaw's report, called The Average Ideology of 11 Members of Each Party. 12 Can you tell us what the horizontal 13 axis of this graph is showing? 14 A. Sure. This graph -- once again, the 15 horizontal axis is showing the time period, showing 16 that we're moving from the early 1970s to the most 17 recent Congress that ended in 2016 over the course of 18 the graph. 19 Q. And what's the vertical axis? 20 A. So the vertical axis is showing a 21 different way of measuring the ideology of Members of 22 Congress based on their roll call voting behavior, 23 and this is the most commonly used way of summarizing 24 the ideology of Members of Congress in the political 25 science literature. It's called the</p>	906	<p>1 Q. Okay. Is there an advantage to using 2 DW-NOMINATE scores over interest-group scores? 3 And you can -- I think you -- you can 4 tell us what that means. 5 A. Absolutely. In earlier decades -- I 6 think much less so today -- political scientists 7 would sometimes use interest-group scores. And I 8 believe that -- 9 Q. And just tell us what an interest-group 10 score is. 11 A. Interest-group score is, you know, you 12 may be a member of, like, the League of Conservation 13 Voters or the NRA, the National Rifle Association, or 14 any number of other lobbying groups or mass 15 membership interest groups -- the Sierra Club, the -- 16 any number of other interest groups. And all of 17 these interest groups -- or many of these interest 18 groups produce a scorecard that tries to evaluate 19 sort of how often Members of Congress vote in the way 20 the interest group wants them to vote, and so there's 21 a number of different of these scorecards sort of 22 floating around. And, typically, these scorecards 23 are only based on 10 or 15, or maybe 20, roll call 24 votes. Whereas, in a typical Congress, Members of 25 Congress will vote on upwards of 500 roll call votes.</p>
905	<p>1 "DW-NOMINATE score" that was developed by Professors 2 Poole and Rosenthal, and it's been cited hundreds of 3 times in political science studies. 4 And, essentially, this measure is based 5 on all of the roll call votes in Congress, the 6 ideology of each Member of Congress. 7 Q. And what's the advantage of using a 8 DW-NOMINATE score over a regular roll call vote? 9 A. Well, the DW-NOMINATE scores are a 10 one-dimensional summary -- so it's on a single 11 index -- that summarizes people's ideology based on 12 all other roll call votes. Moreover, these ideology 13 scores are comparable both -- across Members of 14 Congress both cross-sectionally as well as 15 intertemporally. 16 Q. Can you just explain what you mean by 17 "cross-sectionally"? 18 A. So we can compare Members of Congress, 19 like, in different states, to each other on the same 20 scale, but more importantly, we can compare Members 21 of Congress today to Members of Congress 20 years ago 22 using this technology; whereas, if you just used the 23 raw roll call votes, it wouldn't be obvious how to 24 compare Members of Congress today to Members of 25 Congress 20 or 30 years ago.</p>	907	<p>1 It is a very small slice of the total roll calls that 2 Members of Congress vote on. 3 Moreover, the way the interest groups 4 design these scorecards is designed to emphasize the 5 extremity in Congress, so, typically, like, if you're 6 the League of Conservation Voters and you're 7 designing a scorecard, the goal of your scorecard is 8 to emphasize sort of how liberal -- how great 9 Democrats are on the environment and how terrible the 10 Republicans are. And this is true across interest 11 groups. 12 So this leads to a common problem 13 that's sort of well-known in the literature, called 14 "artificial extremism," where these interest group 15 scorecards tend to exaggerate the polarization we 16 see, which, of course, is a little silly because, you 17 know, if you use all the roll call votes, there's 18 already a lot of polarization, as we've talked about; 19 so if you exaggerate that even more, then it starts 20 to look, you know, truly horrendous. 21 Q. And the bottom line, though, is that 22 you think DW-NOMINATE scores are a better way of 23 measuring ideology? 24 A. Absolutely. I think there's a 25 near-universal consensus in the political -- in</p>

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908	<p>1 the -- in the modern political science literature</p> <p>2 that DW-NOMINATE scores or similar roll call --</p> <p>3 similar metrics that are based on all the roll call</p> <p>4 votes. You can use this as a non-Bayesian approach.</p> <p>5 You can use a slightly different model as Bayesian.</p> <p>6 But the common -- the commonality between DW-NOMINATE</p> <p>7 and the better approach is that they all use all of</p> <p>8 the roll call votes to assess Members of Congress --</p> <p>9 Congress's ideology based on some sort of a</p> <p>10 measurement model.</p> <p>11 THE COURT: Can I interrupt for a</p> <p>12 second, Counsel?</p> <p>13 Can we go off the record?</p> <p>14 (Pause.)</p> <p>15 BY MS. MCKENZIE:</p> <p>16 Q. All right, Dr. Warshaw.</p> <p>17 And does a -- what does a positive</p> <p>18 DW-NOMINATE score indicate, as compared to a negative</p> <p>19 DW-NOMINATE score?</p> <p>20 A. So a positive DW-NOMINATE score denotes</p> <p>21 a conservative ideology -- a conservative roll call</p> <p>22 voting pattern in Congress, whereas a negative score</p> <p>23 indicates a more liberal voting pattern. And those</p> <p>24 are total -- those are completely arbitrary. You can</p> <p>25 obviously flip those. But the way they're</p>	910	<p>1 there's some vertical red or blue lines.</p> <p>2 Are those lines?</p> <p>3 A. Those are all dots. The vertical</p> <p>4 things that look like lines are actually 435 dots in</p> <p>5 each Congress showing the ideology of every single</p> <p>6 Member of Congress in that -- in each Congress.</p> <p>7 Q. Okay. And so what does this figure</p> <p>8 tell you? What can you learn from this graph?</p> <p>9 A. Well, it tells us a number of important</p> <p>10 things. First of all, it shows us that in the 1970s,</p> <p>11 there is relatively large degrees of overlap between</p> <p>12 the parties.</p> <p>13 So you can see, if we look at</p> <p>14 the -- the blue dots in particular, there's a lot of</p> <p>15 blue dots that actually overlap with Republicans.</p> <p>16 And if we focus, for instance, on this blue dot, this</p> <p>17 is a Democrat who is actually more conservative than</p> <p>18 the average Republican in the House; but, more</p> <p>19 generally, there's just a lot -- there's a lot of</p> <p>20 blue dots that overlap with the ideology of</p> <p>21 Republicans, and there's some red dots that overlap</p> <p>22 with Democrats.</p> <p>23 So, certainly, during this time period,</p> <p>24 there is no guarantee that if you elected a Democrat,</p> <p>25 that they would be substantially more -- they</p>
909	<p>1 conventionally done is that a positive, or rightward,</p> <p>2 score is conservative; and a negative, or a leftward,</p> <p>3 score is liberal.</p> <p>4 Q. All right. And let's -- let's return</p> <p>5 to Petitioners' Exhibit 44.</p> <p>6 So what are the dots on this graph</p> <p>7 showing?</p> <p>8 A. Sure. So the dots here show the</p> <p>9 ideology on the DW-NOMINATE scale of every Member of</p> <p>10 Congress over the past 44 -- 40 or so years. And --</p> <p>11 so the dots show every individual Member of Congress.</p> <p>12 And then the -- the blue dots show Democratic Members</p> <p>13 of Congress, and the red dots show Republican Members</p> <p>14 of Congress.</p> <p>15 And the lines show the moving average</p> <p>16 of the average ideology of each Member of Congress</p> <p>17 from each party. So the red line shows the average</p> <p>18 ideology of Republicans, and the blue line shows the</p> <p>19 average ideology of Democrats.</p> <p>20 Q. By the red and blue lines, you mean the</p> <p>21 red and blue lines that are moving from left to right</p> <p>22 across the graph?</p> <p>23 A. Exactly.</p> <p>24 Q. Okay. And just to be clear, because,</p> <p>25 you know, it looks from the graph a little bit like</p>	911	<p>1 certainly were, on average, more conservative than --</p> <p>2 sorry -- Democrats were, on average, more liberal</p> <p>3 than Republicans, but there's certainly no guarantee</p> <p>4 because there was some overlap between the parties.</p> <p>5 But as you move to the right in the</p> <p>6 graph, we can see that, over time, the overlap</p> <p>7 between the parties has diminished considerably, so</p> <p>8 that in the modern period, if you look in the -- in</p> <p>9 the period over the last few Congresses, on the far</p> <p>10 right of the graph, what we can see is that, today,</p> <p>11 there's no overlap between the parties. Every single</p> <p>12 Republican Member of Congress is substantially more</p> <p>13 conservative than the most conservative Democrat.</p> <p>14 So if you elect a Republican to</p> <p>15 Congress instead of a Democrat, there is something</p> <p>16 approaching a 100 percent chance that they will be</p> <p>17 substantially more conservative than the Democrat</p> <p>18 that you might have gotten if you elected a Democrat.</p> <p>19 So I think that's a really important feature we can</p> <p>20 take from this graph.</p> <p>21 The second, I think, important feature</p> <p>22 which is related to this is that the average ideology</p> <p>23 of the two parties, just as we saw in the earlier</p> <p>24 graph, is moving apart over time, so that -- and we</p> <p>25 can see this because the average ideology of a</p>

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<p style="text-align: right;">912</p> <p>1 Republican has gotten substantially more conservative 2 during this time period, going from about -- a value 3 of about .25 to a value of about .5. And then for 4 Democrats, they haven't moved quite as far to the 5 left as Republicans have to the right, but Democrats 6 also have gotten a little bit more liberal over this 7 time period.</p> <p>8 Q. And just visually, on the right of that 9 graph, what tells you visually about -- that there's 10 an absence of overlap between the members of each 11 party today?</p> <p>12 A. The large white space that we see in 13 the graph. So this tells us -- here, you see, unlike 14 over on the left side of the graph, there's no blue 15 and red dots that overlap with each other. Instead, 16 there's the large gulf between the parties. There's 17 essentially, like, you know, no -- no moderates in 18 each party that are similar to members of the other 19 party.</p> <p>20 Q. And how does this graph, what it's 21 showing about the average ideology and the overlap 22 between members of each party, change during the 23 decade between the drawing of the 2002 Map [verbatim] 24 and the current map?</p> <p>25 A. Sure.</p>	<p style="text-align: right;">914</p> <p>1 polarization nationally. 2 MS. MCKENZIE: Can we please call up 3 Petitioners' Exhibit 45, which is Figure 8 4 of Dr. Warsaw's report? 5 BY MS. MCKENZIE: 6 Q. Can you explain what that figure shows 7 at a high level? 8 A. Sure. 9 So this is just showing the same 10 DW-NOMINATE scores that we showed -- that we saw a 11 second ago; but here, instead of showing the ideology 12 of each Member of Congress and the average in each 13 party, we're simply showing the difference between 14 the two parties. 15 So this is showing the difference in 16 the ideology of Democrats and Republicans, so it's 17 similar to the plot that we saw earlier that focused 18 on the percentage of the time that Members of 19 Congress cast conservative roll call votes. And, 20 once again, we can see that the polarization in 21 Congress has increased dramatically over this time 22 period. 23 In the 1970s, there was a difference of 24 about .6 or a little less than .6 between the average 25 Members of Congress from each party; and today,</p>
<p style="text-align: right;">913</p> <p>1 What you can see is in the 2000 -- when 2 the 2001 [verbatim] Map was drawn, in the early -- in 3 the late '90s and early 2000s, there was still some 4 overlap between the parties; so, surely, on average, 5 Republicans were more conservative than Democrats, 6 but there's no guarantee of that.</p> <p>7 And we can see that by the fact that 8 there were lots of blue and red dots that overlapped 9 with each other that it was certainly possible you 10 might elect a, you know, a Republican that was only 11 marginally more conservative than a Democrat would 12 be. Whereas today, we know that if you elect a 13 Republican, they're going to be much more 14 conservative than the Democrat would be.</p> <p>15 MS. MCKENZIE: Petitioners move to 16 admit Exhibit 44 into evidence. 17 THE COURT: Any objection? 18 Without objection, Petitioners' 19 Exhibit 44 is admitted. 20 - - - 21 (Whereupon, Petitioners' Exhibit Number 22 44 was admitted into evidence.) 23 - - - 24 BY MS. MCKENZIE: 25 Q. I think we have one more chart on</p>	<p style="text-align: right;">915</p> <p>1 there's a difference of close to .9 on this scale. 2 So, in other words, polarization has 3 increased by about 50 percent over this time period. 4 It increased particularly sharply I should note in 5 the most recent Congresses, which you can see are 6 much more polarized than earlier Congresses had been. 7 Q. Okay. And just for the record, what 8 are the dots on -- on this graph representing? 9 A. So the dots here represent the 10 difference between the ideology of the -- the average 11 ideology of Democrats and Republicans in each 12 Congress over the past 40-plus years. 13 Q. And the blue line? 14 A. The blue line, once again, is the 15 moving average. This shows us just averaging 16 across -- averaging across the dots, what does the 17 average look like in each -- each part of the time 18 period. 19 Q. Okay. 20 THE COURT: Excuse me, Counsel. 21 Can -- can I just have a 22 clarification of one of your answers? 23 Where did you say the sharpest 24 increase in polarization was? What period 25 of time?</p>

916	<p>1 THE WITNESS: Well, there's</p> <p>2 increases throughout the period, but what</p> <p>3 you can see is that the degree of</p> <p>4 polarization in the most recent Congresses,</p> <p>5 which are those here that follow the 2010</p> <p>6 elections, is where we see the most</p> <p>7 polarization.</p> <p>8 THE COURT: I thought you said --</p> <p>9 so you didn't testify -- I thought you</p> <p>10 testified that the sharpest increase in</p> <p>11 polarization occurred a certain period of</p> <p>12 time, or maybe I misunderstood the</p> <p>13 testimony.</p> <p>14 Did you use the word "sharpest"?</p> <p>15 THE WITNESS: I didn't do a</p> <p>16 statistical test to evaluate when the</p> <p>17 sharpest change occurred.</p> <p>18 THE COURT: Okay. Thank you.</p> <p>19 THE WITNESS: All I meant to say,</p> <p>20 Your Honor, is that the highest polarization</p> <p>21 levels are in the most recent Congresses.</p> <p>22 THE COURT: That, I get, yes.</p> <p>23 BY MS. MCKENZIE:</p> <p>24 Q. All right. So you -- you've shown us</p> <p>25 that Democrats and Republicans vote, on average, very</p>	918	<p>1 election.</p> <p>2 You might think that if legislators in</p> <p>3 these close elections are, like, converging on the</p> <p>4 median voter, then you would expect to see</p> <p>5 essentially no difference between the roll call</p> <p>6 voting behavior of Democrats and Republicans in very</p> <p>7 close elections.</p> <p>8 And, instead, what we see is, even if a</p> <p>9 Democrat only -- or a Republican, say, only wins the</p> <p>10 election by 10 -- by 10 votes or five votes or even</p> <p>11 one vote, their roll call voting behavior is very</p> <p>12 different from what the Republican -- what the other</p> <p>13 party would have been. So if a Republican wins by</p> <p>14 one or two or three votes, they have much more</p> <p>15 conservative ideology in Congress than the Democrat</p> <p>16 would have.</p> <p>17 We can also compare districts with</p> <p>18 similar constituent preferences -- or, sorry -- the</p> <p>19 roll call voting behavior of legislators in districts</p> <p>20 with similar district preferences. So we can say,</p> <p>21 How do Democrats and Republicans behave in a district</p> <p>22 where Barack Obama won, you know, 52 percent of the</p> <p>23 vote; is it the case that Democrats and Republicans</p> <p>24 in this district -- in these districts are very</p> <p>25 similar in their constituent -- in their preferences?</p>
917	<p>1 differently from each other in Congress.</p> <p>2 Could that difference be explained by</p> <p>3 the possibility that Democrats and Republicans just</p> <p>4 represent different kinds of districts, so that if</p> <p>5 they were -- they would -- that both members of</p> <p>6 the -- members of each party would take moderate</p> <p>7 positions in a moderate district?</p> <p>8 A. No, we know from a broad body of</p> <p>9 literature that Democrats and Republicans take very</p> <p>10 different positions from each other even in the same</p> <p>11 district. So even if we imagine a district, say,</p> <p>12 that was a pretty moderate district that maybe leans</p> <p>13 just slightly in one direction or another, it's not</p> <p>14 the case that Democrats and Republicans take similar</p> <p>15 positions in this close moderate district.</p> <p>16 Instead, even in this moderate</p> <p>17 district, they take wildly, divergent polarized</p> <p>18 positions. And there's a couple sources of evidence</p> <p>19 for that that economists and political scientists</p> <p>20 have used.</p> <p>21 One is what's called a "regression</p> <p>22 discontinuity study." And in this -- in this study,</p> <p>23 political scientists and economists compare election</p> <p>24 results or compare the roll call voting behavior of</p> <p>25 legislators when they just barely win or lose the</p>	919	<p>1 Do they take similar positions?</p> <p>2 And, instead, what a wide body of</p> <p>3 literature finds is that Democrats and Republicans in</p> <p>4 these districts, even essentially ones with identical</p> <p>5 preferences, take very different positions from one</p> <p>6 another.</p> <p>7 Q. And just so -- just to make sure</p> <p>8 everyone understands, when you talk about comparing</p> <p>9 Democratic and Republican Members of Congress in</p> <p>10 districts with similar preferences, for example,</p> <p>11 districts that had the same percentage of vote for</p> <p>12 Barack Obama, can you just give us sort of a concrete</p> <p>13 example of what you would be doing to make that</p> <p>14 comparison?</p> <p>15 A. Sure.</p> <p>16 What you might imagine is that in a</p> <p>17 district where the Republican barely won, so in a</p> <p>18 district where they got, like, 51 percent of the</p> <p>19 vote, that they would take a very moderate position,</p> <p>20 because in this district, the -- you know, it's</p> <p>21 essentially a tied election, so you might imagine, in</p> <p>22 order to win that election, they would have to</p> <p>23 moderate their position and -- and essentially adopt</p> <p>24 the position of the median voter. But, in fact,</p> <p>25 that's not at all what the evidence indicates</p>

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920	<p>1 actually happens.</p> <p>2 Q. So just as a hypothetical example, if</p> <p>3 you had a district in Maryland where Barack Obama won</p> <p>4 the presidential vote by 52 to 48 and it also happens</p> <p>5 that that district has a Congressional representative</p> <p>6 who's a Democrat, and you had a district in Oregon</p> <p>7 where Barack Obama won by 52 to 48 and it happens</p> <p>8 that the Congressional representative is a</p> <p>9 Republican, what does that tell you?</p> <p>10 A. I would expect that both of those</p> <p>11 representatives would adopt positions roughly in the</p> <p>12 middle of their parties; neither of those</p> <p>13 representatives would adopt moderate positions; and</p> <p>14 they certainly wouldn't adopt the same position,</p> <p>15 which is what we might expect if they're just cuing</p> <p>16 their behavior off the preferences of the district.</p> <p>17 Q. What does the political science</p> <p>18 literature show about people who are --</p> <p>19 representatives who are like in the hypothetical</p> <p>20 example I just gave you?</p> <p>21 A. What it shows is that they typically</p> <p>22 don't moderate their behavior based on the</p> <p>23 preferences of the district.</p> <p>24 And, again, like, regardless of the</p> <p>25 preferences of the district, the level of divergence,</p>	922	<p>1 MS. MCKENZIE: Let's please call up</p> <p>2 Petitioners' Exhibit 46.</p> <p>3 BY MS. MCKENZIE:</p> <p>4 Q. Which is Figure 9 of your report.</p> <p>5 And let's take a look at the top panel</p> <p>6 there.</p> <p>7 A. So this shows the same DW-NOMINATE</p> <p>8 scores that I showed you earlier for each Member of</p> <p>9 Congress, but here I just showed them for the Members</p> <p>10 of Congress in Pennsylvania.</p> <p>11 Q. Okay. And remind us, the DW-NOMINATE</p> <p>12 score, is positive more conservative?</p> <p>13 A. Correct. So positive score indicates a</p> <p>14 conservative roll call voting record, and a negative</p> <p>15 score indicates a liberal one.</p> <p>16 Q. And the horizontal axis here is time?</p> <p>17 A. Exactly. The horizontal axis shows the</p> <p>18 year of each -- the second year of each Congress.</p> <p>19 Q. And what do the red and blue dots show?</p> <p>20 A. So the red and blue dots -- once again,</p> <p>21 the red dots show Republican Members of Congress, and</p> <p>22 the blue dots show Democratic Members of Congress.</p> <p>23 Q. Is there a red and blue dot for each</p> <p>24 Member of Congress from Pennsylvania in each of</p> <p>25 the years?</p>
921	<p>1 the level of polarization between Democrats and</p> <p>2 Republicans is roughly the same regardless of the</p> <p>3 preferences of the district --</p> <p>4 Q. All right.</p> <p>5 MS. MCKENZIE: Petitioners --</p> <p>6 THE WITNESS: -- and --</p> <p>7 BY MS. MCKENZIE:</p> <p>8 Q. Sorry. Go ahead.</p> <p>9 A. -- we can see that with the table in</p> <p>10 Pennsylvania.</p> <p>11 Q. Okay.</p> <p>12 MS. MCKENZIE: So Petitioners move</p> <p>13 to admit Exhibit 45 into evidence.</p> <p>14 THE COURT: Any objection?</p> <p>15 Without objection, Petitioners' 45</p> <p>16 is admitted.</p> <p>17 - - -</p> <p>18 (Whereupon, Petitioners' Exhibit Number</p> <p>19 45 was admitted into evidence.)</p> <p>20 - - -</p> <p>21 BY MS. MCKENZIE:</p> <p>22 Q. All right. Dr. Warshaw, did you also</p> <p>23 look at the growth in polarization in Pennsylvania's</p> <p>24 Congressional delegation specifically?</p> <p>25 A. I did.</p>	923	<p>1 A. There is.</p> <p>2 Q. Okay. And what do the red and blue</p> <p>3 lines going from left to right show?</p> <p>4 A. So the red and blue lines show the</p> <p>5 moving average in -- in the average ideology of</p> <p>6 Democrats and Republicans in Pennsylvania across this</p> <p>7 time period. It shows roughly the same pattern that</p> <p>8 we saw earlier, that Republicans in Pennsylvania are</p> <p>9 getting more conservative, and the Democrats,</p> <p>10 especially in recent Congresses, are getting a little</p> <p>11 bit more liberal.</p> <p>12 Q. Okay. And how do you see that visually</p> <p>13 on the graph?</p> <p>14 A. You can see that the moving -- the line</p> <p>15 or the red line, which shows the average ideology for</p> <p>16 Republicans, is gradually trending upward, which</p> <p>17 indicates it's gradually trending in a more</p> <p>18 conservative direction, whereas the blue line for</p> <p>19 Democrats is -- especially in recent years, is</p> <p>20 trending down a little bit, which would suggest that</p> <p>21 it's trending in a liberal direction.</p> <p>22 Q. In the most recent Congresses in</p> <p>23 Pennsylvania, is there any overlap at all in the</p> <p>24 average ideology score or in the -- in the ideology</p> <p>25 scores of members of the Pennsylvania delegation?</p>

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924	<p>1 A. No. You can see that, early in the</p> <p>2 time period, just like in the nation as a whole,</p> <p>3 there's some -- if not overlap, close to overlap</p> <p>4 between the ideologies of Democrats and Republicans</p> <p>5 in Pennsylvania. But in more recent time periods, so</p> <p>6 in the time period especially in the last few</p> <p>7 Congress, there's not just no overlap between</p> <p>8 Democrats and Republicans, but what I would</p> <p>9 characterize the vast gulf between the roll call</p> <p>10 ideologies of any Democrat and any Republican in</p> <p>11 Pennsylvania.</p> <p>12 Q. Okay. So what do you conclude about</p> <p>13 how the ideology of Democrats and Republicans</p> <p>14 compares in Pennsylvania's Congressional delegation?</p> <p>15 A. What I conclude is that the -- you</p> <p>16 know, once again, there's a vast difference between</p> <p>17 the ideologies of Democrats and Republicans in</p> <p>18 Pennsylvania, and if citizens -- if a particular</p> <p>19 Congressional district in Pennsylvania elected a</p> <p>20 Republican legislator instead of a Democratic one,</p> <p>21 they could expect a vast difference in their roll</p> <p>22 call voting behavior; and the Republican is certainly</p> <p>23 going to be much more conservative than the Democrat</p> <p>24 would have been in that same district.</p> <p>25 Q. And is vice versa true as well?</p>	926	<p>1 which have a difference of about .75 between the</p> <p>2 average ideology of Democrats and Republicans in</p> <p>3 Congress.</p> <p>4 Q. Are those -- the two dots that you just</p> <p>5 pointed to at the top right, are those the first two</p> <p>6 Pennsylvania Congressional delegations elected after</p> <p>7 the 2011 redistricting?</p> <p>8 A. They are.</p> <p>9 Q. Okay. And so you're saying there's</p> <p>10 currently a .75 divergence between the average</p> <p>11 Democratic and Republican Congressman in Pennsylvania</p> <p>12 in the last two Congresses?</p> <p>13 A. I am.</p> <p>14 Q. Is that a significant number?</p> <p>15 A. That's a very large number, a large --</p> <p>16 a large, substantive difference in their roll call</p> <p>17 records.</p> <p>18 MS. MCKENZIE: Petitioners move to</p> <p>19 admit Exhibit 46 into evidence.</p> <p>20 THE COURT: Any objection?</p> <p>21 MR. TUCKER: No.</p> <p>22 THE COURT: Petitioners' Exhibit 46</p> <p>23 is admitted without objection.</p> <p>24 - - -</p> <p>25 (Whereupon, Petitioners' Exhibit Number</p>
925	<p>1 A. Yeah, true. If you elect a Democrat</p> <p>2 rather than a Republican, the Democrat is going to be</p> <p>3 much more liberal than the Republican would have</p> <p>4 been.</p> <p>5 Q. All right. Let's go back to the bottom</p> <p>6 panel of this chart, please.</p> <p>7 So what's the difference between this</p> <p>8 panel and the top panel?</p> <p>9 A. So once again, instead of showing</p> <p>10 the -- the ideology of each Member of Congress from</p> <p>11 Pennsylvania, here we're simply showing the</p> <p>12 difference between Democrats and Republicans in</p> <p>13 Pennsylvania. So it's showing that in the early</p> <p>14 1970s, there was a difference between Democratic</p> <p>15 candidates from Pennsylvania between, say, .5 and .6,</p> <p>16 which we can see by the dots in the lower left part</p> <p>17 of the graph. So we can see that these dots all fall</p> <p>18 around the .5 or .6.</p> <p>19 But over time, the Congressional</p> <p>20 delegation in Pennsylvania, much like the Congress as</p> <p>21 a whole, has grown more polarized. The difference</p> <p>22 between Democrats and Republicans has grown over</p> <p>23 time. And, again, just like in the earlier graphs,</p> <p>24 the largest differences between Democrats and</p> <p>25 Republicans occurred in the most recent Congresses,</p>	927	<p>1 46 was admitted into evidence.)</p> <p>2 - - -</p> <p>3 MS. MCKENZIE: All right. Can we</p> <p>4 please call up Petitioners' Exhibit 47?</p> <p>5 BY MS. MCKENZIE:</p> <p>6 Q. What is this chart showing?</p> <p>7 A. This chart simply shows a different way</p> <p>8 of thinking about the change in polarization over</p> <p>9 time. So here we show the proportion of nonunanimous</p> <p>10 votes where representatives from Pennsylvania vote</p> <p>11 together, with the intuition being that if Members of</p> <p>12 Congress -- sorry -- when I say "vote together," what</p> <p>13 I mean is they voted together about more than</p> <p>14 90 percent of the time -- and the intuition here</p> <p>15 being that if Members of Congress from Pennsylvania</p> <p>16 are generally voting together, then perhaps it</p> <p>17 doesn't matter very much whether we elect a Democrat</p> <p>18 or Republican, because on the issues facing</p> <p>19 Pennsylvania, you know, they're generally voting in</p> <p>20 the same direction; there might be a little</p> <p>21 difference between the parties.</p> <p>22 In fact, we see that in the 1970s and</p> <p>23 '80s, there was a difference of around .3 or .4 in</p> <p>24 the -- sorry -- voting together -- Democrats and</p> <p>25 Republicans voting together about 40 percent of the</p>

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1 time, you know, which is, like, a reasonably large
 2 percentage of the time; but over this -- our time
 3 period, the percentage of the -- of the time where
 4 Democrats and Republicans from Pennsylvania voted
 5 together has markedly diminished. So in the most
 6 recent Congresses, Democrats and Republicans from
 7 Pennsylvania vote together less than 10 percent of
 8 the time.

9 So there's no consensus among Members
 10 of Congress from Pennsylvania on the issues facing
 11 our nation or facing the state.

12 **Q. Why do you use nonunanimous votes in
 13 this chart?**

14 A. So I wanted to take out votes that --
 15 this is a decision commonly made by political
 16 scientists, because there's many roll call votes that
 17 are essentially on trivial matters, like naming post
 18 offices or naming Federal buildings; and on these
 19 very trivial roll call votes, you know, all of
 20 Congress might agree on it. So, typically, when we
 21 measure any kind of ideological change in Congress,
 22 we take out these non- -- sorry -- these unanimous
 23 votes.

24 **Q. Can we just go back to what you defined
 25 as "consensus," because I wasn't sure if I heard you**

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1 **correctly earlier?**

2 **When you talk about where
 3 representatives from Pennsylvania vote together, what
 4 does that mean?**

5 A. That means they vote together more
 6 than -- I think -- I think I used the threshold of
 7 more than 90 percent of the time.

8 **Q. When you say "90 percent of the time,"
 9 are you --**

10 A. I'm sorry. Ninety percent of Members
 11 of Congress from Pennsylvania vote together.

12 **Q. On a particular roll call?**

13 A. On a particular roll call, exactly. So
 14 the proportion of the time that 90 percent of the
 15 Members of Congress from Pennsylvania vote together
 16 on particular roll calls --

17 **Q. Okay.**

18 A. -- and that's, again, diminished
 19 markedly over time.

20 MS. MCKENZIE: Petitioners move to
 21 admit Exhibit 47.

22 THE COURT: Any objection?

23 MR. TUCKER: No.

24 THE COURT: Petitioners' Exhibit 47
 25 is admitted without objection.

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1 - - -
 2 (Whereupon, Petitioners' Exhibit Number
 3 47 was admitted into evidence.)
 4 - - -

5 MS. MCKENZIE: All right. I'm going
 6 to call up one final chart on polarization
 7 in Pennsylvania, which is Petitioners'
 8 Exhibit 48.

9 BY MS. MCKENZIE:

10 **Q. And that's Table 2 of -- of your
 11 report, Dr. Warsaw.**

12 **Starting from the left, can you tell us
 13 what each column in this table is showing?**

14 A. Absolutely. So this is just a simple
 15 table that shows important ideological and roll call
 16 facts about the Members of Congress from Pennsylvania
 17 in the 113th Congress, which is the Congress that met
 18 after the 2012 election from 2013 and '14.

19 So in this Congress, the left column
 20 shows the number of -- the Congress number. The next
 21 column from the left shows the Member of Congress.
 22 Then the table, I should say, is sorted by districts.
 23 So in the third column, we can see the district
 24 number. The fourth column shows the party of each
 25 Member of Congress from Pennsylvania in the

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1 113th Congress. And, once again, we can see that
 2 there were five Democrats in Congress -- in the
 3 113th Congress from Pennsylvania, and 13 Republicans.

4 The next column shows their ideology
 5 score, which here is the DW-NOMINATE score that I
 6 used for the earlier analyses. And then the final
 7 two columns show the percentage of the time that each
 8 of these Members of Congress votes with the majority
 9 of their own party, both in all votes as well as on
 10 the nonunanimous votes that we talked about a second
 11 ago.

12 **Q. Okay. And these are roll call votes
 13 again?**

14 A. Yes.

15 **Q. Dr. Warsaw, can you read for me the --
 16 the percentage of the time that Congressman Bob Brady
 17 voted with the majority of his party on all votes?**

18 A. He voted with the majority of his own
 19 party about 94 percent of the time.

20 **Q. And what about on nonunanimous votes?**

21 A. Ninety-two percent of the time.

22 **Q. How about Chaka Fattah?**

23 A. So she -- is this member a she?

24 **Q. No.**

25 A. He.

932	<p>1 He voted with the majority of his own</p> <p>2 party 96 percent of the time on all votes, and 94</p> <p>3 percent of the time on nonunanimous votes.</p> <p>4 Q. How about Mike Kelly?</p> <p>5 A. Mike Kelly also voted the vast majority</p> <p>6 of the time with the majority of his own party. So</p> <p>7 95 percent of the time, he voted with the majority of</p> <p>8 his party on all votes and 93 percent of the time on</p> <p>9 nonunanimous votes.</p> <p>10 Q. All right. I'm not going to make you</p> <p>11 read the whole thing.</p> <p>12 Let's just do Scott Perry.</p> <p>13 A. So Scott Perry is in the</p> <p>14 Fourth District. He also voted with the majority of</p> <p>15 his party 94 percent of the time on all votes and</p> <p>16 90 percent of the time on nonunanimous votes.</p> <p>17 Q. All right. Did you calculate the</p> <p>18 average percentage of the time that Pennsylvania's</p> <p>19 representatives voted with a majority of their own</p> <p>20 party in the 113th Congress?</p> <p>21 A. I did. So they voted with a majority</p> <p>22 of their own party 93 percent of the time on all</p> <p>23 votes and about 90 percent of the time on</p> <p>24 nonunanimous votes.</p> <p>25 Q. All right. So what do those numbers</p>	934	<p>1 admit Exhibit 48 into evidence.</p> <p>2 THE COURT: Petitioners' 48 has</p> <p>3 been moved into evidence.</p> <p>4 Any objection?</p> <p>5 Without objection, Petitioners'</p> <p>6 Exhibit 48 is admitted.</p> <p>7 - - -</p> <p>8 (Whereupon, Petitioners' Exhibit Number</p> <p>9 48 was admitted into evidence.)</p> <p>10 - - -</p> <p>11 BY MS. MCKENZIE:</p> <p>12 Q. All right. Let's take a look again at</p> <p>13 Exhibit 41, where you looked at Democrats' vote</p> <p>14 shares in Pennsylvania in 2012 Congressional</p> <p>15 elections.</p> <p>16 A. Yes.</p> <p>17 Q. Other than the five districts that the</p> <p>18 Democrats won, which district was the closest contest</p> <p>19 for Democrats here?</p> <p>20 A. The closest contest for Democrats here</p> <p>21 was clearly the 12th District, where the Republican</p> <p>22 won with about 52 percent of the vote, and the</p> <p>23 Democrat received 48 percent of the vote. So this</p> <p>24 was clearly a relatively close Congressional</p> <p>25 election.</p>
933	<p>1 tell you?</p> <p>2 A. They tell us that, I think -- you know,</p> <p>3 it's fairly common sense -- they tell us that the</p> <p>4 vast majority of the time, Members of Congress from</p> <p>5 Pennsylvania are voting with their own party, and</p> <p>6 they rarely cross party lines to vote with the</p> <p>7 opposite party.</p> <p>8 So you're pretty much guaranteed that</p> <p>9 if you elect a Republican from Pennsylvania, they're</p> <p>10 almost always going to vote with the majority of the</p> <p>11 Republican party, and if you elect the Democrat,</p> <p>12 they're almost always going to vote with the majority</p> <p>13 of the Democratic party.</p> <p>14 Q. So if a Pennsylvania voter is unable to</p> <p>15 elect the candidate from his or her preferred party,</p> <p>16 what is the likely effect on that voter's ability to</p> <p>17 affect the political process?</p> <p>18 A. If they're unable to elect someone of</p> <p>19 their own party -- a voter is unlikely to see their</p> <p>20 preferences enacted by their representative, which</p> <p>21 means that this voter effectively has no voice in</p> <p>22 their nation's capitol via their representative.</p> <p>23 Q. All right. And let's please take a</p> <p>24 look -- sorry.</p> <p>25 MS. MCKENZIE: Petitioners move to</p>	935	<p>1 Q. All right. And let's flip back to</p> <p>2 Exhibit 48.</p> <p>3 Who represented District 12 in the</p> <p>4 113th Congress after that election that we were just</p> <p>5 talking about?</p> <p>6 A. A Congressman named Keith Rothfus.</p> <p>7 Q. And how often did Congressman Rothfus</p> <p>8 vote with a majority of his own party?</p> <p>9 A. 96 percent -- 96 percent of the time.</p> <p>10 Q. And how about for nonunanimous?</p> <p>11 A. 93 percent of the time.</p> <p>12 Q. So do you conclude anything from these</p> <p>13 figures about the representation that Democratic</p> <p>14 voters in a close district would receive if they</p> <p>15 can't -- if they don't -- if they don't win the</p> <p>16 election?</p> <p>17 A. Even in this very close district, it's</p> <p>18 not the case that -- that the Member of Congress, the</p> <p>19 Republican here that was elected, adopted moderate --</p> <p>20 moderate opinions or moderate roll call votes that</p> <p>21 were responsive to the opinions of the Democrats in</p> <p>22 his district.</p> <p>23 Even in this very close district, which</p> <p>24 I think we could -- we could characterize the</p> <p>25 relative -- a very close election, probably a</p>

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<p style="text-align: right;">936</p> <p>1 moderate district in terms of its preferences, the 2 Republican that was elected adopted positions that 3 were, you know, right in the mainstream of the rest 4 of the Republican party. 5 And so the Democrats in this district, 6 despite the fact that it was a very close election, 7 really have almost -- have essentially no influence 8 on this Member of Congress, and it's very unlikely 9 that their preferences are going to be reflected in 10 this Member of Congress's roll call votes. 11 Q. So we've spoken about the efficiency 12 gap as a measure of partisan bias. We've also been 13 talking a lot about the partisan tilt of voting in 14 the House of Representatives. 15 Is there a relationship -- sorry -- is 16 there a reason to think that there would be a 17 relationship between partisan bias as measured by the 18 efficiency gap and voting in the -- in the House? 19 A. Yes. So as -- we know that -- due to 20 our analysis we just talked about from polarization 21 in Congress, we know that if you elect more 22 Republicans, they're likely to adopt much -- much 23 more conservative roll call voting positions than 24 Democrats are. 25 And we've also seen that the -- the</p>	<p style="text-align: right;">938</p> <p>1 over the past 40 years and the average ideology 2 scores of Members of Congress from that state. 3 MS. MCKENZIE: Can we please pull up 4 Petitioners' Exhibit 49? 5 BY MS. MCKENZIE: 6 Q. And this is Table 3 of your report. 7 Can you read the title of this for us? 8 A. Sure. The effect of the efficiency gap 9 on average legislator ideology in each state. 10 Q. All right. And so there's -- there's a 11 lot of math on the table, but what does it show, in 12 plain English? 13 A. In plain English, it's simply a 14 regression, so a statistical analysis that shows the 15 relationship between the efficiency gap and the 16 average ideology of legislators. 17 And in the left part of the table, what 18 we can see is that, on average, a 10 percent change 19 in the efficiency gap, say, in a pro-Republican 20 direction, would change the average ideology of 21 Members of Congress from that state by about .07. 22 Q. Can you just show us how you figured 23 that out? 24 A. Yeah. This -- this regression is based 25 on 100 percent change in the efficiency gap, which,</p>
<p style="text-align: right;">937</p> <p>1 goal of partisan gerrymandering, what the efficiency 2 gap is really capturing is electing more Members of 3 Congress from one party. And you would expect, based 4 on the votes alone, that there's a partisan advantage 5 in the efficiency gap. 6 So when you put those two facts 7 together, that a large partisan bias in the 8 efficiency gap indicates they were electing more 9 members of a particular party relative to the -- what 10 voters prefer in a state, and we know that when we 11 elect members of a particular party, they're pretty 12 likely to adopt very extreme roll call positions that 13 are much different than the -- the other party would 14 have taken -- so you put those two facts together and 15 what it implies is that a partisan advantage in a 16 districting process is likely to lead to a big effect 17 on roll call voting behavior in Congress. 18 So if you have a pro-Republican 19 efficiency gap, it's likely to lead Congress to be 20 more conservative. 21 Q. And did you examine whether, in fact, 22 there's evidence of the relationship you just -- you 23 just hypothesized? 24 A. I did. So I examined the relationship 25 between changes in the efficiency gap in each state</p>	<p style="text-align: right;">939</p> <p>1 of course, is larger than we would observe. But if 2 we just divide this by 10, you can see that a 3 10 percent change in the efficiency gap implies a .07 4 change in the average ideology of Members of Congress 5 from that state. 6 So if you had an efficiency gap that 7 became more pro-Republican, say, by 10 percentage 8 points, that would imply a .07 change in the ideology 9 from that state. 10 Q. And is this graph -- this graph is all 11 states? 12 A. Yes, this looks at all state 13 Congressional plans -- or all states with more than 14 six seats. 15 Q. Okay. And the numbers you just pointed 16 to in the top left, what time period is that over? 17 A. So this is over the last 44 years. 18 Q. What does the right column show? 19 A. So the right column shows how the 20 relationship between the efficiency gap and the roll 21 call voting behavior of Members of Congress has 22 changed over time. And not surprisingly, it shows an 23 increase in the effect of the efficiency gap on the 24 average ideology of Members of Congress in each 25 state, which isn't surprising given that we know</p>

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940	<p>1 polarization has increased sharply in Congress -- in 2 recent Congresses. So it's not surprising that the 3 consequences of electing a Democrat or Republican, as 4 measured in the efficiency gap, have grown larger 5 over time.</p> <p>6 Q. So in the current decade, the 2010s, 7 what was the relationship between a change in the 8 efficiency gap and the average ideology of Members of 9 Congress?</p> <p>10 A. So in the most recent Congresses, a 11 10 percent change in the efficiency gap implies a .09 12 change in the average ideology of Members of Congress 13 from a particular state. And this is a pretty -- 14 this is a pretty large change in the average ideology 15 of a state delegation.</p> <p>16 Q. Can you give us an example of what a 17 .09 shift to the right in the ideology score -- and 18 by that, just to clarify, you mean the DW-NOMINATE 19 score?</p> <p>20 A. Yes.</p> <p>21 Q. Can you give us an example of what a 22 .09 shift to the right means in real life?</p> <p>23 A. So this is roughly the equivalent of 24 the difference between a moderate and extreme member 25 of each party. So you could think of it for the</p>	942	<p>1 And if you have an efficiency gap that 2 moves in a Republican direction, like we've seen in 3 Pennsylvania, the Members of Congress from that state 4 are going to take much more conservative roll call 5 positions than we would see in a state with a more 6 politically -- partisan-neutral efficiency gap.</p> <p>7 MS. MCKENZIE: Petitioners move to 8 admit Exhibit 49 into evidence.</p> <p>9 THE COURT: Any objection? 10 Without objection, Petitioners' 11 Exhibit 49 is admitted. 12 - - - 13 (Whereupon, Petitioners' Exhibit Number 14 49 was admitted into evidence.) 15 - - -</p> <p>16 BY MS. MCKENZIE: 17 Q. Dr. Warshaw, let's see if we can make 18 the effect of a pro-Republican efficiency gap a 19 little less abstract.</p> <p>20 Did you analyze public opinion in 21 Pennsylvania on any particular issue?</p> <p>22 A. I did. I examined public opinion on 23 the Affordable Care Act, which I view as one of the 24 seminal policy issues of the last decade. 25 MS. MCKENZIE: Can we pull up</p>
941	<p>1 Republicans as the difference between Senator Cornyn, 2 who is a very conservative senator from Texas, who 3 was rated by the National Journal in 2012 as the 4 second-most conservative Member of Congress -- or 5 Member of the Senate, and he's also one of the 6 senators most likely to support Trump in 7 FiveThirtyEight, sort of Trump index.</p> <p>8 And in contrast, the difference, .07 -- 9 or .09 in a moderate direction, would be roughly the 10 ideology or the DW-NOMINATE score of Lindsay Graham, 11 who is a more moderate Republican senator. In the 12 most recent 538 index, he's one of the Republicans 13 least likely to support Trump.</p> <p>14 Q. So .09 is the difference between Graham 15 and Cornyn?</p> <p>16 A. Exactly.</p> <p>17 Q. Okay. So what does this finding about 18 the relationship between a pro-Republican efficiency 19 gap and a representative's average ideology score 20 mean for voters in Pennsylvania?</p> <p>21 A. Well, it tells me that the changes in 22 the efficiency gap aren't just influencing the party 23 of the people that's elected; it's actually having 24 big representational consequences for the roll call 25 votes that Members of Congress cast.</p>	943	<p>1 Petitioners' Exhibit 50? It's Figure 11 of 2 the -- of the report.</p> <p>3 BY MS. MCKENZIE: 4 Q. So what were you trying to measure in 5 this report?</p> <p>6 A. So what I measured was public opinion 7 about a roll call vote to repeal the Affordable Care 8 Act that was taken in early 2015. And on this roll 9 call vote, all of the Republicans from Pennsylvania 10 voted to repeal the Affordable Care Act, and all of 11 the Democrats -- Democratic Members of Congress from 12 Pennsylvania voted to keep the -- to -- voted against 13 the repeal to keep the Affordable Care Act in place.</p> <p>14 So I compared the roll call votes of 15 legislators not just in Pennsylvania, but in every 16 state, with the views of the constituents -- of their 17 constituents in their district. So I looked at 18 whether members of the mass public agreed with the 19 roll call position taken by their legislator, which, 20 on this graph, is shown by the percentage of people 21 that have congruent views of their legislator.</p> <p>22 So, in other words, this is showing us 23 what is the percentage of Democrats and Republicans 24 in each state that agree with the roll call position 25 on the Affordable Care Act repeal that their</p>

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<p style="text-align: right;">944</p> <p>1 legislator took.</p> <p>2 Q. And what was the source of the opinion</p> <p>3 survey data that you used?</p> <p>4 A. So I used the survey called the</p> <p>5 Cooperative Congressional Election Study, which is a</p> <p>6 large-scale survey of the American public with a very</p> <p>7 large sample that enables us to characterize public</p> <p>8 opinion in every state and every Congressional</p> <p>9 district.</p> <p>10 Q. Can you just orient us? What is the</p> <p>11 horizontal axis on this chart?</p> <p>12 A. So the horizontal axis here, once</p> <p>13 again, shows variation in the efficiency gap across</p> <p>14 states. And once again, we can see that Pennsylvania</p> <p>15 has an extremely pro-Republican efficiency gap.</p> <p>16 Q. So moving from left to right across the</p> <p>17 chart, you see it goes from a pro-Republican</p> <p>18 efficiency gap to states with a pro-Democratic</p> <p>19 efficiency gap?</p> <p>20 A. Yes.</p> <p>21 Q. All right. And what about the vertical</p> <p>22 axis?</p> <p>23 A. So the virtual axis here shows the</p> <p>24 percentage of Democrats and Republicans in each state</p> <p>25 that agree with the roll call position of their</p>	<p style="text-align: right;">946</p> <p>1 with a pro-Democratic advantage in the efficiency</p> <p>2 gap, where Democrats have an advantage in the</p> <p>3 districting process, like, say, Maryland or</p> <p>4 Massachusetts, in those states, Democrats are more</p> <p>5 likely to agree with their Member of Congress than</p> <p>6 Republicans are.</p> <p>7 And we can see that the vertical line</p> <p>8 is 0 percent in states where there's no partisan</p> <p>9 advantage in -- in the redistricting process -- or in</p> <p>10 the districting process by either party, Democrats</p> <p>11 and Republicans are about equally likely to agree</p> <p>12 with their Member of Congress's roll call vote, which</p> <p>13 suggests, to me, that those are the places where</p> <p>14 we're getting the most equal representation between</p> <p>15 Democrats and Republicans.</p> <p>16 Q. All right.</p> <p>17 MS. MCKENZIE: Petitioners move to</p> <p>18 admit Exhibit 50.</p> <p>19 THE COURT: Any objection?</p> <p>20 MR. TUCKER: No.</p> <p>21 MS. HANGLEY: No objection.</p> <p>22 THE COURT: Petitioners' Exhibit 50</p> <p>23 is admitted without objection.</p> <p>24 - - -</p> <p>25 (Whereupon, Petitioners' Exhibit Number</p>
<p style="text-align: right;">945</p> <p>1 legislator. So the red line shows the percentage of</p> <p>2 Republicans in each state that agreed -- sorry -- in</p> <p>3 each Congressional district but then aggregated up to</p> <p>4 the state level -- that agree with their Member of</p> <p>5 Congress, and then the blue line shows the percentage</p> <p>6 of Democrats in each state that agree with the roll</p> <p>7 call position of their Member of Congress.</p> <p>8 Q. And what does the vertical line at the</p> <p>9 midpoint of the graph show?</p> <p>10 A. So that shows the average percentage of</p> <p>11 the time that Democrats and Republicans agree with</p> <p>12 their representative in places with no partisan bias</p> <p>13 in the efficiency gap. So this is places where each</p> <p>14 party wastes the same number of votes in</p> <p>15 Congressional elections.</p> <p>16 Q. Okay. And what do you conclude from</p> <p>17 this graph?</p> <p>18 A. So what I conclude from this graph is</p> <p>19 that in states with a pro-Republican efficiency gap,</p> <p>20 like Pennsylvania, members of the mass public or</p> <p>21 citizens, more generally, are much more likely -- if</p> <p>22 you're a Republican, you're much more likely to agree</p> <p>23 with the roll call position of your legislator on the</p> <p>24 Affordable Care Act repeal than Democrats are.</p> <p>25 And, conversely, if you're in a state</p>	<p style="text-align: right;">947</p> <p>1 50 was admitted into evidence.)</p> <p>2 - - -</p> <p>3 BY MS. MCKENZIE:</p> <p>4 Q. All right. Let's just sort of -- we're</p> <p>5 about to move on to the final thing that you</p> <p>6 evaluated, but before we do, just taking a step back</p> <p>7 with respect to your overall analysis of the effects</p> <p>8 of partisan bias on representation, what is the --</p> <p>9 what is -- what do you conclude?</p> <p>10 A. So what I conclude is that the growing</p> <p>11 partisan bias that we've seen in the efficiency gaps</p> <p>12 means that people are -- of either party, but</p> <p>13 Democrats in Pennsylvania are increasingly likely to</p> <p>14 not be able to elect a representative of their</p> <p>15 choice. And because of the growing polarization, we</p> <p>16 know that Democrats and Republicans in Congress</p> <p>17 almost always vote the party line with members of</p> <p>18 their own party.</p> <p>19 So when you put these factors together,</p> <p>20 what it shows is that due to the growing -- both the</p> <p>21 growing polarization in Congress as well as due to</p> <p>22 the growing partisan advantages that we're seeing in</p> <p>23 the districting process, particularly in</p> <p>24 Pennsylvania, the people -- the citizens who are shut</p> <p>25 out of the political process by not being able to</p>

948	<p>1 elect a representative of their choice effectively</p> <p>2 have no voice in Washington. They have no influence</p> <p>3 on the way their Member of Congress votes.</p> <p>4 Q. Now, Dr. Warshaw, even if a</p> <p>5 Pennsylvanian doesn't get to elect a Congressional</p> <p>6 representative of his or her choice, that citizen can</p> <p>7 still write an op-ed or give a speech or do other</p> <p>8 things to make his or her views known; is that</p> <p>9 correct?</p> <p>10 A. They can; but when we focus on</p> <p>11 democratic representation, what we typically focus on</p> <p>12 is the effect of citizens through elections in public</p> <p>13 opinion on the law-making process in Congress. And</p> <p>14 if -- if citizens whose votes are wasted, such as the</p> <p>15 Democrats in Pennsylvania whose votes are wasted,</p> <p>16 aren't able to influence their Members of Congress's</p> <p>17 roll call positions, then I think that this suggests</p> <p>18 that gerrymandering has large and pernicious effects</p> <p>19 on democratic representation in our country.</p> <p>20 Q. Thank you.</p> <p>21 So let's turn to the third thing that</p> <p>22 you were asked to evaluate, which is -- I think you</p> <p>23 said earlier is the association between partisan bias</p> <p>24 and trust in government, and particularly, the</p> <p>25 efficiency gap.</p>	950	<p>1 efficiency gap. And in the middle, at the 0 percent</p> <p>2 line, we have states with no partisan advantage in</p> <p>3 the districting process.</p> <p>4 Q. Dr. Warshaw, how does that survey</p> <p>5 measure whether someone is a Democrat or Republican?</p> <p>6 Is it party registration?</p> <p>7 A. No. Political scientists would almost</p> <p>8 never use party registration as an indicator for</p> <p>9 people's partisanship; instead, it asks people what</p> <p>10 their self-identified party ID is. In other words,</p> <p>11 it asks them -- usually, they think of themselves as a</p> <p>12 Democrat or Republican.</p> <p>13 Q. So I think either you just said or</p> <p>14 the -- what's -- what's the horizontal axis?</p> <p>15 A. So the horizontal axis here is the</p> <p>16 magnitude of the efficiency gap with pro-Republican</p> <p>17 efficiency gaps on the left and pro-Democratic ones</p> <p>18 on the right.</p> <p>19 Q. Okay. And what about the vertical</p> <p>20 axis?</p> <p>21 A. The vertical axis is the percentage of</p> <p>22 the people in each party in each state that trust</p> <p>23 their representative to do what's right.</p> <p>24 Q. It's not -- it's not very high, ever,</p> <p>25 is it?</p>
949	<p>1 MS. MCKENZIE: So can we pull up</p> <p>2 Petitioners' Exhibit 51?</p> <p>3 BY MS. MCKENZIE:</p> <p>4 Q. And that's Figure 12 of your report.</p> <p>5 A. So what I was trying to look at here</p> <p>6 was I wanted to look at whether variation in the</p> <p>7 efficiency gap -- in other words, variation in the</p> <p>8 percentage -- in the number of people from each party</p> <p>9 whose votes are wasted because they're not able to</p> <p>10 elect a representative of their choice -- is</p> <p>11 influencing how much they trust their representative;</p> <p>12 in other words, how much do they trust Congress to do</p> <p>13 the right thing.</p> <p>14 And for this, I drew upon the same</p> <p>15 survey I talked about earlier, although a different</p> <p>16 year of it. So here, I drew upon the Cooperative</p> <p>17 Congressional Election Study, and they have a</p> <p>18 question asking thousands of people across the</p> <p>19 country whether they trust their representative to do</p> <p>20 what's right.</p> <p>21 And on this graph -- this graph is set</p> <p>22 up very similar to the previous graph. So on the</p> <p>23 horizontal axis, we can see, on the left, we have</p> <p>24 places with a pro-Republican efficiency gap, and on</p> <p>25 the right, we have states with a pro-Democratic</p>	951	<p>1 A. No. So in general, you know, again --</p> <p>2 like, probably, this won't come as a surprise to most</p> <p>3 people in this room, but, you know, Americans, I</p> <p>4 think generally, are distrustful of our Government</p> <p>5 right now. Trust in Government, you know, is at a</p> <p>6 low point.</p> <p>7 Q. All right. So can you tell us what the</p> <p>8 red dotted line there signifies?</p> <p>9 A. So the red dotted line is the</p> <p>10 percentage of Republicans in each state that trust</p> <p>11 their representative, and the blue line is the</p> <p>12 percentage of Democrats in each state that trust</p> <p>13 their representative.</p> <p>14 Q. Okay. And what about the red and blue</p> <p>15 references to Pennsylvania?</p> <p>16 A. So the red and blue references to</p> <p>17 Pennsylvania -- this indicates the percentage of</p> <p>18 Democrats and Republicans in Pennsylvania that trust</p> <p>19 their representative. So the red -- the red</p> <p>20 Pennsylvania abbreviation is the percentage of</p> <p>21 Republicans in Pennsylvania that trust their</p> <p>22 representative, and the blue abbreviation is -- for</p> <p>23 Pennsylvania is the percentage of Democrats that</p> <p>24 trust their representative.</p> <p>25 Q. And which number is higher?</p>

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952	<p>1 A. So the Republican number is about</p> <p>2 15 percentage points higher than the Democratic</p> <p>3 number surely due to the fact that roughly</p> <p>4 1.3 million more Democratic votes are wasted than</p> <p>5 Republican votes in Pennsylvania. So if you're a</p> <p>6 Democrat, you have a much, much higher chance of</p> <p>7 having your vote wasted.</p> <p>8 And I think, looking across the state,</p> <p>9 like, 80 percent of Democrat -- of the wasted</p> <p>10 Democratic votes are actually in Republican</p> <p>11 districts, where they're cracked.</p> <p>12 Q. So what do the trends in the red and</p> <p>13 blue lines on this graph tell you?</p> <p>14 A. What this indicates is that the</p> <p>15 magnitude of the efficiency gap has a strong</p> <p>16 relationship with citizens' trust in government. And</p> <p>17 on the left, in places with a pro-Republican</p> <p>18 efficiency gap, like Pennsylvania, Republicans are</p> <p>19 far more likely to trust their representative than</p> <p>20 Democrats are. And in places with a pro-Democratic</p> <p>21 efficiency gap, all the way on the right, Democrats</p> <p>22 are more likely to trust their representative than</p> <p>23 Republicans are.</p> <p>24 And in the middle, in places where</p> <p>25 there's really no partisan advantage in the</p>	954	<p>1 Petitioners move the admission of</p> <p>2 Exhibit 51 into evidence.</p> <p>3 THE COURT: Any objection?</p> <p>4 MR. TUCKER: No.</p> <p>5 THE COURT: Without objection,</p> <p>6 Petitioners' Exhibit 51 is admitted.</p> <p>7 - - -</p> <p>8 (Whereupon, Petitioners' Exhibit Number</p> <p>9 51 was admitted into evidence.)</p> <p>10 - - -</p> <p>11 THE COURT: Now, you would like 35?</p> <p>12 MS. MCKENZIE: Yes, please.</p> <p>13 THE COURT: Any objection to 35?</p> <p>14 MR. TUCKER: No.</p> <p>15 MS. HANGLEY: No objection.</p> <p>16 THE COURT: Petitioners' Exhibit 35</p> <p>17 is admitted without objection.</p> <p>18 - - -</p> <p>19 (Whereupon, Petitioners' Exhibit Number</p> <p>20 35 was admitted into evidence.)</p> <p>21 - - -</p> <p>22 BY MS. MCKENZIE:</p> <p>23 Q. Dr. Warsaw, did you review the expert</p> <p>24 report that was submitted by Dr. Gimpel in this case?</p> <p>25 A. I did.</p>
953	<p>1 districting process, there's only a modest difference</p> <p>2 between the parties. They're essentially equally</p> <p>3 likely to trust their representative.</p> <p>4 Q. All right. Dr. Warsaw, did you draw</p> <p>5 any conclusions from this chart about the effect of</p> <p>6 partisan bias or partisan gerrymandering on</p> <p>7 democracy?</p> <p>8 A. I do.</p> <p>9 So the conclusion I draw from this is</p> <p>10 that partisan gerrymandering is not just affecting</p> <p>11 the party of the representative that's elected in</p> <p>12 Congress, nor is it just affecting the roll call</p> <p>13 votes that are taken in Congress; it's affecting our</p> <p>14 citizens' faith in Government itself.</p> <p>15 So in places that have more -- that are</p> <p>16 more gerrymandered, people whose votes are wasted are</p> <p>17 less likely to trust their representatives, which</p> <p>18 suggests, to me, that gerrymandering is undermining</p> <p>19 citizens' faith in our democracy.</p> <p>20 MS. MCKENZIE: Petitioners move the</p> <p>21 admission of Exhibit 35, which is</p> <p>22 Dr. Warsaw's report.</p> <p>23 THE COURT: Do you want to do 51 or</p> <p>24 not?</p> <p>25 MS. MCKENZIE: I do want to do 51.</p>	955	<p>1 Q. Okay. And did you specifically review</p> <p>2 his analysis of the efficiency gap?</p> <p>3 A. I did.</p> <p>4 Q. Did you look at Table 7 of his report?</p> <p>5 A. I did.</p> <p>6 MS. MCKENZIE: Can we please call up</p> <p>7 Legislative Respondents' 14?</p> <p>8 I think if we go to Page 36, we'll</p> <p>9 see Table 7.</p> <p>10 Great.</p> <p>11 BY MS. MCKENZIE:</p> <p>12 Q. So we talked earlier about how</p> <p>13 Dr. Gimpel calculated an efficiency gap using party</p> <p>14 registration.</p> <p>15 Do you remember that?</p> <p>16 A. We did.</p> <p>17 Q. Okay. And where do you see that on the</p> <p>18 chart there?</p> <p>19 A. So that's the top row.</p> <p>20 So this table -- just to remind</p> <p>21 everyone, this shows Dr. Gimpel's calculation of the</p> <p>22 efficiency gap based on a variety of different types</p> <p>23 of statewide elections or other kind of metrics over</p> <p>24 the last few election cycles. And his metric -- his</p> <p>25 estimate of the efficiency gap based on party</p>

956	<p>1 registration is the top row in each of these sort of 2 panels.</p> <p>3 Q. And remind us, what do you think about 4 the validity of using party registration to calculate 5 an efficiency gap?</p> <p>6 A. I think it makes no sense to use party 7 registration to calculate the efficiency gap, 8 particularly here, where we actually have election 9 results. You know, we have House election results, 10 which I think are the most reasonable way to 11 calculate the efficiency gap.</p> <p>12 But for a variety of reasons, we might 13 want to use other election results as a proxy for 14 people's preferences in Congressional elections, 15 perhaps because we think that we want to sort of 16 purge the effect of individual candidates from our 17 analysis.</p> <p>18 So there are two. I think those are 19 probably reasonable metric -- reasonable proxies for 20 people's preferences, although not as good as the 21 Congressional elections themselves. But the party 22 registration numbers, when we have all of these 23 election results, it's not obvious, to me, what value 24 they add to the analysis.</p> <p>25 And certainly, party registration is</p>	958	<p>1 Congressional votes?</p> <p>2 A. He calculated here a Republican 3 advantage -- the polarity here is flipped. So on my 4 scale, a negative number means pro-Republican; here, 5 a positive number does. But that's arbitrary.</p> <p>6 So his -- his numbers indicate a 7 Republican advantage in the efficiency gap of 18 8 percentage points in -- based on U.S. House elections 9 in 2012.</p> <p>10 Q. And what did you calculate as the 11 efficiency gap in Pennsylvania's Congressional 12 elections in 2012 using that same metric of 13 Congressional votes?</p> <p>14 A. So as I showed earlier, I estimated an 15 efficiency gap of 24 percent in Pennsylvania based on 16 their House elections in 2012.</p> <p>17 Q. So yours is higher?</p> <p>18 A. Yes, mine's substantially higher.</p> <p>19 Q. And that means that you calculated a 20 more pro-Republican gap?</p> <p>21 A. I did.</p> <p>22 Q. Did you investigate the reason for the 23 difference?</p> <p>24 A. I did. I was -- to be honest, I was 25 surprised at this difference, because in 2012, there</p>
957	<p>1 not the same as voting, nor is it the same as 2 somebody's partisan identification.</p> <p>3 Q. Okay. So let's -- moving away from the 4 party registration row for a minute, let's focus on 5 Dr. Gimpel's calculation of the efficiency gap in 6 Pennsylvania's Congressional elections using actual 7 Congressional votes --</p> <p>8 A. Sure.</p> <p>9 Q. -- and -- do you see that in this 10 chart?</p> <p>11 A. I do.</p> <p>12 Q. Where is that?</p> <p>13 A. So the second row in each panel shows 14 Dr. Gimpel's estimate of the efficiency gap based on 15 the Congressional elections in Pennsylvania. These 16 are the ones that are most comparable to the 17 analysis -- estimates in my report.</p> <p>18 Q. Okay. Let's go to the far right-hand 19 column.</p> <p>20 Is that the 2012 -- the far right-hand 21 column, is that the 2012 election?</p> <p>22 A. It is.</p> <p>23 Q. And what did Dr. Gimpel calculate as 24 the efficiency gap for the Congressional election in 25 Pennsylvania in 2012 using Pennsylvanian</p>	959	<p>1 were no uncontested races in 2012 in this election 2 year in Pennsylvania.</p> <p>3 So the calculation of the efficiency 4 gap should be very straightforward, and there should 5 be extremely modest differences between, you know, 6 different estimates, the efficiency gap based on, you 7 know, some subtlety in your methodology.</p> <p>8 I didn't expect to see such a large 9 difference as what I saw here.</p> <p>10 Q. What did you do to investigate?</p> <p>11 A. So I looked at the backup table for 12 Professor Gimpel's analysis, his backup spreadsheet.</p> <p>13 Q. Was that a file entitled CD data 2002 14 to 2016 with election returns?</p> <p>15 A. It was.</p> <p>16 Q. And did you notice anything unusual 17 about the number of Congressional seats that 18 Democrats won in 2012 according to Dr. Gimpel's 19 backup data?</p> <p>20 A. I did.</p> <p>21 Q. What did you find?</p> <p>22 A. So what I found when I looked at his 23 backup data is in the 12th Congressional District, I 24 believe, that we talked about earlier where the 25 Republican narrowly won with 52 percent of the vote,</p>

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960	<p>1 Dr. Gimpel's backup data indicates that the Democrat 2 won this election, which, of course, would be news to 3 the Democrat that was actually running in this 4 election.</p> <p>5 So based on this error in his 6 spreadsheet, Dr. Gimpel estimates that the 7 Republican -- or the Democrats won a third of the 8 Congressional seats in Pennsylvania in 2012, when, of 9 course, as we talked about earlier, Democrats only 10 won five of the 18 seats, or about 27 percent of the 11 seats.</p> <p>12 Q. So you're saying Dr. Gimpel showed that 13 the Democrats won six seats when they only won five?</p> <p>14 A. Correct. This error led to the 15 difference in the efficiency gaps that we observe 16 here.</p> <p>17 So I correctly estimate a 24 percent 18 efficiency gap in Pennsylvania in 2012. Dr. Gimpel's 19 calculations incorrectly provide an 18 percent based 20 on this error in his spreadsheet.</p> <p>21 Q. So just going back to the efficiency 22 gap equation that we talked about a little bit 23 earlier --</p> <p>24 MS. MCKENZIE: Do you mind calling 25 that up?</p>	962	<p>1 wasted votes here are a function of whether the 2 Democrats and Republicans won each seat. But if we 3 were to -- in, say, the Third District, if we were to 4 have the -- incorrectly say that the Democrat won, 5 then that would completely change our efficiency gap 6 calculation.</p> <p>7 Q. All right. Do you recall earlier that 8 I asked you a question about how to account for 9 uncontested elections when calculating the efficiency 10 gap?</p> <p>11 A. I do.</p> <p>12 Q. Why is it important to account for 13 uncontested elections?</p> <p>14 A. So if we account for -- if we -- the 15 point of the efficiency gap is that we want to know 16 voters' preferences in Congressional elections in 17 order to figure out how many votes are wasted.</p> <p>18 So if you -- in an uncontested 19 election, of course, we only observe votes for one 20 candidate. So we might only observe -- if you had an 21 uncontested race, what the election returns would 22 suggest is that one candidate got 100 percent of the 23 vote.</p> <p>24 In an uncontested race, where, say, 25 only the Republicans -- there's only a Republican</p>
961	<p>1 THE WITNESS: So the efficiency gap 2 equation estimating the efficiency gap 3 hinges on the number of wasted votes by each 4 party. And as we talked about earlier, a 5 party is advantaged in the efficiency gap if 6 the other party wastes more votes than they 7 do.</p> <p>8 But, of course, in order to 9 understand whether a party is wasting votes, 10 we need to know whether they're winning or 11 losing the election. Because if you lose 12 the election, then all of your votes are 13 wasted, and if you win the election, only 14 those that are in excess of the 50 percent 15 plus one you needed to win the election are 16 wasted.</p> <p>17 MS. MCKENZIE: And could we call up 18 the demonstrative on the efficiency gap that 19 we looked at a little bit earlier?</p> <p>20 BY MS. MCKENZIE:</p> <p>21 Q. Can you just walk us through how an 22 error like the one you said you found in Dr. Gimpel's 23 backup data would affect the calculation of wasted 24 votes in the efficiency gap?</p> <p>25 A. Sure. As we can see, the wasted -- the</p>	963	<p>1 candidate in the race and no Democratic candidate, 2 then the Republican candidate would win 100 percent 3 of the votes. So the Democrat in that district would 4 receive 0 percent of the votes.</p> <p>5 So what this would imply for our 6 efficiency gap calculation is that there were no 7 wasted Democratic votes in this district, and there 8 were, you know, lots of wasted Republican votes, 9 essentially.</p> <p>10 Q. So does it make sense to treat the 11 party that doesn't offer a candidate in an 12 uncontested election as having wasted zero votes?</p> <p>13 A. No, that makes no sense whatsoever.</p> <p>14 Q. Okay. Were there uncontested elections 15 in Pennsylvania's Congressional elections in 2014 and 16 2016?</p> <p>17 A. Yes, there were three uncontested 18 elections in both of these election years.</p> <p>19 Q. When you were calculating the 20 efficiency gap in Pennsylvania for 2014 and 2016, you 21 accounted, you said, for uncontested elections?</p> <p>22 A. I did.</p> <p>23 Q. How did you do that?</p> <p>24 A. I estimated the share that the -- the 25 vote share that the party that didn't run a candidate</p>

964	<p>1 would have won if they had run a candidate based on 2 previous and future results in that district, as well 3 as based on similar districts elsewhere in the 4 country.</p> <p>5 Q. Was that a model you created for this 6 report?</p> <p>7 A. No. I used the model that I use -- 8 commonly use for my work on public opinion and 9 representation. Because the measurement challenge 10 here, in a district where we don't -- where it's an 11 uncontested race, so we don't observe, say, a 12 Democratic candidate, is the same measurement 13 challenge I would see in my public opinion work if I 14 was trying to measure public opinion at the state 15 level, say, and we didn't actually have any survey 16 respondents in a particular state.</p> <p>17 Q. Is what you did a common method in 18 political science for -- when calculating the 19 efficiency gap, figuring out how to account for 20 uncontested elections?</p> <p>21 A. I did. It's very common to estimate 22 the party vote share in uncontested elections based 23 on similar districts elsewhere in the country and 24 previous and future results in that district.</p> <p>25 Q. Are there other ways, besides modeling,</p>	966	<p>1 method and the simpler approach that the 2 winner gets 75 percent of the vote and the 3 loser gets 25 percent, but also comparing my 4 estimates to estimates produced by 5 nonpartisan -- other sources, such as the 6 Brennan Center and the Progressive Policy 7 Institute of California.</p> <p>8 BY MS. MCKENZIE:</p> <p>9 Q. So you found --</p> <p>10 A. This graph simply shows that for each 11 of these metrics, my estimates for the efficiency gap 12 are almost identical to the estimates that you get 13 using other modeling approaches.</p> <p>14 Q. So you're saying that your results 15 wouldn't have changed regardless of what method you 16 used to account for uncontested elections?</p> <p>17 A. Absolutely. So the details of how you 18 account for uncontested elections are less important 19 than the fact that you account for them at all. So 20 there's no reason -- there's no, you know, defensible 21 reason not to account for them at all.</p> <p>22 Q. Based on your expertise in political 23 science in elections, is it valid to calculate an 24 efficiency gap without taking account of uncontested 25 elections?</p>
965	<p>1 to account for uncontested elections?</p> <p>2 A. Of course. We could use a much simpler 3 approach, which was the approach taken by many 4 political science studies, like, in the 1990s, where 5 you simply assume that the winner gets 75 percent of 6 the vote, and the losing candidate gets 25 percent of 7 the vote.</p> <p>8 MS. MCKENZIE: Can we put up 9 Petitioners' Exhibit 52?</p> <p>10 THE WITNESS: So I did that, I 11 calculated the efficiency gap for -- using 12 my -- my measurement approach, as well as 13 using the approach of the winner getting 14 75 percent, which, by the way, is generally 15 not a great way to go because it's making 16 pretty strong assumptions that in every 17 district in the country, the loser would 18 have gotten -- or the party that didn't run 19 a candidate would have gotten 25 percent. 20 So that's why political science studies have 21 generally moved away from this approach.</p> <p>22 But nonetheless, you know, 23 regardless of the methodological details, 24 the estimates we get of the efficiency gap 25 are extremely similar, both between my</p>	967	<p>1 A. No, and I don't know a single study 2 that does that aside from this expert report.</p> <p>3 THE COURT: I'm sorry. I didn't 4 understand your question.</p> <p>5 MS. MCKENZIE: I'll repeat it, 6 Your Honor.</p> <p>7 Based on your expertise in political 8 science in elections, is it valid to 9 calculate the efficiency gap without taking 10 account of uncontested elections?</p> <p>11 THE COURT: So you're saying is it 12 valid to perform a statewide efficiency gap 13 calculation by excluding an uncontested 14 election period?</p> <p>15 MS. MCKENZIE: No. What I'm saying 16 is without -- without creating -- let me 17 rephrase.</p> <p>18 THE COURT: Okay.</p> <p>19 BY MS. MCKENZIE:</p> <p>20 Q. Based on your expertise in political 21 science in elections, is it valid to calculate an 22 efficiency gap for a Congressional districting plan 23 while assuming that in an uncontested election, the 24 party that lost -- that didn't field a candidate 25 wasted zero votes?</p>

968	<p>1 A. No. I think that makes no theoretical 2 sense, and there's no study that I know of that uses 3 that approach.</p> <p>4 Q. Okay.</p> <p>5 MS. MCKENZIE: Petitioners move 6 Exhibit 52.</p> <p>7 THE COURT: Any objection? 8 Without objection, Petitioners' 9 Exhibit 52 is admitted.</p> <p>10 - - - 11 (Whereupon, Petitioners' Exhibit Number 12 52 was admitted into evidence.) 13 - - -</p> <p>14 BY MS. MCKENZIE:</p> <p>15 Q. All right. Now, did you review 16 Dr. Gimpel's calculations of the efficiency gap for 17 Congressional elections in Pennsylvania in 2014 and 18 2016?</p> <p>19 A. I did.</p> <p>20 Q. Did they match yours?</p> <p>21 A. No, they don't. In both cases, they're 22 substantially lower than my efficiency gap estimates, 23 which, again, surprised me.</p> <p>24 Q. And by "lower," what -- what do you 25 mean by "lower"?</p>	970	<p>1 had an estimate of what would have happened if the 2 other party had run a candidate.</p> <p>3 So the combination of these two factors 4 meant that the efficiency gaps that he estimated were 5 much less pro-Republican than the efficiency gaps I 6 estimated.</p> <p>7 Q. And how many -- how many uncontested 8 elections were there in Pennsylvania's Congressional 9 elections in 2014 and 2016?</p> <p>10 A. There were three.</p> <p>11 Q. And which party didn't field a 12 candidate?</p> <p>13 A. I believe the Democrats didn't field a 14 candidate in two of them, and the Republicans didn't 15 field a candidate in one.</p> <p>16 Q. Okay. So in light of that fact, how 17 did Dr. Gimpel's failure to take any special account 18 of -- to take -- to do anything other than 19 attributing zero wasted votes to the party that 20 didn't field an election -- how did that influence 21 his calculation of the efficiency gap?</p> <p>22 A. Once again, it meant that his 23 efficiency gaps were much less pro-Republican than 24 they would have been if he properly accounted for the 25 uncontested votes. So it meant that across both the</p>
969	<p>1 A. I'm sorry. They're -- they're less 2 pro-Republican than the efficiency gaps that I 3 estimate.</p> <p>4 Q. Okay. And did you investigate the 5 difference?</p> <p>6 A. I did.</p> <p>7 Q. And how did you investigate that?</p> <p>8 A. So, once again, I looked at the backup 9 spreadsheet that you described earlier.</p> <p>10 Q. Okay. And what did you find in 11 Dr. Gimpel's backup data with respect to his 12 treatment of uncontested elections?</p> <p>13 A. So what I found is that Professor 14 Gimpel simply assumed that the losing 15 candidate -- the party in uncontested elections that 16 didn't field a candidate got zero votes in that race; 17 and, therefore, he assumed that they wasted zero 18 votes.</p> <p>19 So the consequence of that was 20 deflating, was reducing the number of wasted votes by 21 the losing party. And he also assumed that the 22 winning party, you know, as I mentioned earlier, 23 wasted, essentially, a lot of votes, like, many more 24 votes than we would have assumed that they would have 25 wasted if the other party had run a candidate or we</p>	971	<p>1 2014, '14 and '16 elections, his efficiency gap 2 estimates were much less pro-Republican than they 3 should have been if he had the proper data and had 4 been using the proper methodology.</p> <p>5 Q. And the error you found was different 6 in 2012 versus 2014 and 2016, just to be clear?</p> <p>7 A. Yes --</p> <p>8 Q. Okay.</p> <p>9 A. -- both of them essentially meant 10 that his estimates were less pro-Republican than they 11 should have been.</p> <p>12 Q. And, Dr. Warshaw, did you check the 13 backup data for every single one of the efficiency 14 gap calculations in Table 7 of Dr. Gimpel's report?</p> <p>15 A. No.</p> <p>16 Q. And why not?</p> <p>17 A. The -- I wanted to focus on the results 18 that were most comparable to my report, which was the 19 U.S. House elections.</p> <p>20 Q. Okay. Do you have an opinion about 21 Dr. Gimpel's efficiency gap calculations just based 22 on the things you did check?</p> <p>23 A. Well, given that he made both data 24 entry and modeling errors in the estimates of the 25 efficiency gap for U.S. House elections, it makes me</p>

972	<p>1 think that -- it's not clear, to me, how much I would</p> <p>2 trust his estimates of the efficiency gap for other</p> <p>3 elections.</p> <p>4 I wasn't able to check those, but it</p> <p>5 certainly seems like the same kind of data and</p> <p>6 modeling errors could be true in those efficiency gap</p> <p>7 estimates.</p> <p>8 MR. TUCKER: I object to that</p> <p>9 testimony, Your Honor, as speculative.</p> <p>10 THE COURT: Overruled.</p> <p>11 MS. MCKENZIE: Thank you. That's</p> <p>12 all I have on direct, Your Honor.</p> <p>13 THE COURT: Okay.</p> <p>14 Cross-examination.</p> <p>15 - - -</p> <p>16 CROSS-EXAMINATION</p> <p>17 - - -</p> <p>18 BY MR. TUCKER:</p> <p>19 Q. Good afternoon, Dr. Warshaw. My name</p> <p>20 is Rob Tucker, and I represent Legislative Respondent</p> <p>21 Speaker Turzai in this case.</p> <p>22 I want to start by talking a little bit</p> <p>23 about your background.</p> <p>24 You do not consider yourself an expert</p> <p>25 in redistricting, do you?</p>	974	<p>1 A. Broadly speaking, I am.</p> <p>2 Q. And what are you aware of?</p> <p>3 A. So traditionally, redistricting plans</p> <p>4 often try to maximize the compactness of districts;</p> <p>5 they try to keep communities of interest together;</p> <p>6 they might try to prioritize incumbency protection.</p> <p>7 So, certainly, a variety of goals in the</p> <p>8 redistricting process.</p> <p>9 Q. Are you familiar with the Voting Rights</p> <p>10 Act?</p> <p>11 A. I am.</p> <p>12 Q. And what are you familiar with?</p> <p>13 A. Broadly speaking, I'm familiar that the</p> <p>14 Voting Rights Act requires the minorities to have</p> <p>15 representation in Congress when they're</p> <p>16 geographically compact enough to make that feasible.</p> <p>17 Q. Anything else you're aware of as far as</p> <p>18 specific factors that have to be analyzed in</p> <p>19 determining how and when the Voting Rights Act</p> <p>20 impacts a redistricting plan?</p> <p>21 A. Not specifically, no.</p> <p>22 Q. Are you aware of any legislature, state</p> <p>23 commission or court that has used the efficiency gap</p> <p>24 in drafting a redistricting plan?</p> <p>25 A. Well, the efficiency gap is a new</p>
973	<p>1 A. No, if by "redistricting," you mean the</p> <p>2 drawing of maps, specifically in -- in following a</p> <p>3 redistricting plan. But I would consider myself an</p> <p>4 expert in the consequence of redistricting on the</p> <p>5 representational process.</p> <p>6 Q. Your expertise comes in analyzing the</p> <p>7 impact, potentially, of -- of a redistricting plan,</p> <p>8 correct?</p> <p>9 A. Yes.</p> <p>10 Q. You don't have any knowledge or</p> <p>11 experience in actually how those plans and those</p> <p>12 boundaries are drafted?</p> <p>13 A. I do not.</p> <p>14 Q. Are you aware of what had been</p> <p>15 considered traditional redistricting principles?</p> <p>16 THE COURT: Hold on for a second.</p> <p>17 Hold on.</p> <p>18 (Pause.)</p> <p>19 THE COURT: Go ahead and proceed.</p> <p>20 BY MR. TUCKER:</p> <p>21 Q. I don't remember where we were in the</p> <p>22 question, so let me start over.</p> <p>23 A. Sure.</p> <p>24 Q. So are you aware of what traditional</p> <p>25 districting criteria are?</p>	975	<p>1 measure that was just developed in 2014 by a</p> <p>2 political scientist named Eric McGhee, so it was only</p> <p>3 published a few years ago; so it certainly wasn't</p> <p>4 available to legislators in the 2011 redistricting</p> <p>5 cycle.</p> <p>6 So I don't think -- I'm not sure what</p> <p>7 the point of the question is there.</p> <p>8 THE COURT: The question was, has</p> <p>9 any court, commission or board adopted the</p> <p>10 efficiency gap in drawing a plan?</p> <p>11 That was his question.</p> <p>12 THE WITNESS: So in the -- I don't</p> <p>13 know of a commission that's used it to draw</p> <p>14 a plan, but in the case that's currently</p> <p>15 before the Supreme Court, the Federal Court,</p> <p>16 the Federal District Court used the</p> <p>17 efficiency gap as one of the metrics that</p> <p>18 they use to evaluate the Wisconsin plan.</p> <p>19 So, certainly, there's a history of</p> <p>20 the efficiency gap being used by the courts.</p> <p>21 BY MR. TUCKER:</p> <p>22 Q. When you say "history," you're talking</p> <p>23 about one case, correct?</p> <p>24 A. Yes; that's because the efficiency gap</p> <p>25 is such a new measure.</p>

976	<p>1 Q. Let's talk a little bit about wasted 2 votes. 3 A. Sure. 4 Q. You have two sides of the coin with 5 wasted votes, correct? 6 A. Yes. 7 Q. On one hand, if you're in a losing 8 district, every vote for that party in that district 9 is considered wasted, correct? 10 A. Yes. In a district where voters are 11 cracked across districts, all votes are wasted. 12 Q. It doesn't matter whether voters are 13 cracked or not; under the efficiency gap analysis, 14 any vote for the losing party in that district is 15 considered wasted, correct? 16 A. Exactly. That vote doesn't influence 17 the representative who is actually elected. 18 Q. So if a party gets 49.9 percent of the 19 vote and the other party gets 50.1 percent of the 20 vote, the party that got 49.9 percent of the vote, 21 every single one of those votes is considered wasted, 22 correct? 23 A. It is. And I think there's a strong 24 political science foundation for that, which is that, 25 as I demonstrated earlier, the -- whether you get</p>	978	<p>1 competitive election. It's hard to say whether, over 2 the long term, that's a competitive district. 3 Q. For that particular election cycle, you 4 would consider it competitive? 5 A. Absolutely. 6 Q. Now, you went through a demonstrative 7 example with counsel about how to calculate the 8 efficiency gap. 9 Do you recall that? 10 A. Yes, I do. 11 Q. I believe this is correct. 12 The demonstrative that you went through 13 with counsel, demonstrating how one would calculate 14 an efficiency gap in a -- in a simulated situation, 15 correct? 16 A. Sure. 17 Q. And in this situation, we had three 18 different districts, and the Republicans won two of 19 the districts, and the Democrats won one of them, 20 correct? 21 A. Yes. 22 Q. But the way the votes ended up in each 23 of those districts resulted in a calculation of a 24 24 percent efficiency gap, correct? 25 A. Yes, exactly.</p>
977	<p>1 49.9 percent of the vote or 30 percent of the vote, 2 it doesn't actually matter for the winning 3 candidate's behavior. 4 The -- if a Republican wins a district 5 with 50.1 percent of the vote, they're not going to 6 be any more moderate than a Republican that won with 7 65 percent of the vote. So in each of those cases, 8 the Democrat losing -- the voters who lose, whether 9 they're 49.9 percent or 30 percent, are equally 10 wasted because they have no effect on the 11 representatives' roll call voting behavior in 12 Congress. 13 Q. And I understand, and we'll get to your 14 opinions on ideology. 15 What I'm trying to do is confirm that 16 we can agree on the calculation of the efficiency 17 gap, and that is that on that side of the coin, every 18 vote, even if it's 49.9 percent, every one of those 19 votes is considered wasted, correct? 20 A. Correct. 21 Q. Would you consider a district where the 22 vote count was 49.9 percent to 51.1 percent a 23 competitive district? 24 A. I would. 25 I certainly would consider that a</p>	979	<p>1 Q. Are you aware of whether having very, 2 very competitive districts can actually result in a 3 very high efficiency gap as well? 4 A. Certainly, it could. If one party won 5 a very large percent of the elections by narrow 6 margins, then that would give them a large efficiency 7 gap in their favor. 8 Q. So let's take a look at an example of 9 that. 10 In this simulation, which is very 11 similar to the one you went through with counsel, we 12 have five -- five districts. In four of them, the 13 Democrats win four of them with 51 percent of the 14 vote to 49 percent of the vote. And in the last one, 15 the Republicans win the district with 51 percent of 16 the vote, where the Democrats only get 49 percent, 17 correct? 18 Do you see that? 19 A. Yes. 20 Q. Would you consider each of these five 21 districts competitive? 22 A. I would. 23 Q. But in this instance -- let me get the 24 full demonstrative up here. 25 In this instance, do you agree that the</p>

980	<p>1 efficiency gap would be calculated to be</p> <p>2 29.4 percent?</p> <p>3 A. I do.</p> <p>4 So if this were a real districting</p> <p>5 plan -- and this doesn't look anything like the</p> <p>6 actual Pennsylvania plan -- then this would be a</p> <p>7 pro-Democratic efficiency gap since they win four of</p> <p>8 the five seats.</p> <p>9 Q. But, in this case, you consider all</p> <p>10 five of these districts to be competitive in this</p> <p>11 election cycle?</p> <p>12 A. I would.</p> <p>13 The efficiency gap is not trying to</p> <p>14 measure competitiveness, though. It's merely trying</p> <p>15 to measure partisanship bias, which, I think, for</p> <p>16 thinking about the representational process, partisan</p> <p>17 bias, particularly when it's persistent, is a much</p> <p>18 more important metric than the competitiveness of</p> <p>19 elections, especially since we just saw the</p> <p>20 competitiveness of election has no effect on the roll</p> <p>21 call voting behavior of legislators. They don't</p> <p>22 adopt more moderate positions when you have</p> <p>23 competitive elections.</p> <p>24 Q. So as I understand what you're saying,</p> <p>25 the efficiency gap doesn't necessarily measure</p>	982	<p>1 geography, correct?</p> <p>2 A. No; I studied political geography for</p> <p>3 my work, so I wouldn't say, you know, I don't know</p> <p>4 anything about political geography, but it's not the</p> <p>5 primary focus of my work.</p> <p>6 Q. And you haven't been offered as an</p> <p>7 expert in this case on political geography?</p> <p>8 A. No. I'll note many of my papers do</p> <p>9 study political geography.</p> <p>10 Q. So you don't have any specific</p> <p>11 knowledge necessarily of how the political geography</p> <p>12 of Pennsylvania might have impacted the efficiency</p> <p>13 gaps, correct?</p> <p>14 A. I haven't studied the political</p> <p>15 geography of Pennsylvania specifically and how it</p> <p>16 might influence the efficiency gap.</p> <p>17 I think what I can say about political</p> <p>18 geography, though, is that the -- I think the</p> <p>19 question is a little bit misleading, because I think</p> <p>20 that what I argued in my report was that the evidence</p> <p>21 that gerrymandering is influencing the efficiency gap</p> <p>22 in Pennsylvania is a very large increase that we</p> <p>23 observed in the efficiency gap between 2010 and 2012.</p> <p>24 And I understand political geography enough to state</p> <p>25 that it's very unlikely if there's any change in</p>
981	<p>1 whether or not districts are competitive?</p> <p>2 A. That's correct.</p> <p>3 There's a number -- certainly, there's</p> <p>4 surely a number of goals you might want to achieve in</p> <p>5 the redistricting process, and the efficiency gap</p> <p>6 focuses on partisan bias, which, as a scholar of</p> <p>7 representation, I view as far away the most important</p> <p>8 part of the redistricting process for influencing the</p> <p>9 policy representation that citizens receive. But,</p> <p>10 surely, there's a number of other metrics that you</p> <p>11 might want to look at as well.</p> <p>12 Q. So you can have very, very competitive</p> <p>13 districts in a state that result in a high efficiency</p> <p>14 gap?</p> <p>15 A. Of course.</p> <p>16 Q. And on the reverse side, you can have</p> <p>17 very noncompetitive districts in a state, but if</p> <p>18 they're symmetrical -- in other words, one party is</p> <p>19 winning big on some districts and the other party is</p> <p>20 winning big on other districts -- you can have a low</p> <p>21 efficiency gap, maybe even zero, but no competitive</p> <p>22 districts, correct?</p> <p>23 A. Correct.</p> <p>24 Q. I believe you testified earlier that</p> <p>25 you don't consider yourself an expert in political</p>	983	<p>1 political geography that could explain the sharp</p> <p>2 increase in the pro-Republican advantage in the</p> <p>3 efficiency gap that we observed between 2010 and</p> <p>4 2012.</p> <p>5 Q. Well, I certainly don't want my</p> <p>6 question to be misleading, so let me be clear and ask</p> <p>7 it again.</p> <p>8 You don't have any specific expertise</p> <p>9 or knowledge in the political geography of</p> <p>10 Pennsylvania, do you?</p> <p>11 A. No, aside from the fact that I lived</p> <p>12 there for 18 years.</p> <p>13 Q. You talk about packing one political</p> <p>14 party or another into a district. That can impact</p> <p>15 the efficiency gap, correct?</p> <p>16 A. Of course.</p> <p>17 Q. But you agree that packing can happen,</p> <p>18 as a general sense, from geography, correct?</p> <p>19 A. Yes, packing certainly can happen.</p> <p>20 Certainly, the efficiency gap can be influenced by</p> <p>21 any number of factors, one of which is geography.</p> <p>22 But as I demonstrated in my report, there's no way</p> <p>23 that geography could explain -- or it's very, very</p> <p>24 unlikely that any change in political geography could</p> <p>25 explain the change in the efficiency gap that we</p>

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1 observed between 2010 and '12.
 2 So, moreover, in Pennsylvania,
 3 historically, we haven't seen a pro-Republican -- a
 4 persistent pro-Republican advantage in the efficiency
 5 gap prior to the 2011 Redistricting Plan. So if
 6 there was a persistent political geography in
 7 Pennsylvania that helped Republicans, then we would
 8 see is a large pro-Republican efficiency gap that was
 9 persistent over a long period of time. We wouldn't
 10 see the very sharp change that we observed between
 11 the 2010 and '12 plans.
 12 **Q. Well, again, as you testified, you're**
 13 **not an expert in political geography in Pennsylvania.**
 14 **You don't know if there's been changes**
 15 **in that political geography over that time, do you?**
 16 A. Well, I can state, based on my
 17 knowledge of voting behavior in Congressional
 18 elections, that's there no change -- there's no
 19 factors that I'm aware of that change sharply between
 20 the 2010 and '12 Congressional elections.
 21 And as we said at the outset, I am an
 22 expert in Congressional elections, so I do have a
 23 very close understanding of the factors that
 24 influence people in Congressional elections. And
 25 based on my knowledge of Congressional elections, I

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1 can't think of any theoretical factor, including
 2 political geography, in Congressional elections,
 3 which are the object -- are the target of our study
 4 here, that change so dramatically over that two-year
 5 period.
 6 **Q. I understand that's your opinion. That**
 7 **wasn't my question, though.**
 8 **My question was, You don't have any**
 9 **expertise on whether or not there have been changes**
 10 **in Pennsylvania's political geography over, say, the**
 11 **last decade, do you?**
 12 A. I think the last decade isn't relevant.
 13 What's relevant here is between 2010 and '12.
 14 **Q. Do you have any expertise or knowledge**
 15 **about the changes in Pennsylvania's political**
 16 **geography between 2010 and '12?**
 17 A. I've not studied in detail changes in
 18 Pennsylvania's political geography, but I know as a
 19 general matter of Congressional elections that I'm
 20 not aware of any factor in Congressional elections,
 21 theoretical factor that influences citizens' voting
 22 in Congressional elections, which is what we're
 23 talking about today, that changed sharply over that
 24 time period, including political geography.
 25 **Q. I understand. I just want to make sure**

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1 **this is clear for the record.**
 2 THE COURT: Counsel, it's clear --
 3 let me help you out. He was not qualified
 4 as an expert in political geography.
 5 MR. TUCKER: Thank you, Your Honor.
 6 THE COURT: Okay.
 7 BY MR. TUCKER:
 8 **Q. I'd like to take a look at Petitioners'**
 9 **Exhibit 38. And I believe you discussed this on your**
 10 **direct examination, that this is an analysis of the**
 11 **national history of efficiency gaps using U.S.**
 12 **Congressional elections from -- I think sometime**
 13 **around 1970 to the present; is that correct?**
 14 A. Yeah, more specifically, from 1972,
 15 which is the first Congressional election after "one
 16 person, one vote," the Supreme Court decision, forced
 17 the redrawing of districts to make sure they were
 18 equal populace through the 2016 election.
 19 **Q. Did this study, in any way, take into**
 20 **account district-level characteristics of candidates?**
 21 A. It didn't.
 22 **Q. And did it include any analysis of the**
 23 **impact of the Voting Rights Act?**
 24 A. It did not.
 25 **Q. So as I understand your testimony, it's**

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1 **your opinions that -- particularly after the 2010**
 2 **Census, in that redistricting process, that the**
 3 **Republicans got a boost, a higher efficiency gap,**
 4 **based upon redistricting, correct?**
 5 A. Yes, they received a precipitous
 6 increase in the pro-Republican advantage in the
 7 efficiency gap following the 2011 plan.
 8 **Q. I also understand your testimony to be**
 9 **that efficiency gaps are durable, meaning they don't**
 10 **tend to change very often over time; is that correct?**
 11 A. Correct, the efficiency gaps that we've
 12 observed following the 2011 Redistricting Plan going
 13 into place have been extremely durable in the 2014
 14 and '16 Congressional elections, which, obviously,
 15 are two very different Congressional elections.
 16 Republican -- in 2014, Republicans gained seats
 17 nationwide. And in 2016, Democrats gained seats.
 18 So these are two very different
 19 elections; nonetheless, in both elections, the
 20 efficiency gap was extremely durable.
 21 **Q. So if the efficiency gap was durable,**
 22 **wouldn't we see an immediate drop in the -- in the**
 23 **2012 elections followed by a flat line going forward?**
 24 A. Yes, we observed a relatively flat
 25 line, which is roughly what we observe.

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1 **Q. You observe a flat line after 2012**
 2 **there?**
 3 A. We do. I think in the grand scheme of
 4 things, that's a pretty flat line. They've moved a
 5 little bit towards zero; but, by and large, the
 6 efficiency gaps that we've observed in 2014 and 2016
 7 are very similar to the efficiency gaps in 2012.
 8 **Q. I just want to make sure we're looking**
 9 **at the same thing.**
 10 **So you're saying from the 2012, which I**
 11 **believe is the third row of dots from the right --**
 12 **Correct?**
 13 A. Um-hum.
 14 **Q. -- from that point on, the blue line is**
 15 **flat?**
 16 A. In 2012, Republicans had, on average,
 17 about an 8 percent advantage in the efficiency gap.
 18 And in 2014 and '16, it was around 5 percent. So,
 19 you know, yeah, it's -- it's moved a little bit
 20 towards the middle over the last two election cycles,
 21 but, in general, the efficiency gaps in 2016, as we
 22 saw earlier, are very similar to the efficiency gaps
 23 in 2012 -- that we had in 2012.
 24 THE COURT: Counsel, you know this
 25 particular petition was not marked, right --

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1 this particular exhibit?
 2 I don't believe this exhibit was
 3 used in direct examination. I just -- is
 4 this 38?
 5 MR. TUCKER: This is 38.
 6 THE COURT: Thirty-eight. I didn't
 7 have it marked.
 8 MR. TUCKER: I believe it wasn't,
 9 sir, but it was in my report. It is also in
 10 his report.
 11 THE COURT: I understand.
 12 I just didn't know if you wanted to
 13 have it marked -- if you actually wanted to
 14 have it marked on the record and admitted.
 15 I didn't know if you wanted to do that.
 16 MR. TUCKER: You know what,
 17 Your Honor? Thank you for pointing that
 18 out. I actually didn't -- didn't realize
 19 that it had not been admitted.
 20 So, yes, I would like to move
 21 this -- Petitioners' Exhibit 38 into
 22 evidence.
 23 THE COURT: Any objection?
 24 MS. MCKENZIE: Certainly not.
 25 THE COURT: Petitioners' Exhibit 38

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1 is admitted without objection.
 2 - - -
 3 (Whereupon, Petitioners' Exhibit Number
 4 38 was admitted into evidence.)
 5 - - -
 6 BY MR. TUCKER:
 7 **Q. When you talk about durability, I**
 8 **believe you stated in your report that there's been**
 9 **no studies on durability based upon the most recent**
 10 **redistricting period, correct?**
 11 A. I believe there's been -- my
 12 understanding is no studies that have looked at the
 13 durability through the 2016 Congressional elections.
 14 I might be wrong, but I think they might have looked
 15 at the 2014 elections, although I'm not sure about
 16 that.
 17 **Q. But there's been nothing -- if you're**
 18 **talking about the most redistricting -- the most**
 19 **recent redistricting cycle, we're talking about 2012,**
 20 **2014, 2016 elections, correct?**
 21 A. To my knowledge, outside of my report,
 22 there's been no published research that's examined
 23 the 2016 elections, the efficiency gaps in the 2016
 24 elections.
 25 **Q. In your report, you also state that a**

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1 **variety of factors could affect the absolute value of**
 2 **the efficiency gap.**
 3 **What are those factors?**
 4 A. Sure.
 5 So, you know, any number of factors
 6 could. So, certainly, political geography could play
 7 a role in differences in the absolute efficiency
 8 gaps, something like the Voting Rights Act, or, you
 9 know, any number of factors that I wouldn't want to
 10 speculate upon. But I'm certainly not claiming that
 11 intentional gerrymandering is the only factor that
 12 contributes to the efficiency gap, the absolute
 13 differences in the efficiency gap.
 14 **Q. I think one we've already talked about**
 15 **and seen an example of is competitive districts can**
 16 **impact the efficiency gap, correct?**
 17 A. Yes. Although it's not clear, to me,
 18 they would cause, on average, a change in the
 19 efficiency gap. If you had lots of competitive
 20 elections, it might increase the variability of the
 21 efficiency gap. But it's not clear, to me, that it
 22 would bias our estimates of the efficiency gap in one
 23 direction or not.
 24 **Q. Fair point.**
 25 **I guess the better question is, if one**

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1 party happened to win a bunch of close elections in a
 2 particular election cycle, that could impact the
 3 efficiency gap?
 4 A. It could; although as an election
 5 asymptotically approaches a tight election,
 6 essentially it's going to be random who wins or loses
 7 those elections. So, certainly, if, by chance, the
 8 party won, you know, a number of close elections, you
 9 know, that would give them an advantage in the
 10 efficiency gap.
 11 But I want to note that's not what we
 12 saw in Pennsylvania in 2012, where there was only one
 13 close election, and even that election wasn't
 14 actually that -- you know, it was close, but it
 15 wasn't tied or close to tied.
 16 **Q. I want to refer you now to Petitioners'**
 17 **Exhibit 39. I believe we did look at this one during**
 18 **your direct examination.**
 19 A. Yes, sir.
 20 **Q. In -- if I understood your testimony,**
 21 **this graph intends to show the durability of the**
 22 **efficiency gap, correct?**
 23 A. Yes.
 24 **Q. But you're only analyzing it from 2012**
 25 **to 2016, correct?**

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1 A. That's correct here. Because I viewed
 2 that as the hardest tests, and I did look at -- the
 3 relationship between the 2014 Plan and the
 4 relationship was much stronger there. It was even
 5 stronger there. So I viewed as looking at the -- the
 6 relationship between the efficiency gaps right after
 7 the plan went into place and, you know, halfway
 8 through the redistricting cycle in the most recent
 9 election available, it's really the best test we have
 10 for the durability of the recent redistricting plans.
 11 **Q. So this is only over a four-year**
 12 **period?**
 13 **That's the only thing I wanted to point**
 14 **out.**
 15 **Correct?**
 16 A. That's correct. Although, in my view,
 17 this is the most politically meaningful way to show
 18 the durability of the post-2011 Plans.
 19 **Q. Now let's take a look Petitioners'**
 20 **Exhibit 40.**
 21 **And, as I understand your testimony,**
 22 **this graph purports to show the efficiency gap that**
 23 **you calculated in Pennsylvania for Congressional**
 24 **elections?**
 25 A. Yes.

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1 **Q. And it's from 1970 through the 2016**
 2 **elections?**
 3 A. Correct, 1972 through 2016.
 4 **Q. And the dots on this graph, each**
 5 **correspond to the efficiency gap for a particular**
 6 **election year, correct?**
 7 A. Correct.
 8 MR. TUCKER: One moment, Your Honor.
 9 BY MR. TUCKER:
 10 **Q. So, again, we have here the graph,**
 11 **which is Petitioners' Exhibit 40, correct, which is**
 12 **the efficiency gaps you calculated historically in**
 13 **Pennsylvania on Congressional elections, correct?**
 14 A. Yes.
 15 **Q. And I want to point to a couple years**
 16 **to make sure we agree on the years we're talking**
 17 **about with each of these dots.**
 18 **This one right here is 2000- --**
 19 **THE COURT:** If you can just speak
 20 louder, you won't have to crank -- speak to
 21 the back of the room.
 22 MR. TUCKER: Sure.
 23 BY MR. TUCKER:
 24 **Q. This dot right here that I'm pointing**
 25 **to, that reflects the 2008 Congressional election,**

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1 **correct?**
 2 A. Yes, I believe that's correct.
 3 **Q. And then this one reflects the 2010**
 4 **Congressional election, correct?**
 5 A. Yes, that's right.
 6 **Q. And then this one reflects the 2012**
 7 **Congressional election, correct?**
 8 A. Yes. That's true.
 9 **Q. As I understand your testimony here, is**
 10 **that you're saying that the 2011 redistricting**
 11 **process caused a huge change in the efficiency gap in**
 12 **favor of the Republicans, correct?**
 13 A. Yes.
 14 **Q. But, in fact -- and I want to kind of**
 15 **illustrate this -- what we really see here is**
 16 **actually a linear line that's a decline beginning in**
 17 **2008, correct?**
 18 A. You see -- you do see a decline between
 19 2008 and '10, but the decline between 2010 and 2012
 20 is much steeper than the decline between 2008 and
 21 2010.
 22 This is a linear line there you have --
 23 sort of slightly obscures that. It makes it look
 24 like it's linear, where it's actually not linear.
 25 It's about a 15-point difference between the

996	<p>1 efficiency gap in 2010 and '12 and about a 10-point 2 difference between the efficiency gaps in 2008 and 3 '10.</p> <p>4 Q. And -- but there was already a change 5 in the efficiency gap from 2008 to 2010, correct?</p> <p>6 A. Yes, but that's because 2010 was, you 7 know -- just a minute ago, you showed an example 8 where if you win a number of elections relatively 9 closely, then you'd have a large change in the 10 efficiency gap.</p> <p>11 What happened in 2010, certainly, 12 nationwide, was that Republicans won a large number 13 of seats in Congress from Democrats, what we call a 14 "wave election year." 2012 didn't look anything like 15 that. So there's no reason, based on the national 16 Congressional elections, to expect that the trend we 17 saw between 2008 and '10 would continue from 2010 to 18 '12.</p> <p>19 Moreover, there's no reason to expect 20 the trend would not only continue, but, in fact, the 21 slope would not just continue linearly, as you 22 suggested, but it would actually increase 23 by 50 percent. So the change between 2010 and '12 is 24 much larger than the -- than any change we had seen 25 before in Pennsylvania.</p>	998	<p>1 think that was totally true, but there was more truth 2 to that.</p> <p>3 Whereas today, Congressional elections 4 are extremely predictable. People typically vote the 5 same way up and down the ballot. Members of the mass 6 public are extremely sorted by party, so it's very 7 unlikely for someone to vote for the Republican for 8 president and the Democrat for Congress, or 9 vice versa, which is totally different in the 10 election patterns we saw in earlier decades, where 11 it's very common for people to split their tickets.</p> <p>12 Q. So you're analyzing that through the 13 current part of this decade, correct?</p> <p>14 A. Correct.</p> <p>15 Q. So we're talking about a four-year 16 period?</p> <p>17 A. Yes, since that's the four-year period 18 that's most relevant after the 2011 Plans went into 19 place.</p> <p>20 Q. But when we actually look at the 21 historical efficiency gaps in Pennsylvania over time, 22 over decades of time, we see it as a wavy line, 23 correct?</p> <p>24 A. We do, we see it as a wavy line that's 25 generally centered around zero and, in fact, in the</p>
997	<p>1 Q. But, obviously, the change between 2008 2 and 2010 can't be attributed to the redistricting 3 plan, correct?</p> <p>4 A. No -- that's correct -- certainly not 5 to the 2011 Redistricting Plan.</p> <p>6 Q. And we see this -- we've seen this 7 change before, haven't we, in the graph? 8 I mean, if we look at just after the 9 2001 redistricting cycle, we see a dip in the graph 10 then as well, correct?</p> <p>11 A. Yes.</p> <p>12 Q. But then we see the line come back up 13 during that decade, correct?</p> <p>14 A. So certainly in -- there's some 15 variability in the efficiency gap, but one thing I'll 16 note is that the variability in the efficiency gap is 17 actually much smaller today than it was in earlier 18 decades. And the reason for that is that in earlier 19 decades, I think what -- I can't remember which of 20 your experts, but, you know, some of your expert 21 reports suggested that, like, oh, people are 22 constantly switching their votes in Congressional 23 elections and, like, who knows who is going to win a 24 particular Congressional election.</p> <p>25 Whereas I think in 1980 or '90, I don't</p>	999	<p>1 early part of the time period favored Democrats and 2 through most of this time period has had no 3 persistent partisanship bias.</p> <p>4 So the pro-Republican, we certainly 5 never had a time period like we've seen in the last 6 three years, where you had a very large Republican 7 bias over the course of a redistricting cycle. So I 8 view that as a very sharp change in the partisan bias 9 in Pennsylvania's efficiency gap after the 2011 Plans 10 went into place.</p> <p>11 Q. But we don't know what's going to come 12 in future elections, do we?</p> <p>13 A. Of course not, but all we can do is 14 make our evaluation of that based on what's happened 15 in recent elections. And we know that in recent 16 elections, the efficiency gaps have been extremely 17 durable. And the efficiency gaps in 2012 were 18 extremely predictive of the efficiency gaps we saw 19 later in the cycle, and that's true in the nation as 20 a whole, and it's certainly true in Pennsylvania, 21 which had a pro-Republican efficiency gap of 22 24 percent in 2012 and negative of 19 percent in 23 2016.</p> <p>24 So as we can see, despite -- you know, 25 2012, '14 and '16 were very different Congressional</p>

CROSS-EXAMINATION - CHRISTOPHER WARSHAW, PH.D.

1000	<p>1 elections. We had -- there was a midterm year; we</p> <p>2 had two presidential election years: two in which</p> <p>3 Democrats gained seats; one in which Republicans</p> <p>4 gained seats. But across all three of these very</p> <p>5 different elections, the substantial pro-Republican</p> <p>6 advantage in the efficiency gap in Pennsylvania</p> <p>7 remained. And this efficiency gap only appeared</p> <p>8 after the 2011 Plan was in place.</p> <p>9 Q. But even in the last four years, we've</p> <p>10 seen changes in the efficiency gap, correct?</p> <p>11 A. Sure. You've seen modest changes; but</p> <p>12 on the whole, the efficiency gaps, both in</p> <p>13 Pennsylvania and the nation as a whole, are extremely</p> <p>14 similar between -- in 2010, '14 and '16.</p> <p>15 Q. Well, I mean, according to the graph,</p> <p>16 as I interpret your graph, the increase in favor of</p> <p>17 the Republicans and the efficiency gap from 2010 to</p> <p>18 2012, half of that was erased between 2012 and 2014,</p> <p>19 correct?</p> <p>20 A. If we average across these three years,</p> <p>21 the efficiency gap was negative 19 percent across</p> <p>22 these three years.</p> <p>23 THE COURT: Professor, we're going</p> <p>24 to be a long way if you -- if you just -- I</p> <p>25 will let you answer the question, and then</p>	1002	<p>1 correct?</p> <p>2 THE COURT: I'm sorry. The vote to</p> <p>3 what?</p> <p>4 MR. TUCKER: The vote-to-seat ratio.</p> <p>5 THE COURT: Okay.</p> <p>6 THE WITNESS: No. As I see it, the</p> <p>7 point of the efficiency gap is to measure</p> <p>8 the relative number of wasted votes by each</p> <p>9 party, which I think captures -- which I</p> <p>10 think does have a mathematical relationship</p> <p>11 with vote-seat ratio, but I think it's a --</p> <p>12 the intuition behind it is about measuring</p> <p>13 the type of gerrymandering that legislatures</p> <p>14 are doing.</p> <p>15 BY MR. TUCKER:</p> <p>16 Q. Do you know how many seats the</p> <p>17 Republicans held after the 2010 Congressional</p> <p>18 elections?</p> <p>19 A. I think Democrats held seven.</p> <p>20 Q. So it would make the Republicans held</p> <p>21 12, correct?</p> <p>22 A. Because there are 19 districts.</p> <p>23 Q. So after the 2012 elections, where we</p> <p>24 see the increase in the efficiency gap, the</p> <p>25 Republicans now end up with 13 seats, correct?</p>
1001	<p>1 you can give the explanation.</p> <p>2 THE WITNESS: Okay.</p> <p>3 THE COURT: You're allowed to</p> <p>4 explain your answer, but answer first and</p> <p>5 then explain.</p> <p>6 THE WITNESS: I understand.</p> <p>7 So, yes, in 2014, party efficiency</p> <p>8 gap moderated a little bit as it obviously</p> <p>9 went to negative 15 percent.</p> <p>10 BY MR. TUCKER:</p> <p>11 Q. You're saying moderated a little bit,</p> <p>12 and I guess that's where I disagree with you, when</p> <p>13 you're saying "a little bit," because, to me, as I</p> <p>14 look at the graph, it seems like it was half of the</p> <p>15 efficiency gap that the Republicans had gained from</p> <p>16 the previous cycle, the Democrats had gained back.</p> <p>17 Is that accurate?</p> <p>18 A. Yes, I think that's mathematically</p> <p>19 accurate.</p> <p>20 I think what's clearly going to be true</p> <p>21 is there's going to be some variability in the</p> <p>22 efficiency gaps election to election, but on the</p> <p>23 whole, they're very consistent over time.</p> <p>24 Q. Part of the purpose of the efficiency</p> <p>25 gap is really to help measure the vote-to-seat ratio,</p>	1003	<p>1 A. Correct.</p> <p>2 Q. So they gain one more seat?</p> <p>3 A. Well, Pennsylvania lost a seat in the</p> <p>4 decennial redistricting, so I think that's not</p> <p>5 entirely the right way of looking at it.</p> <p>6 The proportion of the seats in</p> <p>7 Pennsylvania that were held by Republicans increased</p> <p>8 dramatically between these two elections. And I'll</p> <p>9 note, 2010 was an election year that was extremely</p> <p>10 favorable for Republicans, you know, not just in the</p> <p>11 nation as a whole, but in Pennsylvania; whereas 2012</p> <p>12 was an election that Pennsylvania voted for</p> <p>13 Barack Obama for president, and Democrats won the</p> <p>14 majority of the Congressional votes statewide.</p> <p>15 So the fact that, between these two</p> <p>16 elections, the Republican advantage in the efficiency</p> <p>17 gap increased, I think, is illustrative.</p> <p>18 Q. Let's talk a little bit about packing</p> <p>19 again, because I think you referred to that during</p> <p>20 your testimony earlier.</p> <p>21 A. Sure.</p> <p>22 Q. You also indicated that you are at</p> <p>23 least generally aware of the Voting Rights Act,</p> <p>24 correct?</p> <p>25 A. At a very general level.</p>

1004	<p>1 Q. Are you aware of, under the current</p> <p>2 plan, whether any districts had to be drawn in</p> <p>3 compliance with the Voting Rights Act?</p> <p>4 A. I'm not.</p> <p>5 Q. And if I told you there was a district</p> <p>6 that had to be drawn to be in compliance with the</p> <p>7 Voting Rights Act -- and what I mean by that is to be</p> <p>8 drawn as a majority-minority district.</p> <p>9 Do you know what a majority-minority</p> <p>10 district is?</p> <p>11 A. I do.</p> <p>12 Q. And what's your understanding of what a</p> <p>13 majority-minority district is?</p> <p>14 A. It's where there's enough minority</p> <p>15 voters in the district to ensure there's a very high</p> <p>16 likelihood that they can represent -- elect a</p> <p>17 representative of their choice.</p> <p>18 So in the simple version of it, it</p> <p>19 would literally be a majority-minority district, as</p> <p>20 your question implies, but I think in many versions</p> <p>21 of it, it might be slightly less than a</p> <p>22 majority/minority if we assume there's some</p> <p>23 cross-racial voting patterns.</p> <p>24 Q. And are you aware of whether in such</p> <p>25 districts you tend to see a much higher concentration</p>	1006	<p>1 incumbents versus the quality of the challengers in</p> <p>2 any district?</p> <p>3 A. No, I did not. I don't see the</p> <p>4 relevance of that for the calculation of the</p> <p>5 efficiency gap.</p> <p>6 Q. Well, part of the efficiency gap is --</p> <p>7 is based upon the vote totals that each party gets in</p> <p>8 a district, correct?</p> <p>9 A. It is.</p> <p>10 Q. And if one party doesn't put up a very</p> <p>11 good candidate, they're probably not going to get as</p> <p>12 many votes as the other party, correct?</p> <p>13 A. I think that's true -- certainly in,</p> <p>14 you know, particular election, that could be true,</p> <p>15 but there's no reason to think that over multiple</p> <p>16 elections that a certain party will persistently put</p> <p>17 up bad candidates.</p> <p>18 Q. But I guess to go back to your answer,</p> <p>19 then, you didn't think that a party putting up -- you</p> <p>20 know, not putting up a good challenger could have any</p> <p>21 impact.</p> <p>22 Do you still stand by that answer?</p> <p>23 A. I'm sorry. Can you repeat the</p> <p>24 question, sir?</p> <p>25 Q. Let me just rephrase the question kind</p>
1005	<p>1 of democratic voters in those districts?</p> <p>2 A. In general, yes, we do.</p> <p>3 Q. And that's not packing Democratic</p> <p>4 voters into those districts, is it?</p> <p>5 A. I think it would depend on what the</p> <p>6 intent was. If the intent of the districting plan</p> <p>7 was to enhance representation of minorities, that</p> <p>8 wouldn't -- that -- the intent there wouldn't be to</p> <p>9 pack Democrats, but I think in all cases, certainly,</p> <p>10 the effect of a -- of a large majority-minority</p> <p>11 district is, in general, it does pack Democrats. But</p> <p>12 it's hard to know what the legislature's intent was</p> <p>13 behind that. Certainly, that was beyond the scope of</p> <p>14 my report.</p> <p>15 Q. Let's just talk hypothetically.</p> <p>16 If the intent of any legislature, in</p> <p>17 any state, is to create a minority-majority district</p> <p>18 to comply with the Voting Rights Act and that, in</p> <p>19 turn, creates a district that has a high</p> <p>20 concentration of Democratic voters, that's going to</p> <p>21 have an impact on the efficiency gap, isn't it?</p> <p>22 A. Sure, and I acknowledge that in my</p> <p>23 report.</p> <p>24 Q. In your analysis on the efficiency gap,</p> <p>25 did you factor at all in the quality of the</p>	1007	<p>1 of after this discussion.</p> <p>2 Can the quality of a challenger that's</p> <p>3 put up in a Congressional district race -- can that</p> <p>4 impact the efficiency gap?</p> <p>5 A. Surely, it could in a particular</p> <p>6 district. And certainly, if one party persistently</p> <p>7 put up better candidates, that certainly could affect</p> <p>8 their vote totals in individual districts. But I</p> <p>9 think one thing I would emphasize is the efficiency</p> <p>10 gaps that I get using Congressional election results</p> <p>11 are extremely similar to the efficiency gaps I</p> <p>12 estimate using presidential election results, which,</p> <p>13 indeed, don't include -- don't, you know, are -- are</p> <p>14 totally abstract away from the Congressional</p> <p>15 elections and incumbencies that you're talking about.</p> <p>16 Moreover, in Professor Gimpel's report,</p> <p>17 he also finds a very large pro-Republican advantage</p> <p>18 in the efficiency gap, essentially regardless of the</p> <p>19 type of election you use in Pennsylvania. So across,</p> <p>20 I think, 17 of the 18 elections he looks at, there</p> <p>21 was a very large and substantial pro-Republican</p> <p>22 efficiency gap.</p> <p>23 So I think it's -- certainly, in the</p> <p>24 abstract, the candidates could, in particular</p> <p>25 circumstances, influence the efficiency gap; but I</p>

1008	<p>1 think there's no reason to think that's what's going</p> <p>2 on in Pennsylvania, given that you get essentially</p> <p>3 the same results using a wide variety of metrics of</p> <p>4 the efficiency gap: in my report, using presidential</p> <p>5 vote share, and in Professor Gimpel's report, using a</p> <p>6 wide variety of other statewide elections. All of</p> <p>7 them indicate a large pro-Republican efficiency gap.</p> <p>8 Q. You only looked at, though,</p> <p>9 Congressional races in Pennsylvania, correct?</p> <p>10 A. Yes, but I also calculated -- I</p> <p>11 discussed -- I think in a footnote and in my</p> <p>12 appendix, I discuss that I estimated the efficiency</p> <p>13 gap based on presidential election results as well</p> <p>14 and I found -- I found very similar efficiency gaps.</p> <p>15 So here, the candidates -- the</p> <p>16 incumbency doesn't matter, the candidate's identity</p> <p>17 doesn't matter, yet the efficiency gap was almost</p> <p>18 identical, is what I estimated using Congressional</p> <p>19 elections.</p> <p>20 Q. Did you factor in incumbency in your</p> <p>21 analysis?</p> <p>22 A. I didn't, because the goal of the</p> <p>23 efficiency gap is to measure the number of wasted</p> <p>24 votes for each party.</p> <p>25 Q. How do you know it doesn't matter if</p>	1010	<p>1 What I show in the footnote of my</p> <p>2 report -- sorry for misspeaking. What I show in the</p> <p>3 footnote of my report is that even using presidential</p> <p>4 vote share, Pennsylvania still has one of the largest</p> <p>5 pro-Republican efficiency gaps in the country, both</p> <p>6 in 2012 and in all of history.</p> <p>7 Q. Fair.</p> <p>8 I just -- just to be clear, make sure I</p> <p>9 didn't miss anything, so that analysis for the</p> <p>10 presidential election calculations is not in your</p> <p>11 report?</p> <p>12 A. Well, the summary of it is in the</p> <p>13 footnote.</p> <p>14 Q. But --</p> <p>15 A. So I didn't include the details, but</p> <p>16 the summary is in my report. The summary of my</p> <p>17 analysis is in the footnote.</p> <p>18 And, once again, I focused on</p> <p>19 Congressional elections, because I think the point of</p> <p>20 a gerrymander is to waste the other party's votes in</p> <p>21 Congressional elections. So I think, you know, while</p> <p>22 certainly we should look at lots of other metrics for</p> <p>23 the efficiency gap to make sure they cooperate with</p> <p>24 each other, ultimately, the goal of the gerrymander</p> <p>25 is to maximize your seats in the legislature relative</p>
1009	<p>1 you didn't factor it into your analysis?</p> <p>2 A. Because I know that when I estimate the</p> <p>3 efficiency gap using presidential vote, which is</p> <p>4 totally separate from Congressional incumbency, you</p> <p>5 get a very similar answer. And, once again,</p> <p>6 Professor Gimpel also gets very similar</p> <p>7 pro-Republican advantage in the efficiency gap using</p> <p>8 a wide variety of statewide elections.</p> <p>9 So it's not just that there's a</p> <p>10 pro-Republican efficiency gap in Pennsylvania in</p> <p>11 Congressional elections. No matter what election you</p> <p>12 use, you see a large pro-Republican efficiency gap.</p> <p>13 Q. And I did see the footnote that said</p> <p>14 you ran the numbers with presidential elections.</p> <p>15 But you didn't include any of that</p> <p>16 analysis in your report, did you?</p> <p>17 A. I did. In the Appendix, I show the</p> <p>18 relationship between -- we talked about it earlier</p> <p>19 in -- I include it in two places.</p> <p>20 So first of all, in the supplementary</p> <p>21 Appendix, in Figure A-1, I show that there's a .94</p> <p>22 correlation between my estimate of the efficiency gap</p> <p>23 based on -- I'm sorry -- sorry. I don't show that</p> <p>24 here. This is looking at different ways of measuring</p> <p>25 uncontested races.</p>	1011	<p>1 to the number of votes.</p> <p>2 Q. Are you aware of something in politics</p> <p>3 called the "partisan vote index"?</p> <p>4 A. I am, loosely speaking, yes. It's not</p> <p>5 something that political scientists typically use in</p> <p>6 our research, but I'm certainly colloquially aware of</p> <p>7 it in my following of elections.</p> <p>8 Q. Well, I'll dispute the -- that it's not</p> <p>9 something political scientists use in their research,</p> <p>10 but I guess you're saying you don't use it at all in</p> <p>11 your research?</p> <p>12 MS. MCKENZIE: Objection.</p> <p>13 THE COURT: Hold on a second.</p> <p>14 What's your objection?</p> <p>15 MS. MCKENZIE: Never mind. I</p> <p>16 withdraw.</p> <p>17 THE COURT: Okay. Thank you.</p> <p>18 THE WITNESS: Neither I nor the</p> <p>19 majority of scholars of Congressional</p> <p>20 elections use it in published studies.</p> <p>21 As an expert in elections, in</p> <p>22 Congressional elections, I'll stipulate to</p> <p>23 that.</p> <p>24 BY MR. TUCKER:</p> <p>25 Q. I think that's a pretty safe question.</p>

1012	<p>1 I'm assuming you didn't factor in the</p> <p>2 PVI, or the partisan vote index, at all into your</p> <p>3 analysis?</p> <p>4 A. I did not.</p> <p>5 I would say, though, if I was going to</p> <p>6 look at -- well, no. I didn't -- I didn't focus on</p> <p>7 PVI in my analysis.</p> <p>8 Q. I will now refer you to Petitioners'</p> <p>9 Exhibit 42.</p> <p>10 A. Sure.</p> <p>11 Q. As I understand it, this is a summary</p> <p>12 of the efficiency gaps across -- and I think you had</p> <p>13 said at one point, maybe during your testimony, all</p> <p>14 states, because as I understand it, it excludes any</p> <p>15 states that have six Congressional seats or less, or</p> <p>16 less than six Congressional seats?</p> <p>17 A. Exactly. And this is -- this is</p> <p>18 addresses exactly the issue --</p> <p>19 THE COURT: Which one is it, six or</p> <p>20 less, or less than six?</p> <p>21 THE WITNESS: I'm sorry. I focused</p> <p>22 on ones with more than six. So greater than</p> <p>23 six. So if there's six or less, they're</p> <p>24 excluded from my analysis.</p> <p>25 THE COURT: Okay.</p>	1014	<p>1 there as well, although I haven't studied that.</p> <p>2 But I'll note that the magnitude of the</p> <p>3 efficiency gap that we saw there -- so while, for one</p> <p>4 or two election cycles, it was among the largest in</p> <p>5 the country in 2002 and 2004, the magnitude of those</p> <p>6 efficiency gaps was nothing like we saw after the</p> <p>7 2011 Plan.</p> <p>8 So here, you can see that, sure, after</p> <p>9 the 2002 Plan -- 2001 Plan went into place, there was</p> <p>10 a pro-Republican efficiency gap of about</p> <p>11 10 percentage points. But that's, you know,</p> <p>12 dramatically smaller than the 24 percent, 15 percent</p> <p>13 and 19 percent pro-Republican efficiency gaps we've</p> <p>14 seen after the most recent plan went into place.</p> <p>15 Q. So I want to rewind way back to the</p> <p>16 beginning of your answer there, where you talked</p> <p>17 about in 2000, I think, or just after 2000, we see</p> <p>18 Pennsylvania having a very high efficiency gap</p> <p>19 compared to other states, correct?</p> <p>20 A. Yes, there was a one or two election</p> <p>21 period where it had a relatively high gap compared to</p> <p>22 other states --</p> <p>23 Q. And I think --</p> <p>24 A. -- absolutely.</p> <p>25 Q. -- I know you said you haven't studied</p>
1013	<p>1 THE WITNESS: And the reason for</p> <p>2 that is exactly what you showed in your</p> <p>3 stipulation. If you have a very small</p> <p>4 number of districts, then, certainly, a</p> <p>5 couple close election results, which we can</p> <p>6 view as something close -- something</p> <p>7 essentially random certainly could have a</p> <p>8 big effect on the efficiency gap.</p> <p>9 But this is much less likely in a</p> <p>10 state with more Congressional districts red.</p> <p>11 BY MR. TUCKER:</p> <p>12 Q. And your testimony earlier was critical</p> <p>13 of the 2011 Plan because the efficiency gaps since</p> <p>14 that plan was enacted have either been the highest or</p> <p>15 close to the highest of any state, correct?</p> <p>16 A. Yes.</p> <p>17 Q. But that's not the only time throughout</p> <p>18 history that Pennsylvania has had an efficiency gap</p> <p>19 that's been the highest or close to the highest of</p> <p>20 any state, correct?</p> <p>21 A. In the early 2000s, Pennsylvania also</p> <p>22 had a relatively large pro-Republican efficiency gap,</p> <p>23 which -- I haven't studied this plan exactly, but</p> <p>24 that was also after the 2001 Plan went into place.</p> <p>25 So there might have been intentional gerrymandering</p>	1015	<p>1 it, but you said that could have been because that</p> <p>2 plan was gerrymandered, correct?</p> <p>3 A. It's certainly possible. I haven't</p> <p>4 studied this explicitly, so I couldn't say for</p> <p>5 sure --</p> <p>6 Q. But we saw in the last decade --</p> <p>7 A. -- but I'll note here that unlike what</p> <p>8 we saw in the most recent plan, you didn't see, you</p> <p>9 know, a large jump in the efficiency gap in 2002</p> <p>10 compared to 2000.</p> <p>11 So I wouldn't want to speculate that it</p> <p>12 was -- you know, it's hard to say. The evidence</p> <p>13 there is much less clear cut than we've seen in the</p> <p>14 most recent plan, where there's much stronger</p> <p>15 evidence that the increase in the efficiency gap is</p> <p>16 both large relative to other states and large</p> <p>17 relative to historical efficiency gaps, but was</p> <p>18 almost certainly due to the plan coming into place.</p> <p>19 Q. But in the 2000s decade, despite the</p> <p>20 fact that it dropped after the 2000 Census, we</p> <p>21 actually see the efficiency gap rise to actually be</p> <p>22 pro-Democratic, don't we?</p> <p>23 A. Well, I would say the efficiency gap</p> <p>24 of -- I don't know -- 3 percent or something --</p> <p>25 THE COURT: Could you -- could</p>

CROSS-EXAMINATION - CHRISTOPHER WARSHAW, PH.D.

1016	<p>1 you -- could -- Professor, this could be</p> <p>2 really long. If -- I don't mean to cut you</p> <p>3 off, but please, give your answer to the</p> <p>4 question first, and then if you want to</p> <p>5 explain, you can explain.</p> <p>6 Okay?</p> <p>7 I think -- do you want restate the</p> <p>8 question?</p> <p>9 MR. TUCKER: Sure.</p> <p>10 THE COURT: Okay.</p> <p>11 BY MR. TUCKER:</p> <p>12 Q. In the 2000s decade, so after the 2001</p> <p>13 reapportionment where we saw, and you were referring</p> <p>14 to, a drop in the efficiency gap that led to</p> <p>15 Pennsylvania having one of the highest efficiency</p> <p>16 gaps in the country --</p> <p>17 That's what you said, correct?</p> <p>18 A. Yes.</p> <p>19 Q. -- we see, during that very same</p> <p>20 decade, that the efficiency gap changed to the point</p> <p>21 where it was actually in favor of the Democrats,</p> <p>22 didn't we?</p> <p>23 A. Yes.</p> <p>24 Q. Okay. Thank you.</p> <p>25 And going back to Petitioners' Exhibit</p>	1018	<p>1 correct?</p> <p>2 A. Sure. The consensus in the literature</p> <p>3 is that certainly, looking over the period of 1970 to</p> <p>4 2008 or 2010, that gerrymandering did not cause</p> <p>5 polarization. We don't have any evidence on the --</p> <p>6 whether the 2011 Plan contributed to polarization,</p> <p>7 and I don't have an opinion either way on the effect</p> <p>8 in recent Congresses.</p> <p>9 Q. You agree the Senate is polarized,</p> <p>10 correct?</p> <p>11 A. Yes.</p> <p>12 Q. And it's -- it can't be gerrymandered</p> <p>13 because its districts -- doesn't have districts?</p> <p>14 A. Correct.</p> <p>15 THE COURT: Counsel --</p> <p>16 Do you want to finish your answer?</p> <p>17 THE WITNESS: No, sir.</p> <p>18 THE COURT: Okay.</p> <p>19 Counsel, can we take a brief break?</p> <p>20 Are you at a point where you can break?</p> <p>21 MR. TUCKER: This would actually be</p> <p>22 a great point for a break.</p> <p>23 THE COURT: Great. We'll be in</p> <p>24 recess for 10 minutes.</p> <p>25 THE CLERK: The Court is now in</p>
1017	<p>1 42, there are other years, historically, where we've</p> <p>2 seen Pennsylvania on -- having one of the highest</p> <p>3 efficiency gaps, for example, 1990? It looks like</p> <p>4 it's the second highest?</p> <p>5 A. Yes. But, again, the absolute</p> <p>6 magnitude of the efficiency gap was much smaller than</p> <p>7 today, much smaller than the efficiency gap, really,</p> <p>8 of any of the efficiency gaps in Pennsylvania after</p> <p>9 the 2011 Plan went into place.</p> <p>10 I think that's demonstrated -- you</p> <p>11 know, the value of thinking about the magnitude, not</p> <p>12 just where it ranks relatively, is that, you know,</p> <p>13 clearly, as you're suggesting, the efficiency gaps</p> <p>14 vacillated a little bit during those decades, but</p> <p>15 that's because the magnitude of them was much</p> <p>16 smaller.</p> <p>17 Moreover, voters were much less sorted</p> <p>18 by party, so there was a lot less predictability in</p> <p>19 Congressional elections based on the partisanship and</p> <p>20 partisan allegiance of voters.</p> <p>21 Q. Let's -- let's switch gears off the</p> <p>22 efficiency gap a little bit and talk about</p> <p>23 polarization.</p> <p>24 I understand from your report you agree</p> <p>25 that gerrymandering doesn't cause polarization,</p>	1019	<p>1 recess.</p> <p>2 - - -</p> <p>3 (Whereupon, a recess was taken from</p> <p>4 3:58 p.m. to 4:10 p.m.)</p> <p>5 - - -</p> <p>6 THE CLERK: Ladies and gentlemen,</p> <p>7 Court is now in session.</p> <p>8 THE COURT: Please be seated,</p> <p>9 everyone.</p> <p>10 Let's continue with</p> <p>11 cross-examination.</p> <p>12 BY MR. TUCKER:</p> <p>13 Q. Dr. Warshaw, before we broke, we were</p> <p>14 going to begin talking a little bit about</p> <p>15 polarization.</p> <p>16 And I believe the last thing we</p> <p>17 discussed was that you agree that gerrymandering</p> <p>18 doesn't cause polarization, correct?</p> <p>19 A. That's correct. There's a clear</p> <p>20 consensus in the literature that certainly, prior to</p> <p>21 the 2010 cycle, redistricting didn't cause</p> <p>22 polarization. I don't think there's clear evidence</p> <p>23 since then, but I have no opinion either way.</p> <p>24 Q. Under the current plan, there are still</p> <p>25 five districts that are represented by someone from</p>

1020	<p>1 the Democratic party, correct?</p> <p>2 A. Yes, that's correct.</p> <p>3 Q. So I'm assuming your opinion is that</p> <p>4 those voters generally will have their interests</p> <p>5 represented in Congress?</p> <p>6 A. Those voters who elect Democrats will</p> <p>7 have a representative that represents them in</p> <p>8 Congress. The larger representational process, the</p> <p>9 average delegation for Pennsylvania, is still</p> <p>10 likely -- is less likely to represent them.</p> <p>11 But sure -- but absolutely, the</p> <p>12 individual representative that represents those</p> <p>13 Member of Congress will represent them pretty</p> <p>14 closely.</p> <p>15 Q. Will represent those Democrat voters --</p> <p>16 A. Those Democratic voters in those</p> <p>17 districts.</p> <p>18 But in my calculations, less than half</p> <p>19 of the Democrats in Pennsylvania lived in -- lived in</p> <p>20 districts that the Democrat actually won. So the</p> <p>21 majority of voters -- of Democratic voters in</p> <p>22 Pennsylvania lived in Republican-won districts, and</p> <p>23 80 percent of the wasted votes of the Democratic --</p> <p>24 Democrats' wasted votes in Pennsylvania were in</p> <p>25 districts that Democrats lost.</p>	1022	<p>1 A. Well, I think their ideological --</p> <p>2 THE COURT: Professor, please</p> <p>3 answer the question, and then you can</p> <p>4 explain.</p> <p>5 THE WITNESS: Yes, I agree that I</p> <p>6 think their representative will not</p> <p>7 represent their ideological preferences, but</p> <p>8 I think the overall Congressional delegation</p> <p>9 from Pennsylvania is still biased in their</p> <p>10 direction and will represent them.</p> <p>11 BY MR. TUCKER:</p> <p>12 Q. As we've already agreed, Pennsylvania</p> <p>13 has five representatives from the Democratic Party to</p> <p>14 U.S. Congress, correct?</p> <p>15 A. Yes, that's true.</p> <p>16 Q. Can't those five representatives still</p> <p>17 represent the interests that are similar to</p> <p>18 Democratic voters in other districts?</p> <p>19 A. Well, the way roll call votes are</p> <p>20 conducted in Congress is in order for a roll call</p> <p>21 vote to pass, you need a majority. So if Democrats</p> <p>22 are locked into being in the minority due to</p> <p>23 efficient -- due to a partisan bias in their</p> <p>24 Republican -- Republicans' advantage in states like</p> <p>25 Pennsylvania, then it's unlikely that the preferences</p>
1021	<p>1 Q. What about Republican voters in</p> <p>2 districts that have a Democratic representative in</p> <p>3 Congress? Are their interests represented in</p> <p>4 Congress?</p> <p>5 A. So for the relatively small number of</p> <p>6 Republican voters in those five districts, sure, just</p> <p>7 like -- I think my analysis is symmetric. If you're</p> <p>8 a Republican in those districts, the Democratic</p> <p>9 legislator in Washington is less likely to represent</p> <p>10 your views.</p> <p>11 Q. I think you indicated before the</p> <p>12 relatively small number of voters in those districts.</p> <p>13 Let's take a look at the Democratic vote share for</p> <p>14 the districts in -- I think this was 2012; is that</p> <p>15 correct?</p> <p>16 A. Yes.</p> <p>17 Q. And in District 17, it looks like</p> <p>18 there's close to 40 percent voters that voted for</p> <p>19 Republican in that district, correct?</p> <p>20 A. Um-hum.</p> <p>21 Q. And so is it your opinion that those</p> <p>22 votes -- those Republican votes are wasted, and those</p> <p>23 Republican voters will not have their interests</p> <p>24 represented in Congress because they -- the elected</p> <p>25 representative from that district was a Democrat?</p>	1023	<p>1 of Democrats are going to be translated into law or</p> <p>2 policy.</p> <p>3 Q. That's not just a Pennsylvania issue,</p> <p>4 though.</p> <p>5 You're talking about the full U.S.</p> <p>6 Congress, correct?</p> <p>7 A. Absolutely. But I think that in order</p> <p>8 to think -- in order to think beyond just the effect</p> <p>9 of the efficiency gap on the partisanship of</p> <p>10 individual elected officials and the ideological</p> <p>11 preferences of those individual elected officials, I</p> <p>12 think it's, you know, important and useful to connect</p> <p>13 the gerrymandering that we see nationwide on -- I</p> <p>14 think, you know, in both Democratic and Republican</p> <p>15 directions, although, surely, in recent years,</p> <p>16 there's been more Republican gerrymanders.</p> <p>17 But I think that that adversely harms</p> <p>18 the larger legislature, not just the individual</p> <p>19 seats.</p> <p>20 Q. But, certainly, the five democratic</p> <p>21 Members of Congress from Pennsylvania, they can</p> <p>22 represent those similar interests of Democratic</p> <p>23 voters throughout the State, even ones that don't</p> <p>24 reside in their district, can't they?</p> <p>25 A. No, I actually don't think they do. I</p>

1024	<p>1 think that representatives have no obligation to</p> <p>2 represent people outside their district. And, again,</p> <p>3 in the winner-take-all system in Congress, when</p> <p>4 Democrats -- there's only 13 -- there's only five out</p> <p>5 of 18 Democrats from Pennsylvania, it's hard to see</p> <p>6 how Democrats' preferences from Pennsylvania are</p> <p>7 going to be adequately represented in Congress.</p> <p>8 Q. Do you think that the interests of a</p> <p>9 Democrat in one district in Pennsylvania are</p> <p>10 staunchly different than the interests of a Democrat</p> <p>11 in another district in Pennsylvania?</p> <p>12 A. I couldn't say. I didn't evaluate that</p> <p>13 in my report.</p> <p>14 Q. Well, if they were similar, then -- if,</p> <p>15 for example, the interests and the issues that are</p> <p>16 important to a Democrat in, say, District 10, which</p> <p>17 is represented by a Republican, are similar to the</p> <p>18 interests of a Democratic voter in District 17 that</p> <p>19 is represented by a Democrat, those interests would</p> <p>20 still be represented in Congress, correct?</p> <p>21 A. Well, I want to understand the limits</p> <p>22 of your argument.</p> <p>23 So would they -- under your implied</p> <p>24 question, would they be adequately represented if</p> <p>25 there was only one Democrat in Congress from</p>	1026	<p>1 political science for that -- for that assertion. So</p> <p>2 I didn't analyze that specifically in -- in my</p> <p>3 report, because I didn't view that as being in</p> <p>4 dispute.</p> <p>5 And I think that is the consensus of</p> <p>6 political science scholars, as well as scholars in</p> <p>7 economics and political economy.</p> <p>8 I think any statement to the contrary</p> <p>9 is outside the norm -- outside the mainstream of</p> <p>10 political science research.</p> <p>11 Q. I want to show you Petitioners' Exhibit</p> <p>12 44.</p> <p>13 And you recall this exhibit?</p> <p>14 A. I do.</p> <p>15 Q. Can you just generally, again, explain</p> <p>16 what this is?</p> <p>17 A. So, graphically, it shows the increase</p> <p>18 in polarization in members of the U.S. House over the</p> <p>19 past 44 years. It shows the Republicans are getting</p> <p>20 more conservative, while Democrats are getting more</p> <p>21 liberal. And there's no overlap between the parties</p> <p>22 in the modern Congress.</p> <p>23 Q. And as I understand, you used the</p> <p>24 DW-NOMINATE scores to put together this graph?</p> <p>25 A. I did.</p>
1025	<p>1 Pennsylvania? Like, why stop at five?</p> <p>2 If it doesn't matter how many Democrats</p> <p>3 represent -- Democratic legislators are in Congress</p> <p>4 from Pennsylvania, then why not have only two</p> <p>5 representatives -- Democratic representatives?</p> <p>6 Under your theory, they would still</p> <p>7 adequately represent the Democratic voters. But I</p> <p>8 think that contradicts common-sense conceptions of</p> <p>9 how representation actually works.</p> <p>10 Q. I'm just trying to ask if there's still</p> <p>11 a voice to try to be heard in Congress on behalf of</p> <p>12 the Democrats from Pennsylvania.</p> <p>13 A. I think that -- sure.</p> <p>14 Q. You talked a lot in your earlier</p> <p>15 testimony about the fact that even in close races in</p> <p>16 Congressional districts, that no matter who wins, the</p> <p>17 winner tends to vote almost always for their party,</p> <p>18 correct?</p> <p>19 A. Yes.</p> <p>20 Q. They don't -- they don't come to the</p> <p>21 middle and vote more moderately?</p> <p>22 A. Correct.</p> <p>23 Q. Did you analyze at all the historical</p> <p>24 correlation of that conclusion?</p> <p>25 A. There's a wide body of evidence in</p>	1027	<p>1 Q. And do the DW-NOMINATE scores take into</p> <p>2 effect any particular issues?</p> <p>3 A. No. They're an average across all roll</p> <p>4 call votes.</p> <p>5 Q. So it doesn't necessarily analyze those</p> <p>6 particular issues that really divide, sometimes, the</p> <p>7 parties, things such as healthcare?</p> <p>8 A. No, my analysis does not, but other</p> <p>9 studies have looked at specific issues and found</p> <p>10 results that are identical to these.</p> <p>11 Q. Those aren't results that you cited in</p> <p>12 your report?</p> <p>13 A. No. But I think, theoretically, using</p> <p>14 all roll call votes makes a lot more sense than</p> <p>15 cherry-picking roll call votes that fit a particular</p> <p>16 theory and perspective.</p> <p>17 Q. And I want -- I hope I get this</p> <p>18 language right that you used before, but I believe</p> <p>19 you said that based upon this chart, since the</p> <p>20 2011 Plan was enacted, there's no Republican that's</p> <p>21 more liberal than any Democrat; is that correct?</p> <p>22 A. Yes, I think that's what I said.</p> <p>23 Q. But on the flip side, there's also</p> <p>24 no -- we don't see, since that time, any Democrat</p> <p>25 that's more conservative than any Republican, do we?</p>

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1 A. Absolutely. It's a symmetric
 2 argument -- or finding.
 3 **Q. And I think we talked about, just a**
 4 **few minutes ago, looking at these -- the dots, any of**
 5 **those dots that would reflect Republicans being**
 6 **represented by a Democrat, those Republicans'**
 7 **interests are -- are not going to be represented, is**
 8 **what you're saying, correct?**
 9 A. Correct. The Republicans would not --
 10 in a district that was represented by Democrats,
 11 would be unlikely to have their representative
 12 represent their -- their ideological preferences.
 13 **Q. Dr. Warsaw, you're not opining in this**
 14 **case that -- how any particular Petitioner in this**
 15 **case was impacted by the plan, are you?**
 16 A. No. I haven't studied those
 17 Petitioners specifically, but I can offer social
 18 science evidence on how Democrats whose votes are
 19 wasted would be represented and representation would
 20 be impacted.
 21 **Q. And I'm assuming you agree that voters**
 22 **don't have a right to elect a candidate of their**
 23 **choice, do they?**
 24 A. I think voters have a right that -- to
 25 not have the legislature design a redistricting plan

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1 that intentionally deprives them of the right to a
 2 representative of their choice.
 3 **Q. But they don't have a right to have**
 4 **their candidate actually win?**
 5 A. I think that's a legal question that I
 6 can't -- I don't want to speculate upon.
 7 **Q. Okay.**
 8 MR. TUCKER: Your Honor, can I have
 9 one minute to confer with counsel?
 10 THE COURT: Sure.
 11 (Counsel confer.)
 12 BY MR. TUCKER:
 13 **Q. Dr. Warsaw, do you have any analysis**
 14 **in your report that shows that there was a**
 15 **correlation between the efficiency gap and**
 16 **polarization?**
 17 **Actually, let me -- let me stop. That**
 18 **wasn't a very well-phrased question. Let me try it**
 19 **again.**
 20 **Do you have any analysis in your report**
 21 **that shows that the efficiency gap caused**
 22 **polarization?**
 23 A. No, I do not, nor am I asserting that.
 24 MR. TUCKER: I don't have any other
 25 questions. Thank you very much for your

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1 time, Dr. Warsaw.
 2 THE COURT: Thank you.
 3 Any other cross-examination?
 4 MR. LEVINE: No, Your Honor.
 5 MS. HANGLEY: No, Your Honor.
 6 THE COURT: Redirect.
 7 MS. MCKENZIE: Yes, Your Honor.
 8 - - -
 9 REDIRECT EXAMINATION
 10 - - -
 11 BY MS. MCKENZIE:
 12 **Q. Dr. Warsaw, so you were asked a couple**
 13 **of questions about the Voting Rights Act.**
 14 **Do you recall that?**
 15 A. Yes, I do.
 16 **Q. And, you know, just to be clear, I know**
 17 **you're not an expert, but is it your understanding**
 18 **that the Voting Rights Act applies just to**
 19 **Pennsylvania, or does it apply to the whole country?**
 20 A. My understanding is that the -- with
 21 the exception of the part of the Voting Rights Act
 22 that was recently struck down by the Supreme Court,
 23 that it applies to the whole country.
 24 MS. MCKENZIE: Can we pull up
 25 Petitioners' 42?

1031

1 BY MS. MCKENZIE:
 2 **Q. All right. So we just established the**
 3 **Voting Rights Act complied -- applies to the whole**
 4 **country, right?**
 5 A. Yes.
 6 **Q. All right. And based on this figure,**
 7 **how did Pennsylvania's efficiency gap compare to**
 8 **other states in the 2012, 2014 and 2016 elections?**
 9 A. In the 2012, 2014 and 2016 elections,
 10 Pennsylvania's efficiency gaps were extreme relative
 11 to other states, as well as due to its previous
 12 efficiency gaps.
 13 **Q. All right. You were also asked a**
 14 **question by the counsel for the**
 15 **Legislative Respondents about your calculations of**
 16 **the efficiency gap based on presidential elections?**
 17 A. Yes, I was.
 18 **Q. And you did that as a sort of backup or**
 19 **confirmation?**
 20 A. Exactly, I did it as a robustness check
 21 to make sure that my analysis wasn't sensitive to
 22 the -- the kind of assumptions that we were talking
 23 about.
 24 **Q. And did you turn over all the data --**
 25 **the backup data you used to make those calculations?**

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1 A. I did, of course.

2 **Q. Okay. All right.**

3 MS. MCKENZIE: All right. Can we

4 pull up Petitioners' Exhibit 40, please?

5 BY MS. MCKENZIE:

6 **Q. All right. Legislative Respondents'**

7 **counsel asked you some questions about fluctuations**

8 **in the efficiency gap over the past 45 years in**

9 **Pennsylvania?**

10 A. Yes.

11 **Q. All right. So tell me this: Between**

12 **1972 and the enactment of the 2011 Plan, how many**

13 **times had Pennsylvania had an efficiency gap greater**

14 **than 10 percent in either direction, Republican or**

15 **Democrat?**

16 A. Only once.

17 **Q. And how many Congressional elections**

18 **were there over that period? And feel free to**

19 **just -- just count between '72 and before the**

20 **2011 Plan.**

21 A. Something like 20.

22 **Q. All right. So one out of 20?**

23 A. Yes.

24 **Q. Since enactment of the 2011 Plan, how**

25 **many times has Pennsylvania had an efficiency gap**

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1 **that's greater than 10 percent?**

2 A. Every single time.

3 **Q. How many is that?**

4 A. Three.

5 **Q. Right.**

6 **Okay. And there were three elections**

7 **in that period?**

8 A. Yes.

9 **Q. Okay.**

10 **All right. So Legislative Respondents**

11 **also asked you a few questions about a -- a**

12 **demonstrative in which they calculated a hypothetical**

13 **efficiency gap.**

14 **Do you remember that?**

15 A. Yes, I do.

16 **Q. Okay. I want to just put that up for a**

17 **sec.**

18 MS. MCKENZIE: That's --

19 THE WITNESS: That's ours.

20 MS. MCKENZIE: -- the wrong one.

21 Oh, no. That's the right one.

22 ^[Pause.]

23 BY MS. MCKENZIE:

24 **Q. All right. So this is -- this is a**

25 **hypothetical in which there are five districts, and**

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1 **the Democrats win 51 to 49 in four of the districts,**

2 **right?**

3 A. Yes.

4 **Q. All right. So if -- if Democrat**

5 **mapmakers and the State wanted to gerrymander the**

6 **districting plan, what's the likelihood that they**

7 **would want to draw district boundaries in a way that**

8 **results in Democratic candidates winning four or five**

9 **elections by a margin of 51 to 49?**

10 A. Well, I think this would be a crazy way

11 to design a gerrymander because, clearly, these

12 elections, I think, as the other side pointed out,

13 are largely determined by chance in a 51-49 election.

14 So you would never design a districting plan if you

15 were trying to maximize your seat share to have a

16 series of 51-49 elections.

17 Instead, what you would do, as what

18 we've seen in Pennsylvania in 2012, you would have a

19 number of elections that you win by a 55-45 margin,

20 roughly, and the other side wins the districts they

21 win by a much larger margin of 70-30 or 80-20.

22 So this plan doesn't actually have the

23 kind of packing that we see in a real plan. Notice

24 there's no districts here -- even though this is

25 hypothetically a democratic gerrymander, there's no

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1 districts here that packs Republican voters into it.

2 Moreover, the cracked districts here

3 don't look anything like what we would see in a real

4 gerrymander.

5 **Q. Do you think this demonstrative is a**

6 **useful comparison -- or is a useful way to think**

7 **about the sort of validity of the efficiency gap as a**

8 **measure of partisan bias?**

9 A. I don't, because it doesn't

10 actually represent what we would see -- the kind of

11 districting plans we would see in the real world.

12 **Q. Okay.**

13 MS. MCKENZIE: All right. If we

14 could call up -- I think it's

15 Petitioners' 40.

16 Yes, please.

17 BY MS. MCKENZIE:

18 **Q. Okay. Now, I think you were asked a**

19 **couple of questions about Pennsylvania's efficiency**

20 **gap in 2014 --**

21 A. Um-hum.

22 **Q. -- and the questions were sort of aimed**

23 **at getting at the fact that the efficiency gap became**

24 **a little bit less pro-Republican; is that right?**

25 A. Yes.

REDIRECT EXAMINATION - CHRISTOPHER WARSHAW, PH.D.

<p style="text-align: right;">1036</p> <p>1 Q. All right. And what was the efficiency 2 gap in Pennsylvania in 2014? 3 A. Fifteen percent -- it was a negative 4 15 percent Republican advantage. 5 Q. Okay. And how does that -- how does 6 that efficiency gap compare to the efficiency gaps in 7 every single prior Pennsylvania Congressional 8 election that you calculated? 9 A. That's larger than we've ever seen -- 10 according to my calculations, that we've ever seen 11 before in Pennsylvania. 12 So the smallest pro-Republican 13 efficiency gap that postdated the 2011 Plan going 14 into place was still more pro-Republican than 15 Pennsylvania had ever seen before. 16 MS. MCKENZIE: Your Honor, can I 17 just confer with my colleagues for a moment? 18 THE COURT: Sure. 19 (Counsel confer.) 20 MS. MCKENZIE: Nothing further. 21 THE COURT: Thank you, Dr. Warsaw, 22 for your testimony. You may step down. 23 THE WITNESS: Thank you. 24 (The witness was excused.) 25</p>	<p style="text-align: right;">1038</p> <p>1 THE COURT: Are they all the same 2 nature or -- 3 MR. JONES: No; they're different 4 natures. That's actually -- 5 THE COURT: Is this the only Agre 6 exhibit you're going to talk about? 7 MR. JONES: It is. The only related 8 point that I would add is we just wanted to 9 make a very clear record that we -- and I 10 understand it will be denied -- that we are 11 moving the admission of additional materials 12 that Speaker Turzai produced in the Agre 13 litigation that were not -- that were not 14 introduced into evidence there and do not 15 appear on the public docket. 16 So I understand from Your Honor's 17 earlier ruling -- 18 THE COURT: So you're going to make 19 me -- you're going to make me rule on that 20 again? 21 MR. JONES: I just want to call out 22 the exact exhibit numbers so we'll have a 23 clear record of which ones we wanted in -- 24 THE COURT: I understand what you 25 want to do. So let's talk about 140.</p>
<p style="text-align: right;">1037</p> <p>1 THE COURT: Petitioners call their 2 next witness, please. 3 MR. JONES: Your Honor, Petitioners 4 don't have any more live witnesses that 5 we're planning to call during trial, so 6 we're prepared shortly to close our case. 7 There are a few, sort of, 8 housekeeping matters that we'd like to take 9 care of. 10 THE COURT: Why don't you approach 11 the podium up here? And we can talk about 12 this. 13 MR. JONES: Sure. 14 Thank you, Your Honor. 15 So I have four items, the first is 16 that there are a handful of exhibits that 17 we'd like to admit. One is the -- one of 18 the Turzai materials that was produced in 19 discovery in the Agre case and that was 20 admitted as an admitted trial exhibit during 21 the Agre trial. Its Petitioners' 22 Exhibit 140. 23 Would you like me to go through all 24 of them first, or do you want to do them one 25 at the time?</p>	<p style="text-align: right;">1039</p> <p>1 What's your motion on 140? 2 MR. JONES: We would move to admit 3 140 into evidence. 4 THE COURT: Any objection? 5 MR. TUCKER: Yes, Your Honor. This 6 exhibit hasn't been used with any witness. 7 It hasn't been authenticated. No foundation 8 has been laid for it. 9 I don't know how or why they're 10 moving an exhibit into evidence that has not 11 been used in their case thus far. 12 THE COURT: Your response to that? 13 MR. JONES: I don't believe there -- 14 there could be a legitimate foundation -- 15 I'm sorry -- authenticity objection. It is 16 a document that was produced by Speaker 17 Turzai's counsel under cover of an e-mail 18 that we showed earlier identifying this 19 document as one of the items that was part 20 of the facts and data considered in the 21 creation of the 2011 Plan. 22 We got it from them -- 23 THE COURT: Well, no. Hold on for 24 a second. You didn't get it from them. You 25 got it from the counsel that was</p>

1040	<p>1 representing the Petitioners. 2 You weren't counsel for -- the 3 parties here are not the same parties in the 4 Agre case? 5 MR. JONES: Correct. 6 THE COURT: You didn't really get 7 it from them? 8 MR. JONES: Correct. 9 THE COURT: Where did you get it 10 from? 11 MR. JONES: We got it from the 12 plaintiffs in the Agre case. 13 THE COURT: When you say -- so I'm 14 relying on a document that was given to you 15 from the plaintiffs in the Agre case that 16 they say they got from Speaker Turzai's 17 counsel? 18 MR. JONES: Yes. 19 THE COURT: On that basis, you want 20 me to admit the exhibit? 21 MR. JONES: Yes. And if there is 22 any question about the authenticity of it, I 23 suppose we would -- we could try to call the 24 lawyer who received the e-mail from 25 Speaker Turzai's counsel. We had hoped that</p>	1042	<p>1 by which it came through the Federal case. 2 You keep standing up, Counsel. I'm 3 not sure -- would you like to confer? 4 MS. MCKENZIE: I would, if possible. 5 THE COURT: Okay. 6 (Counsel confer.) 7 MR. JONES: Okay. So in 8 Legislative Respondents' motion to exclude 9 the testimony of our expert, Dr. Chen, 10 Legislative Respondents stated to this Court 11 that this specific document was one that 12 they produced as part of the production in 13 the Agre case. 14 THE COURT: Did Dr. Chen testify 15 about this document? 16 MR. JONES: No, he did not. 17 THE COURT: Do you have any 18 testimony about this document as to what it 19 is, what its relevancy is to the case, 20 anything liking that? 21 MR. JONES: No, we don't have any 22 live testimony. The -- the only thing we 23 have -- 24 THE COURT: So my question is going 25 to be -- let's say I put it in.</p>
1041	<p>1 that wouldn't be necessary. 2 MR. TUCKER: Your Honor, if I may, 3 it's not just an authenticity issue; it's a 4 relevance issue as well. This document 5 hasn't been used once in their 6 case-in-chief, so I don't know or understand 7 why we're even seeking to admit documents 8 that have no part of this case thus far. 9 MR. JONES: I'm sorry. One 10 additional point, Your Honor. 11 I'm told that -- that Petitioners' 12 Exhibit 140 was actually -- it was admitted 13 as a trial exhibit in the Agre case. So it 14 is an exhibit there. 15 THE COURT: That doesn't seem to be 16 the objection. The objection seems to be 17 you haven't used it here. You've not had 18 any testimony on it. You've not used it in 19 your presentation. 20 So I -- I don't know that you have 21 anybody to testify as to what it is and what 22 it purports to be. I just -- I don't have 23 any -- in other words, I don't have the 24 discovery that -- I don't have the actual 25 discovery document certified by the lawyer</p>	1043	<p>1 How are you going to use it in your 2 posttrial brief? How are you going to use 3 it if there's no testimony in this record to 4 indicate what it is? 5 MR. JONES: So we could -- we could 6 connect it to the statement in their brief 7 where they told this Court that it was a 8 document that Speaker Turzai had produced in 9 response to an order of the Federal Court to 10 produce the material -- the facts and data 11 that were considered in crafting the 12 2011 Plan. 13 THE COURT: So you're going to use 14 a motion to exclude against them to seek 15 admission? That's creative. 16 MR. JONES: Yes -- yes, Your Honor. 17 It's not that creative. There's case law -- 18 I don't have the citations on my fingertips, 19 but I could get them -- that there is 20 authentication, essentially, by -- by a 21 party stating in its own pleadings that the 22 document -- 23 THE COURT: That's not a pleading; 24 that was a motion. Pleadings are different. 25 Pleadings are a petition, an answer,</p>

1044	<p>1 preliminary objections. A motion is 2 different than a pleading. 3 Do you have -- do you have a case 4 that says that a representation in a 5 document seeking to exclude an exhibit can 6 be then used as a basis to seek admission of 7 the exhibit? 8 MR. JONES: The cases referred -- 9 refer to pleadings -- 10 THE COURT: Do you want to confer 11 with counsel again? 12 MR. JONES: No. I don't have a case 13 to that effect. 14 THE COURT: Do you want to confer 15 again? 16 You understand my problem here is 17 you're asking me to -- I think what my 18 ruling was earlier is that you certainly can 19 use exhibits at trial that were used at the 20 trial of the Agre case. That doesn't mean 21 that just because they were used at the Agre 22 case, you can just move their admission 23 without any -- without using them. 24 You can do that if there's a 25 stipulation. We have a lot of stipulated</p>	1046	<p>1 and State Court as -- as a -- as a -- one -- 2 THE COURT: How was it used in the 3 Agre case? Did they just offer it up to the 4 Federal Judges, and they accepted it? 5 I want to hear from somebody who 6 knows about this exhibit. So with all due 7 respect to this counsel, if someone -- I see 8 a lot of head shaking and standing up. 9 So . . . 10 MS. MCKENZIE: Absolutely, 11 Your Honor. So my -- my understanding is 12 that this -- so the exhibit we're talking 13 about is an exhibit entitled CD18 14 Maximized -- 15 THE COURT: I don't want to know 16 what the exhibit is. 17 My specific question was, Did the 18 plaintiffs offer this document to the 19 Federal Judges in the Agre case and just 20 say, We move its admission? 21 MS. MCKENZIE: They had an expert 22 discussing it. 23 THE COURT: Okay. But you don't 24 have any witnesses in here that are going to 25 use this exhibit?</p>
1045	<p>1 exhibits that are coming into the record 2 without any testimony whatsoever. But here, 3 you're asking for the admission of an 4 exhibit without any testimony. 5 My ruling allows to you use the 6 exhibit at trial, but you haven't used it. 7 Do you understand the distinction 8 I'm drawing? 9 MR. JONES: I do. I understand the 10 distinction. 11 THE COURT: Okay. 12 MR. JONES: Part of the problem, of 13 course, is that we don't know the identity 14 of the people who actually drew the maps, 15 because that information has not been 16 provided to us. So we wouldn't -- 17 THE COURT: Because you're in 18 State Court -- 19 MR. JONES: Right. 20 THE COURT: -- and I'm subject to 21 the Pennsylvania Constitution. 22 MR. JONES: Certainly, certainly. 23 I'm just pointing out the dilemma 24 that -- and I have a document that's been 25 represented in court filings in both Federal</p>	1047	<p>1 MS. MCKENZIE: I think we may try to 2 use it on cross, Your Honor. That may 3 be -- that may be different than what you're 4 asking. 5 But I would just say that, frankly, 6 the document speaks for itself, and we 7 would -- we think that given the absence of 8 an authenticity objection and in light of 9 your prior ruling relating to getting 10 documents in that were admitted as exhibits 11 in the Agre case, we think that you or the 12 Supreme Court could look at this document, 13 which is, again, of undisputed authenticity, 14 and draw some conclusions just based on 15 looking at it. 16 MR. TUCKER: We completely disagree, 17 Your Honor. And I don't -- I want to be 18 careful to not to get into all the substance 19 of the document for a lot of the reasons 20 we've discussed in this trial, but what 21 they're trying to do with this document is 22 use it to show intent. But they have no 23 witnesses who are going to testify that, 24 one, this document was used by anybody in 25 the Legislature in drafting the plan or how</p>

1048	<p>1 it was used.</p> <p>2 So the purpose -- the admitted</p> <p>3 purpose that counsel had indicated they want</p> <p>4 to use this for to show some legislative</p> <p>5 intent, they have no way to connect that</p> <p>6 because there's no testimony on the</p> <p>7 document.</p> <p>8 THE COURT: I understand that, but</p> <p>9 is that something you can argue to the</p> <p>10 Supreme Court if I allow it in?</p> <p>11 MR. TUCKER: But if you allow it in,</p> <p>12 you're allowing in evidence that's going to</p> <p>13 have no context. And then they're just</p> <p>14 going to try to argue and make assumptions</p> <p>15 on that context, and we don't think that's</p> <p>16 appropriate. That's not appropriate</p> <p>17 evidence to be admitting in this case when</p> <p>18 there's no foundation laid for it; there's</p> <p>19 no witnesses talked about it. It's pure</p> <p>20 speculation at that point.</p> <p>21 So, essentially, we'd be submitting</p> <p>22 evidence to the Pennsylvania Supreme Court</p> <p>23 with zero context to what this document is,</p> <p>24 who created it, how they used it, when,</p> <p>25 anything that you would normally get out of</p>	1050	<p>1 the testimony she gave on it.</p> <p>2 THE COURT: Right.</p> <p>3 But you're -- I'm sorry. Go ahead.</p> <p>4 Proceed.</p> <p>5 MS. HANGLEY: I'm sorry, Your Honor.</p> <p>6 If there's a question about</p> <p>7 authenticity, I believe the question is</p> <p>8 answered in the Agre proceeding.</p> <p>9 THE COURT: I'm not sure that --</p> <p>10 I'm not sure there's an objection to</p> <p>11 authenticity here. I think there's an</p> <p>12 objection to just allowing a document in in</p> <p>13 the abstract.</p> <p>14 As I understand the objection, they</p> <p>15 want to put this in just because it exists</p> <p>16 in the Agre docket, but it's on the Agre</p> <p>17 docket because there was context. There was</p> <p>18 a witness that testified about it, and it</p> <p>19 came through in her testimony.</p> <p>20 Isn't that correct?</p> <p>21 MS. HANGLEY: That's correct.</p> <p>22 THE COURT: Okay. There's no</p> <p>23 testimony here about that document. I think</p> <p>24 that's their -- I think that's their</p> <p>25 objection.</p>
1049	<p>1 testimony when you're using a document.</p> <p>2 So if the Pennsylvania Supreme Court</p> <p>3 would then rely upon it, we think that would</p> <p>4 be entirely inappropriate. So for that</p> <p>5 reason, there's absolutely no reason that it</p> <p>6 should be in the record of the Pennsylvania</p> <p>7 Supreme Court --</p> <p>8 MS. HANGLEY: Your Honor --</p> <p>9 MR. TUCKER: -- and it would also,</p> <p>10 Your Honor, violate -- I understand</p> <p>11 Your Honor's desire to draw this distinction</p> <p>12 on the privilege issue between Federal and</p> <p>13 State Court, but Your Honor's order was</p> <p>14 pretty clear that they -- like you said,</p> <p>15 they could use documents in this case that</p> <p>16 were admitted in there -- in the case in</p> <p>17 Agre, but they haven't used it here.</p> <p>18 MS. HANGLEY: Your Honor, if I can</p> <p>19 just add -- shed a little bit of light on</p> <p>20 this, we were parties in the Agre case; we</p> <p>21 were there. The document was used in the</p> <p>22 case. It was testified to by an expert</p> <p>23 Anne Hanna. It was admitted into evidence.</p> <p>24 We have the transcript here, if you'd like</p> <p>25 to see the description of the exhibit and</p>	1051	<p>1 And I'm not sure who you're trying</p> <p>2 to help, since you're sitting on the</p> <p>3 Respondents' side.</p> <p>4 MS. HANGLEY: I'm trying to tell</p> <p>5 everyone what happened since there was some</p> <p>6 talk about -- that no one here was there --</p> <p>7 THE COURT: Look --</p> <p>8 MS. HANGLEY: -- I was there.</p> <p>9 THE COURT: -- I understand that,</p> <p>10 and I understand that what happened in the</p> <p>11 Agre case is public, and I get -- I get the</p> <p>12 idea that there are probably people that</p> <p>13 think that, you know, you should just let it</p> <p>14 in because it's out there and it was in the</p> <p>15 Agre case. And that's a very -- it's a very</p> <p>16 facially appealing position.</p> <p>17 But that was a different proceeding</p> <p>18 under a different set of laws without the</p> <p>19 Constitution. And I'm pretty sure --</p> <p>20 although I can't speak for the Federal</p> <p>21 Judges -- that they wouldn't have just</p> <p>22 allowed a document to be handed up and let</p> <p>23 it go in without testimony.</p> <p>24 MS. HANGLEY: And that's not what</p> <p>25 happened in that case.</p>

1052	<p>1 THE COURT: Exactly. But you would</p> <p>2 agree with me -- was there any situation in</p> <p>3 the Agre litigation where a party just</p> <p>4 handed up a document and said, Well, they're</p> <p>5 not challenging authenticity, so you should</p> <p>6 admit it?</p> <p>7 MS. HANGLEY: I don't recall that</p> <p>8 happening in the Agre case --</p> <p>9 THE COURT: Okay.</p> <p>10 MS. HANGLEY: -- or in other trials</p> <p>11 that I've been in.</p> <p>12 THE COURT: In other trials you've</p> <p>13 been in either.</p> <p>14 That's the problem we're having.</p> <p>15 I'm also understanding the fact that</p> <p>16 I'm trying to create as complete of a record</p> <p>17 as possible for the Supreme Court so the</p> <p>18 Supreme Court can decide things.</p> <p>19 I would like -- is there any</p> <p>20 other -- I'd like to think about this a</p> <p>21 little bit, not a long time, but a little</p> <p>22 bit.</p> <p>23 Do we want -- are the other ones</p> <p>24 going to be easier, or are they going to be</p> <p>25 similar in kind?</p>	1054	<p>1 I mean, there's a lot of different REDMAP</p> <p>2 documents we're talking about here.</p> <p>3 And, again, these are documents that</p> <p>4 have had no part of their case thus far,</p> <p>5 zero. We haven't heard the word "REDMAP"</p> <p>6 mentioned once in their case. Now they just</p> <p>7 want to go ahead and admit them with no</p> <p>8 testimony, no context, nothing.</p> <p>9 THE COURT: Okay. I'm going to</p> <p>10 take a recess, and I'm going to consider the</p> <p>11 circumstances that we're in.</p> <p>12 And I'll be back when I have an</p> <p>13 answer.</p> <p>14 MS. MCKENZIE: Thank you.</p> <p>15 THE CLERK: The Commonwealth Court</p> <p>16 is now adjourned -- in recess. I apologize.</p> <p>17 - - -</p> <p>18 (Whereupon, a recess was taken from</p> <p>19 4:47 p.m. to 5:55 p.m.)</p> <p>20 - - -</p> <p>21 THE CLERK: The Commonwealth Court</p> <p>22 is back in session.</p> <p>23 THE COURT: Please be seated,</p> <p>24 everyone.</p> <p>25 We're going to take this one at a</p>
1053	<p>1 MS. MCKENZIE: I think they're going</p> <p>2 to be easier.</p> <p>3 THE COURT: Okay.</p> <p>4 MS. MCKENZIE: So the other</p> <p>5 documents that we wanted to move the</p> <p>6 admission of, first, they're the REDMAP</p> <p>7 documents. And we've got -- you know, I</p> <p>8 think you already ruled on those, but I'm</p> <p>9 not sure they've been sort of formally</p> <p>10 admitted.</p> <p>11 And we have affidavits from the</p> <p>12 SGLF --</p> <p>13 THE COURT: The REDMAP documents are</p> <p>14 different because I understand you're moving</p> <p>15 them under 901 or -2, or whatever. They're</p> <p>16 self-authenticating business records.</p> <p>17 MS. MCKENZIE: So I just wanted to</p> <p>18 formally move their admission because I</p> <p>19 didn't think -- I wasn't sure that we had</p> <p>20 done that yet.</p> <p>21 MR. TUCKER: Your Honor, I think</p> <p>22 we'd like an opportunity to object to that.</p> <p>23 I don't agree that they're</p> <p>24 self-authenticating business records. I</p> <p>25 mean, some of them are Internet articles --</p>	1055	<p>1 time.</p> <p>2 So Petitioners' Exhibit 140 --</p> <p>3 Counsel -- Petitioners' Counsel approach.</p> <p>4 So you are moving your Exhibit 140?</p> <p>5 MS. MCKENZIE: Yes, Your Honor.</p> <p>6 THE COURT: Please put on the</p> <p>7 record the basis for your proffer.</p> <p>8 MS. MCKENZIE: Our -- the basis for</p> <p>9 the proffer is that this was a document</p> <p>10 produced by Speaker Turzai in the Federal</p> <p>11 litigation. I think its authenticity is</p> <p>12 undisputed.</p> <p>13 And do you want me to talk about the</p> <p>14 contents, Your Honor, or --</p> <p>15 THE COURT: I want to know -- okay.</p> <p>16 So you're offering this as a</p> <p>17 document that was produced by Speaker Turzai</p> <p>18 in other litigation, correct?</p> <p>19 MS. MCKENZIE: In other litigation,</p> <p>20 yes -- yes.</p> <p>21 THE COURT: Do you have a witness</p> <p>22 to testify to that fact?</p> <p>23 MS. MCKENZIE: We do not, I suppose,</p> <p>24 have a witness. We could call one of their</p> <p>25 attorneys.</p>

1056	<p>1 THE COURT: Is that attorney on 2 your witness list? 3 MS. MCKENZIE: No, Your Honor. 4 THE COURT: Do you have an exhibit 5 that proves what you're saying? 6 THE WITNESS: For this particular 7 document, no, Your Honor. 8 THE COURT: Okay. Do you have any 9 other evidence in your pretrial memorandum 10 or that you're able to offer here today to 11 support the foundation you're laying for 12 this document? 13 MS. MCKENZIE: The evidence that we 14 have is the representation -- in this case, 15 the evidence that we have is the 16 representation from counsel in the motion 17 that we were talking about before the break, 18 representing that this was a document from 19 Speaker Turzai in relation to the 2011 Plan. 20 THE COURT: And what was that 21 representation? What representation did 22 they -- are you relying on? What was the 23 contents of the representation? 24 MS. MCKENZIE: You know, I don't 25 have the document in front of me, but I</p>	1058	<p>1 MR. TUCKER: Your Honor, we have 2 several objections to the admission of this 3 document. The first is authenticity. There 4 still are the Rules of Evidence, and there 5 has to be authenticity proven by the 6 Petitioners in this case; and they haven't 7 had any witness, nor have they disclosed any 8 witness, that can authenticate this document 9 is what they purport it to be. 10 They also have no witness to lay the 11 foundation for this document. And because 12 of that, allowing it into the record would 13 be putting it into the record without any 14 context: without any context of what it is; 15 who prepared it; how it was created; what it 16 was used for; or anything like that. And so 17 we believe that allowing it into the record 18 and then having the Supreme Court being able 19 to review it would only be allowing them to 20 review it purely on speculation grounds, and 21 we don't believe that would be appropriate. 22 And, lastly, we object on the 23 legislative privilege grounds, that allowing 24 this document into the record would force 25 Legislative Respondents into a reverse</p>
1057	<p>1 think it's a footnote that -- that 2 represents that this document, along with 3 every other relevant, related document on 4 our exhibit list, was produced by 5 Speaker Turzai in the Federal litigation. 6 THE COURT: Does it represent what 7 it is, other than the fact that it was 8 produced? 9 MS. MCKENZIE: I don't believe so. 10 THE COURT: Okay. 11 Counsel for Legislative Respondents, 12 please put all of your objections on the 13 record. 14 MR. TUCKER: Would you like me to 15 come up to the podium, Your Honor? 16 THE COURT: Yes, please. 17 Counsel, you can -- 18 MS. MCKENZIE: I'm sorry. 19 THE COURT: Do you have any other 20 proffers you'd like to make in support of 21 admission? 22 MS. MCKENZIE: With this particular 23 document, no, Your Honor. 24 THE COURT: Okay. Please return to 25 counsel table.</p>	1059	<p>1 sword-and-shield argument, where if they're 2 allowing it in and they're going to, then, 3 be able to use it for purposes of what they 4 said they are going to use it for, trying to 5 demonstrate some type of legislative intent 6 out of the document, that forces our 7 clients, who have asserted the privilege in 8 this case, now to have to make a very 9 difficult decision as to whether or not they 10 then need to respond to those assertions. 11 And without having an admissible 12 document that they, through the Rules of 13 Evidence, are able to get into evidence in 14 trial, we should not -- our client should 15 not be forced into that very, very, very 16 difficult position. 17 So I believe those are all our -- 18 one second, Your Honor. 19 And just to clarify -- I think this 20 was part of my other argument -- but, you 21 know, we argue the relevance of this 22 document. It has not been referenced at all 23 in their case. There's been no testimony 24 about this document. It's never come up in 25 their case-in-chief. And so we don't</p>

1060	<p>1 believe it should be in the record for that 2 reason as well.</p> <p>3 THE COURT: The reason why I'm 4 going through this exercise, counsel, is 5 because we are -- this Court is not truly 6 operating as a trial court. Generally 7 speaking, usually when an appellate court 8 reviews what a trial court rules on 9 evidentiary matters, the standard of review 10 is what's called an "abuse of discretion." 11 So because this Court is really sort 12 of sitting in a hearing capacity for the 13 Supreme Court, I'm not exactly sure what 14 level of deference the Supreme Court 15 Justices are going to give to my evidentiary 16 rules. So it's important, I think, for me 17 to allow you both to include everything on 18 the record that you want to include, because 19 I'm pretty sure they're not going to let you 20 have oral argument on evidentiary issues. 21 So that's why I'm asking 22 Petitioners' counsel to put all of your 23 proffers on the record and Respondents' 24 counsel to put all your objections on the 25 record, because I would imagine, if you try</p>	1062	<p>1 Is my ruling understood on 2 Exhibit 140?</p> <p>3 MR. TUCKER: Yes, Your Honor. 4 MS. MCKENZIE: Yes, Your Honor. 5 Can I ask one question? 6 THE COURT: Sure. 7 MS. MCKENZIE: We may try to use 8 this exhibit on cross-examination in this 9 case. 10 THE COURT: Okay. Well, we'll deal 11 with that when we get to it. 12 Thank you. 13 Now I need Duck Tape wrapped around 14 my head. 15 So we are admitting it for the 16 limited purposes that I stated on the 17 record. 18 - - - 19 (Whereupon, Petitioners' Exhibit Number 20 140 was admitted into evidence.) 21 - - - 22 THE COURT: What's your next 23 exhibit? 24 MS. MCKENZIE: Your Honor, so I can 25 do these one by one, or not, but the</p>
1061	<p>1 to assert an objection you didn't assert 2 here or make a proffer that you didn't make 3 here, that the Supreme Court, if I can 4 predict anything, would hopefully or likely 5 say you can't do it anew later. 6 So with the proffer and with the 7 objections that have been made, I am going 8 to sustain the objections; however, I am 9 going to admit the document for the sole 10 purpose of -- of allowing the Supreme Court 11 to revisit my evidentiary ruling if it so 12 chooses. 13 This particular document will be 14 kept separately from all the trial exhibits 15 and will be sealed. That way, the 16 Supreme Court will only look at it if they 17 feel that I've made a mistake in this 18 evidentiary ruling. It will also not be 19 cited by any parties in their post-trial 20 briefs submitted to me. I will not consider 21 it. But it is admitted solely for the 22 purpose of allowing you to preserve your 23 objection and for Petitioners to challenge 24 my evidentiary ruling with the 25 Supreme Court.</p>	1063	<p>1 Exhibits 124 through 134, and I believe the 2 first two, so 124 and 125, are the 3 declarations from -- a custodian from the 4 RSLC and the SGLF, and then the documents 5 after that through 134 are -- are documents 6 that were produced by them and authenticated 7 as business records, and -- 8 THE COURT: Wait a minute. 9 So 124 is what you claim to be the 10 authenticating affidavit? 11 MS. MCKENZIE: Yes, Your Honor. 12 THE COURT: What is 125, because 13 that looks like an affidavit as well? 14 MS. MCKENZIE: Yes. So it's -- 15 there are two affidavits. One is on -- 16 they're on behalf of different 17 organizations. 18 THE COURT: But they're 19 authenticating the same group of documents? 20 MS. MCKENZIE: Different -- 21 different documents, but related together. 22 So the first is authenticating documents 23 produced by the RSLC in response to our 24 subpoena. 25 THE COURT: Which ones are those?</p>

1064	<p>1 So 125 relates to what other</p> <p>2 exhibits -- or 124 relates to which</p> <p>3 exhibits?</p> <p>4 MS. MCKENZIE: 124 relates to 126,</p> <p>5 127, 128, 129 -- let me skip over -- 131,</p> <p>6 132, 133 and 134.</p> <p>7 THE COURT: I'm assuming the</p> <p>8 Bates Numbers that are referenced in the</p> <p>9 subpoena correspond with the exhibit numbers</p> <p>10 that you've provided?</p> <p>11 MS. MCKENZIE: The Bates Numbers</p> <p>12 referenced in the subpoena correspond not</p> <p>13 with the exhibit numbers.</p> <p>14 THE COURT: Well, I'm -- I mean</p> <p>15 that the exhibits 126, 127, 128, 129, 131,</p> <p>16 132, 133, 134 have the same -- are Bates</p> <p>17 Numbered to correspond to the affidavit?</p> <p>18 MS. MCKENZIE: Yes, yes.</p> <p>19 THE COURT: That was my -- that was</p> <p>20 my -- that was my question.</p> <p>21 MS. MCKENZIE: Yes.</p> <p>22 THE COURT: Okay. And what's your</p> <p>23 proffer with regard to Affidavit 124,</p> <p>24 Exhibit -- Petitioners' Exhibit 124 and</p> <p>25 Exhibits 126 through 129 and 131 through</p>	1066	<p>1 MS. MCKENZIE: Thank you.</p> <p>2 (Counsel confer.)</p> <p>3 MS. MCKENZIE: All right. Sorry</p> <p>4 about that, Your Honor.</p> <p>5 So 125, which is the second</p> <p>6 affidavit, we are -- we are withdrawing.</p> <p>7 THE COURT: Okay. So -- well, you</p> <p>8 haven't moved it yet, so I'm not sure how</p> <p>9 you're withdrawing it.</p> <p>10 MS. MCKENZIE: Okay. Then I won't</p> <p>11 move it.</p> <p>12 So --</p> <p>13 THE COURT: The only ones that I'm</p> <p>14 looking at are 124, which is the -- which is</p> <p>15 purportedly an affidavit of a records</p> <p>16 custodian.</p> <p>17 MS. MCKENZIE: Okay. Yes.</p> <p>18 THE COURT: Is that correct?</p> <p>19 MS. MCKENZIE: That's correct.</p> <p>20 THE COURT: And as far as the</p> <p>21 affidavit of that records custodian, his</p> <p>22 affidavit, or her affidavit, is addressed to</p> <p>23 126, 127, 128, 129, 131, 132, 133 and 134,</p> <p>24 correct?</p> <p>25 MS. MCKENZIE: That's correct.</p>
1065	<p>1 134?</p> <p>2 What's your proffer?</p> <p>3 MS. MCKENZIE: So, Your Honor, our</p> <p>4 proffer is that the contents of these</p> <p>5 exhibits are covered by your prior ruling</p> <p>6 that they would be admissible and --</p> <p>7 THE COURT: No, I didn't rule that</p> <p>8 they would be admissible; I ruled that you</p> <p>9 could use them.</p> <p>10 MS. MCKENZIE: Okay.</p> <p>11 So our -- our proffer as to their</p> <p>12 admissibility is that Pennsylvania</p> <p>13 Rule 803(6) says that you don't need a live</p> <p>14 witness if you have the kind of</p> <p>15 certification that we're talking about.</p> <p>16 THE COURT: 803 what?</p> <p>17 MS. MCKENZIE: It's 803(6)(d), I</p> <p>18 believe.</p> <p>19 THE COURT: Do you have any other</p> <p>20 argument in favor of admission of these</p> <p>21 exhibits?</p> <p>22 MS. MCKENZIE: Your Honor, may I</p> <p>23 confer with my colleagues about -- about one</p> <p>24 of these for a moment?</p> <p>25 THE COURT: Sure.</p>	1067	<p>1 THE COURT: Okay. So any other</p> <p>2 arguments with regard to why the Court</p> <p>3 should admit those documents into the</p> <p>4 record?</p> <p>5 MS. MCKENZIE: Just two quickly,</p> <p>6 Your Honor.</p> <p>7 The first is that these -- these</p> <p>8 declarations were offered in response to our</p> <p>9 subpoena authorized by this Court in</p> <p>10 exchange for, you know, as a response to the</p> <p>11 subpoena; and the second is that we believe</p> <p>12 these documents are probative of intent and</p> <p>13 for -- for the reasons that my colleague,</p> <p>14 Mr. Robinson, explained on Monday morning.</p> <p>15 THE COURT: Anything else?</p> <p>16 MS. MCKENZIE: No, Your Honor.</p> <p>17 THE COURT:</p> <p>18 Legislative Respondents, any objections?</p> <p>19 MR. TUCKER: Yes, Your Honor.</p> <p>20 The first objection is, we have a</p> <p>21 double hearsay problem here. While the</p> <p>22 affidavits may fix the hearsay problem by</p> <p>23 authenticating the attached documents as</p> <p>24 business records, the affidavits themselves</p> <p>25 are hearsay. They are out-of-court</p>

1068	<p>1 statements that go to prove the truth of the</p> <p>2 matter asserted, so they're admissible under</p> <p>3 the hearsay rule.</p> <p>4 So the affidavits.</p> <p>5 THE COURT: How do you respond to</p> <p>6 803(6)?</p> <p>7 MR. TUCKER: Well, I think that's</p> <p>8 the double hearsay problem, 803(6) is -- is</p> <p>9 the -- the purpose of the affidavits is to</p> <p>10 authenticate the attached documents as</p> <p>11 business records. But that doesn't change</p> <p>12 the fact that the affidavits themselves are</p> <p>13 hearsay. They're out-of-court statements</p> <p>14 that are being offered for the truth of the</p> <p>15 matter asserted. It's a double hearsay</p> <p>16 problem.</p> <p>17 THE COURT: But the declaration</p> <p>18 itself -- the rule specifically entitles</p> <p>19 you, instead of having to submit a live</p> <p>20 witness, to authenticate a document through</p> <p>21 a declaration.</p> <p>22 So the declaration can't be a</p> <p>23 vehicle to authenticate a document and</p> <p>24 hearsay at the same time. So I'm going to</p> <p>25 overrule that objection.</p>	1070	<p>1 no testimony linking these documents to any</p> <p>2 intent of the General Assembly.</p> <p>3 This was the argument we made in our</p> <p>4 motion in limine, and I believe Your Honor</p> <p>5 denied that motion in limine to allow them</p> <p>6 an opportunity to use these documents in</p> <p>7 this case. And they didn't use them. And</p> <p>8 so for the same reasons we've been arguing,</p> <p>9 that there's no context to these documents,</p> <p>10 and there's no reason they should be</p> <p>11 admitted into the record in this case,</p> <p>12 unless and until there was some testimony</p> <p>13 linking these documents to some involvement</p> <p>14 in the 2011 Plan. And there's been none of</p> <p>15 that.</p> <p>16 THE COURT: Anything else you'd like</p> <p>17 to put on the record?</p> <p>18 MR. TUCKER: No, thank you, Your</p> <p>19 Honor.</p> <p>20 THE COURT: Okay. With respect to</p> <p>21 the motion to admit Petitioners' Exhibit</p> <p>22 124, 126, 127, 128, 129, 131, 132, 133 and</p> <p>23 134 --</p> <p>24 MS. MCKENZIE: Yes.</p> <p>25 THE COURT: -- I am going to</p>
1069	<p>1 MR. TUCKER: Then our second</p> <p>2 objection, Your Honor, is that -- it is the</p> <p>3 same objection I articulated earlier, which</p> <p>4 is there's been absolutely no reference or</p> <p>5 mention of these documents at any point in</p> <p>6 the Plaintiffs' case-in-chief.</p> <p>7 The word "REDMAP" hasn't been</p> <p>8 mentioned once. The RSLC hasn't been</p> <p>9 mentioned once. And because of that,</p> <p>10 there's no testimony about these documents,</p> <p>11 about what they are, what -- how they were</p> <p>12 created. I mean, there's -- there's</p> <p>13 nothing -- there's no context to these</p> <p>14 documents.</p> <p>15 Basically, we have authenticated --</p> <p>16 some of these are basically just news</p> <p>17 articles, Internet news articles, and</p> <p>18 there's absolutely no context that's been</p> <p>19 provided of how they're relevant to the</p> <p>20 case.</p> <p>21 Counsel indicated that they want to</p> <p>22 use it to show intent, but there's</p> <p>23 absolutely nothing in these documents that</p> <p>24 says anything about the intent of the</p> <p>25 General Assembly, nothing. And there's been</p>	1071	<p>1 sustain the objections. Subject to my same</p> <p>2 ruling, I'm, nonetheless, going to put them</p> <p>3 in the record the way I put the other ones</p> <p>4 in the record. I'm not going to repeat all</p> <p>5 the things that I said previously. But the</p> <p>6 same rules apply.</p> <p>7 What's next?</p> <p>8 And by the way, if there's anybody</p> <p>9 else on this side that has an objection -- I</p> <p>10 say "this side" -- Respondents' side that</p> <p>11 has an objection, I'm not trying to exclude</p> <p>12 you; I'm just assuming you're innocent</p> <p>13 bystanders.</p> <p>14 MS. HANGLEY: No objection,</p> <p>15 Your Honor.</p> <p>16 THE COURT: Okay. Speak up. If</p> <p>17 you have an objection, speak up.</p> <p>18 MS. HANGLEY: No objection to the</p> <p>19 assumption or the exhibit.</p> <p>20 THE COURT: Okay.</p> <p>21 MS. MCKENZIE: Yes, Your Honor.</p> <p>22 So Petitioners now move the</p> <p>23 admission of Petitioners 27, 28, 29, 30, 31</p> <p>24 and 33.</p> <p>25 THE COURT: Okay. What's your</p>

1072	<p>1 proffer?</p> <p>2 MS. MCKENZIE: Your Honor, our</p> <p>3 proffer is that Exhibit 33, which is an</p> <p>4 e-mail from Speaker Turzai's counsel,</p> <p>5 authenticates and also lays the foundation</p> <p>6 for these documents as documents that were</p> <p>7 the facts and data considered in creating</p> <p>8 the 2011 Plan, and it's not hearsay. It's</p> <p>9 admission of a party opponent through --</p> <p>10 through their -- through their counsel.</p> <p>11 And I'll add that --</p> <p>12 THE COURT: Is 33 related to the</p> <p>13 other ones?</p> <p>14 MS. MCKENZIE: It is, Your Honor.</p> <p>15 So the -- in that e-mail, you'll</p> <p>16 see -- you'll see a link, and documents 27</p> <p>17 through 31 are files -- well, documents 27</p> <p>18 through 30 are files that were downloaded</p> <p>19 from this link.</p> <p>20 THE COURT: Files that were</p> <p>21 downloaded by whom?</p> <p>22 MS. MCKENZIE: By Petitioners'</p> <p>23 counsel and provided to our expert,</p> <p>24 Jowei Chen.</p> <p>25 THE COURT: So by your -- you --</p>	1074	<p>1 THE COURT: Do you have any</p> <p>2 evidence you're planning to offer today in</p> <p>3 support of the admission of these exhibits?</p> <p>4 MS. MCKENZIE: Well, we offered</p> <p>5 evidence through Dr. Chen about -- about</p> <p>6 these exhibits.</p> <p>7 THE COURT: So he testified about</p> <p>8 these exhibits?</p> <p>9 MS. MCKENZIE: That's correct.</p> <p>10 THE COURT: Okay. Were these</p> <p>11 exhibits entered in the record of the Agre</p> <p>12 case?</p> <p>13 MS. MCKENZIE: They were not.</p> <p>14 THE COURT: They were not.</p> <p>15 MS. MCKENZIE: Yes.</p> <p>16 THE COURT: So according to my</p> <p>17 prior order, you are not allowed to use them</p> <p>18 in this case, correct?</p> <p>19 MS. MCKENZIE: I think your prior</p> <p>20 order -- yes, that we were not allowed to</p> <p>21 admit these documents.</p> <p>22 I'm just offering them for the</p> <p>23 record. I understand that your prior order</p> <p>24 precludes the admission of these documents</p> <p>25 but did not prohibit the testimony of</p>
1073	<p>1 you were -- counsel for the Petitioners in</p> <p>2 this case downloaded it?</p> <p>3 MS. MCKENZIE: That's correct.</p> <p>4 THE COURT: And how did you get</p> <p>5 this link?</p> <p>6 MS. MCKENZIE: We were forwarded a</p> <p>7 copy of this e-mail.</p> <p>8 THE COURT: From whom?</p> <p>9 MS. MCKENZIE: From Plaintiffs'</p> <p>10 counsel in Agre.</p> <p>11 THE COURT: So Exhibits 27, 28, 29,</p> <p>12 30 and 31 are the files that you downloaded</p> <p>13 from this link?</p> <p>14 MS. MCKENZIE: Yes, with one proviso</p> <p>15 on 31, which is that 31 is the only printed</p> <p>16 one in this binder. The others we submitted</p> <p>17 on CD, because they're very large Excel</p> <p>18 files.</p> <p>19 So 30 is just a summary exhibit</p> <p>20 of -- of 10 relevant portions of that</p> <p>21 document, 10 columns from that document, the</p> <p>22 10 that Professor Chen talked about that we</p> <p>23 created just so that we could have a printed</p> <p>24 copy without having to print, you know,</p> <p>25 9,000 pages.</p>	1075	<p>1 Dr. Chen.</p> <p>2 THE COURT: Correct.</p> <p>3 MS. MCKENZIE: So I understand that,</p> <p>4 Your Honor. I'm just offering them for the</p> <p>5 record, and I understand that under your</p> <p>6 prior order, you are very likely to deny</p> <p>7 their admission.</p> <p>8 THE COURT: I actually think 33 was</p> <p>9 already objected to; you already offered 33,</p> <p>10 and I sustained the objection on that</p> <p>11 exhibit. So I'm not going to rule on that</p> <p>12 one again.</p> <p>13 MS. MCKENZIE: Okay. Thank you.</p> <p>14 THE COURT: Do you have anything</p> <p>15 else you want to put on the record with</p> <p>16 regard to these exhibits?</p> <p>17 MS. MCKENZIE: The only other thing</p> <p>18 I would put on the record is that we</p> <p>19 produced all these documents back to the</p> <p>20 Legislative Respondents, and I -- I don't</p> <p>21 think there is any genuine dispute that</p> <p>22 these documents are the authentic versions</p> <p>23 of the documents that were provided at that</p> <p>24 link -- in Exhibit 33.</p> <p>25 THE COURT: Okay. Anything else?</p>

1076	<p>1 MS. MCKENZIE: That's it, 2 Your Honor. 3 THE COURT: Okay. Thank you. 4 Please step back. 5 Legislative Respondents, please put 6 your objections on the record. 7 MR. TUCKER: Your Honor, I'll be 8 very brief because I think you've already 9 ruled on both of these issues. 10 We will rely on the same arguments 11 we had the last time on Exhibit 33. We 12 don't agree to the authenticity of the 13 document. We also believe that it's 14 hearsay. And Your Honor has already ruled 15 that it's not admissible, and we'll -- we 16 agree with that ruling, obviously. 17 And then as far as the other 18 documents, Your Honor also already ruled on 19 this, which was, Dr. Chen was allowed to 20 talk at length about what he saw in the 21 data, but Your Honor ruled that the data 22 itself is not admissible because it is 23 protected by the legislative privilege and 24 it is not admitted in the trial in Agre. 25 And just reasserting that for the record</p>	1078	<p>1 ruling. 2 So I guess my -- what's the best way 3 to do that? Should we proffer them, or is 4 the Court going to forward them 5 notwithstanding that they were admitted, 6 or . . . 7 THE COURT: Well, I feel -- I feel 8 pretty -- I'm on pretty good ground on that 9 one, primarily because I said on the record 10 I'm acting fairly consistently with what the 11 Federal -- actually, I think I am acting 12 consistently with what the Federal Judges in 13 the Agre case had observed and held at the 14 conclusion of the trial in that case and 15 before closing arguments. 16 I am certain, though -- so I am not 17 going to admit them at all here, and I'm not 18 going to necessarily tell you how to 19 practice law in front of the Pennsylvania 20 Supreme Court. I would suspect, though, 21 that if you filed an application in there 22 and -- and asked the Supreme Court if they 23 would allow you to submit them to that 24 Court, then they may be willing to do that. 25 Your arguments are on the record</p>
1077	<p>1 here. 2 Thank you. 3 Wait, one more second, Your Honor. 4 (Pause.) 5 MR. TUCKER: Your Honor, and, also, 6 the Petitioners -- because Exhibit 33 is not 7 admissible -- they can't rely on an 8 inadmissible document to authenticate the 9 other documents that they were trying to -- 10 or seeking to admit. 11 Okay. Thank you. 12 THE COURT: Thank you. 13 Exhibits 27, 28, 29, 30 and 31. As 14 the Court has already ruled on the 15 admissibility of 33, I'm sustaining the 16 objections, and Exhibits 27, 28, 29, 30, 30 17 and 31 will not be admitted into the record. 18 MS. MCKENZIE: May I approach on the 19 remaining exhibits, Your Honor? 20 THE COURT: Sure. 21 MS. MCKENZIE: Thanks. 22 And just on -- on the exhibits that 23 you just ruled on and also on 33, you know, 24 we'd like to make them available to the 25 Supreme Court so that they could revisit the</p>	1079	<p>1 here, and the Supreme Court can consider 2 those arguments. But I feel pretty -- you 3 know, I don't like to weigh these things. 4 I'm not much of a gambler. But I feel 5 pretty good on that one. 6 MS. MCKENZIE: Thank you, 7 Your Honor. 8 So I think the remaining documents 9 are going to be pretty easy. So just for 10 the record, Petitioners move the admission 11 of 135, 136, 137, 138, 139 and 141 through 12 161. 13 THE COURT: That's a lot of 14 exhibits. 15 MS. MCKENZIE: Yes, Your Honor. 16 THE COURT: What's -- what's the 17 commonality such that you offered them all 18 at the same time? 19 MS. MCKENZIE: These were -- these 20 were all exhibits that were produced -- 21 they're maps and PowerPoint presentations 22 that were produced -- relating to the 2011 23 redistricting, the kinds of maps that we 24 talked about earlier that have partisan 25 scoring in various districts, PowerPoint</p>

1080	<p>1 presentations.</p> <p>2 THE COURT: What is your</p> <p>3 evidentiary basis for their admission? What</p> <p>4 witnesses? For what -- what's your proffer</p> <p>5 for admitting them?</p> <p>6 MS. MCKENZIE: It's -- it's a</p> <p>7 similar proffer to what we had for -- for</p> <p>8 140, which is that we don't believe there's</p> <p>9 any genuine dispute as to authenticity,</p> <p>10 especially in light of the -- or in light of</p> <p>11 the Legislative Respondents' admission in</p> <p>12 the filing with this Court that these all --</p> <p>13 all of these documents were produced by</p> <p>14 them; we believe they're relevant, for</p> <p>15 reasons that I think are already on the</p> <p>16 record; and we don't believe there's a -- a</p> <p>17 rule that requires a live -- a live witness</p> <p>18 because the documents speak for themselves.</p> <p>19 So I think under your prior ruling,</p> <p>20 these are not admissible, but we're going to</p> <p>21 proffer them.</p> <p>22 THE COURT: Which category -- I'm</p> <p>23 going to make an assumption here just to</p> <p>24 move this along.</p> <p>25 Are these a category of documents</p>	1082	<p>1 able to proffer them to the Supreme Court,</p> <p>2 and we'll do it in the way that you</p> <p>3 suggested.</p> <p>4 THE COURT: Fine.</p> <p>5 You can do it in the way I don't</p> <p>6 suggest, too. I mean, it's -- it's -- it's</p> <p>7 up to you.</p> <p>8 MS. MCKENZIE: Thank you.</p> <p>9 THE COURT: Let me let</p> <p>10 Legislative Respondents put their objections</p> <p>11 on the record.</p> <p>12 MR. TUCKER: Yes, Your Honor.</p> <p>13 We object on authenticity grounds,</p> <p>14 that there's a lack of foundation for these</p> <p>15 documents, that they are privileged under</p> <p>16 Your Honor's orders in this case and that</p> <p>17 there's been zero testimony or reference to</p> <p>18 these documents -- the documents in this</p> <p>19 case.</p> <p>20 THE COURT: Any other objections?</p> <p>21 MR. TUCKER: That's it. Thank you.</p> <p>22 THE COURT: Okay. Based on the</p> <p>23 Court's prior ruling, then, dealing with the</p> <p>24 Agre documents, as well as the other</p> <p>25 objections that have been lodged by</p>
1081	<p>1 that were produced out of the public through</p> <p>2 discovery in the Agre case that you have</p> <p>3 just by virtue of the fact that Plaintiffs</p> <p>4 in the Agre case shared them with you but</p> <p>5 that otherwise are not public in the sense</p> <p>6 that they were filed of record in the docket</p> <p>7 or used at trial?</p> <p>8 MS. MCKENZIE: Correct, some of them</p> <p>9 were discussed at trial, but they were not</p> <p>10 admitted as exhibits or filed on the record.</p> <p>11 THE COURT: On the record.</p> <p>12 MS. MCKENZIE: Yeah.</p> <p>13 THE COURT: So they would fall</p> <p>14 under my first -- my ruling on the Agre</p> <p>15 case?</p> <p>16 MS. MCKENZIE: That's right.</p> <p>17 THE COURT: Anything else you'd</p> <p>18 like to put on the record with regard to</p> <p>19 your argument?</p> <p>20 MS. MCKENZIE: No. No, other than</p> <p>21 that if Your Honor sustains the objection</p> <p>22 that I anticipate will -- will occur -- and</p> <p>23 I anticipate that you're going to sustain</p> <p>24 it -- that I'd just like to make the same</p> <p>25 point that we would, you know, like to be</p>	1083	<p>1 Legislative Respondents, the Court will be</p> <p>2 sustaining the objections and will not admit</p> <p>3 Exhibits 135, 136, 137, 138, 139 and 141</p> <p>4 through 161.</p> <p>5 Did I get those numbers correctly?</p> <p>6 MS. MCKENZIE: Yes.</p> <p>7 THE COURT: Anything else before</p> <p>8 you rest your case, Petitioners?</p> <p>9 MS. MCKENZIE: Yes, Your Honor.</p> <p>10 The only -- the only other matter,</p> <p>11 or two matters, is that there's some</p> <p>12 witnesses, fact witnesses, that we intend to</p> <p>13 submit through deposition designations via</p> <p>14 agreement with the other parties.</p> <p>15 Those are the remaining Petitioners</p> <p>16 who didn't testify live and also deposition</p> <p>17 designations from some state legislators.</p> <p>18 And my understanding is that we will intend</p> <p>19 to PACFile those designations on Friday.</p> <p>20 THE COURT: PACFile the</p> <p>21 designations along with the excerpts?</p> <p>22 MS. MCKENZIE: Yes, Your Honor.</p> <p>23 THE COURT: Okay. Any objection</p> <p>24 from Respondents?</p> <p>25 MR. TUCKER: No, Your Honor.</p>

1084	<p>1 THE COURT: Any Respondents?</p> <p>2 MR. LEVINE: No, Your Honor.</p> <p>3 MS. WARREN: No, Your Honor.</p> <p>4 MS. HANGLEY: No, Your Honor.</p> <p>5 THE COURT: Okay. So what's --</p> <p>6 what's your second thing? Or is that your</p> <p>7 last thing?</p> <p>8 MS. MCKENZIE: That was my last</p> <p>9 thing.</p> <p>10 THE COURT: Okay. So for purposes</p> <p>11 of your case presentation, we're leaving the</p> <p>12 record open until Friday for you to PACFile</p> <p>13 the deposition designations but for that</p> <p>14 purposes only?</p> <p>15 MS. MCKENZIE: Yes, Your Honor.</p> <p>16 THE COURT: Otherwise, you rest?</p> <p>17 MS. MCKENZIE: Otherwise, we rest.</p> <p>18 THE COURT: Thank you very much.</p> <p>19 MR. TUCKER: Your Honor, can we just</p> <p>20 be clear for the record?</p> <p>21 Is their case being left open just</p> <p>22 for the designations?</p> <p>23 THE COURT: I just said that.</p> <p>24 MR. TUCKER: I'm just making sure it</p> <p>25 was just for the designations, that's all.</p>	1086	<p>1 needed to know.</p> <p>2 MR. TUCKER: Your Honor, one thing</p> <p>3 to clear for the record on the designations.</p> <p>4 There are objections to the designations</p> <p>5 each side has asserted, but there's a</p> <p>6 meet-and-confer effort going on that we're</p> <p>7 hoping to resolve any of those objections</p> <p>8 without needing the Court's involvement</p> <p>9 before they need to be filed on Friday.</p> <p>10 THE COURT: Okay. I'm not sure</p> <p>11 what else to say.</p> <p>12 Okay. Anything else?</p> <p>13 MS. MCKENZIE: No, Your Honor.</p> <p>14 THE COURT: So do you rest your</p> <p>15 case?</p> <p>16 MS. MCKENZIE: Yes.</p> <p>17 THE COURT: Okay. Just give me a</p> <p>18 second.</p> <p>19 Why don't we take a -- I assume you</p> <p>20 have a motion to make?</p> <p>21 MR. TUCKER: If we can have a brief</p> <p>22 recess to confer, I'd appreciate that.</p> <p>23 THE COURT: That's what I was going</p> <p>24 to do.</p> <p>25 We'll take a 10-minute recess.</p>
1085	<p>1 THE COURT: That's all you're</p> <p>2 asking for, right?</p> <p>3 Except for the filing of your</p> <p>4 designations on Friday that you've agreed to</p> <p>5 with opposing counsel, which I'm expecting,</p> <p>6 you have all talked together, and there will</p> <p>7 be no objections that are going to be filed,</p> <p>8 that it's just going to be done on Friday.</p> <p>9 You're otherwise resting your case?</p> <p>10 MS. MCKENZIE: We reserve our right</p> <p>11 to, you know, offer rebuttal, but other than</p> <p>12 that --</p> <p>13 THE COURT: You're resting your</p> <p>14 case-in-chief?</p> <p>15 MS. MCKENZIE: Yeah.</p> <p>16 THE COURT: See, what's going to</p> <p>17 happen is he's going to make a motion, so</p> <p>18 that's why he wants to know if you're</p> <p>19 resting your case. He's going to make a</p> <p>20 motion. I don't know if anybody else is</p> <p>21 planning to make a motion, but I need to</p> <p>22 know that you've rested your case.</p> <p>23 MS. MCKENZIE: Subject to the</p> <p>24 deposition exception, we do, Your Honor.</p> <p>25 THE COURT: Okay. That's what I</p>	1087	<p>1 THE CLERK: The Court is now in</p> <p>2 recess.</p> <p>3 - - -</p> <p>4 (Whereupon, a recess was taken from</p> <p>5 6:27 p.m. to 6:41 p.m.)</p> <p>6 - - -</p> <p>7 THE CLERK: All rise.</p> <p>8 Commonwealth Court is back in</p> <p>9 session.</p> <p>10 THE COURT: Please be seated,</p> <p>11 everyone.</p> <p>12 Subject to the designation of</p> <p>13 deposition testimony in lieu -- deposition</p> <p>14 testimony in lieu of live testimony, which</p> <p>15 will be filed on Friday, and the parties'</p> <p>16 working out any objections that they have,</p> <p>17 which I know they will attempt to do</p> <p>18 earnestly, Petitioners have rested their</p> <p>19 case.</p> <p>20 Are there any motions for the Court</p> <p>21 to consider at this point in time?</p> <p>22 MR. TUCKER: Yes, Your Honor.</p> <p>23 May I approach the podium?</p> <p>24 THE COURT: Please.</p> <p>25 MR. TUCKER: Your Honor, under</p>

1088	<p>1 Pennsylvania Rule of Civil Procedure 230.1, 2 Legislative Respondents file -- or make an 3 oral motion for nonsuit that the Plaintiffs 4 have not sustained the elements of their -- 5 or submitted evidence to sustain the 6 elements of their claims in this case. 7 First of all, we believe that 8 partisan gerrymandering claims to be 9 nonjudicial under current U.S. 10 Supreme Court precedent that we believe the 11 Pennsylvania Supreme Court will follow, as 12 it has in the past. 13 Secondly, assuming -- 14 THE COURT: What case are you 15 relying on from the Supreme Court that says 16 that gerrymandering cases are nonjudicial? 17 MR. TUCKER: We are relying upon the 18 plurality opinion from the -- the Vieth 19 case, Your Honor. 20 THE COURT: Okay. You realize that 21 Bandemer is still good law, at least for 22 purposes of the Supreme Court's majority 23 position that gerrymandering is judicial? 24 MR. TUCKER: Actually, the 25 Supreme Court never reached a majority</p>	1090	<p>1 test that the Supreme Court of Pennsylvania 2 had adopted, and that's either the intent 3 prong or the effects prong. 4 First of all, we don't believe that 5 they have submitted sufficient evidence to 6 demonstrate that the 2011 Plan intentionally 7 discriminated against a political group. We 8 don't believe there has been demonstrated 9 that the districts were drawn to advantage 10 the Republicans over the Democratic Party or 11 any other political group. 12 But even if this Court were to find 13 that the Plaintiffs -- or, I'm sorry -- the 14 Petitioners, in this case, have demonstrated 15 such evidence to -- to allow this case to 16 continue forward, they have not submitted 17 sufficient evidence of the second prong, 18 which is the effects test. 19 And there are two parts to the 20 effects test. The first is that they must 21 have put forth some evidence that an 22 identifiable group has -- has been or is 23 projected to be disadvantaged at the polls, 24 and this can be accomplished through either 25 election results or projected outcomes. And</p>
1089	<p>1 position in Bandemer on that -- on the test 2 that should apply. 3 THE COURT: No, that's not what I 4 said. Let's be careful. 5 I think -- I think the Bandemer 6 majority said that gerrymandering claims are 7 judicial. It's true that they didn't 8 reach a majority position with regard to 9 what the test should be. But you would 10 agree with me that Bandemer stands for the 11 proposition, at least from the United States 12 Supreme Court, that they're judicial. 13 MR. TUCKER: I agree with that, but 14 I believe the -- under the Vieth case, that 15 Bandemer decision is now no longer the 16 correct law in the U.S. Supreme Court. And 17 the Pennsylvania Supreme Court has not had 18 the opportunity yet to address the current 19 state of civil law under the Vieth decision 20 since Erfer. 21 But if the Pennsylvania 22 Supreme Court were to apply Erfer, we don't 23 believe that the Plaintiffs, in their 24 case-in-chief, have demonstrated the 25 elements to meet either prong of the Erfer</p>	1091	<p>1 we don't believe that there's been 2 sufficient evidence submitted here to 3 demonstrate that the Petitioners have 4 actually been disadvantaged at the polls in 5 Pennsylvania Congressional elections. 6 The second part of the test is that 7 by being disadvantaged, the identifiable 8 group will lack political power and be 9 denied a fair representation. And we 10 haven't seen any evidence from the 11 Petitioners that they've actually been shut 12 out of the process, which is essentially 13 what that second part of the effects test 14 requires them to show, that they were shut 15 out of this political process. 16 To the contrary, we've seen evidence 17 that the Democratic Party still has had five 18 seats in Congress in each of the last three 19 Congressional cycles. And, actually, the 20 Pope v. Blue case from the Western District 21 of North Carolina (1992) found that when 22 there is still representation in Congress, 23 that that political party has not been shut 24 out of the political process. 25 And merely having diminishing</p>

1092	<p>1 chances of winning elections is not enough 2 under the second prong of the effects test. 3 Again, they have to show that they've been 4 shut out of the process. 5 So evidence that they've submitted 6 in this case that may even show -- and we 7 dispute that it doesn't -- may show that 8 maybe winning elections is more difficult, 9 that isn't sufficient to meet the very heavy 10 burden under the Supreme Court's test in 11 Erfer. 12 They must show that individuals or 13 groups of individuals who vote for losing 14 candidates -- sorry -- individuals or groups 15 of individuals who vote for losing 16 candidates usually are deemed adequately to 17 represent -- be represented by the winning 18 candidates. And, again, that's testimony 19 we've also seen in this case, is that 20 there's -- there's nothing that shows that 21 they're -- the Democratic Party is not able 22 to be represented by the current members of 23 the Pennsylvania Congressional Delegation. 24 And so for those reasons, 25 Your Honor, we submit under Rule 230.1 for a</p>	1094	<p>1 speech claim would render unlawful all 2 consideration of political affiliation in 3 districting, just as it renders unlawful all 4 consideration of political affiliation in 5 hiring for nonpolicy-level government jobs. 6 And that's from the -- from the 7 Vieth case. 8 The reality is that districting 9 inevitably has, and is intended to have, 10 political consequences, and political 11 considerations are a part of that process. 12 The Courts that have examined free 13 speech and expression claims in redistrict 14 claims have held there is no -- 15 THE COURT: You've actually -- 16 we've got to remember we have a court 17 reporter here. You've still got to slow 18 down. 19 MR. TUCKER: -- there is no 20 independent violation of the free speech and 21 association rights absent a violation of 22 equal protection. And we haven't seen any 23 evidence of violation of -- of equal 24 protection here. 25 Petitioners appear to concede this</p>
1093	<p>1 motion for nonsuit. 2 THE COURT: So you're moving only 3 as to Count II? 4 MR. TUCKER: We believe that they 5 haven't also met their claims under -- under 6 Count I. 7 First of all, I think -- are you 8 talking about the First Amendment claim? 9 THE COURT: Right. 10 MR. TUCKER: For -- for the reasons 11 that -- I can go through those as well, if 12 you want, Your Honor. 13 THE COURT: You may want to. 14 MR. TUCKER: Yeah. One second, 15 Your Honor. 16 (Pause.) 17 MR. TUCKER: Your Honor, we also 18 make the same motion under -- Petitioners' 19 claim under the Free Speech and Associations 20 Clause. 21 First, although the U.S. 22 Supreme Court has opined that Free 23 Speech and Association claims are at least 24 plausible, a plurality of the Court has 25 expressed concerns that permitting a free</p>	1095	<p>1 because their first element of their free 2 speech claim is substantially similar to the 3 first element of Petitioners' equal 4 protection claim. 5 Other Courts reviewing free speech 6 claims in the partisan gerrymandering 7 context have rejected such claims where the 8 plaintiffs were not prevented from speaking, 9 endorsing a candidate, or campaigning for a 10 candidate. And the evidence we've heard in 11 this trial from the Petitioners is that none 12 of them were prohibited from speaking, 13 endorsing a candidate, or campaigning for a 14 candidate -- or -- I'm sorry -- campaigning 15 for a candidate. 16 There has been zero evidence that 17 they've been prohibited from doing any of 18 those things submitted by Petitioners in 19 this case. 20 Finally, I want to talk a little bit 21 about the level of intent the Petitioners 22 are required to show, which we don't believe 23 they've done so in this case. 24 Petitioners must show that those 25 responsible for the map redraw with -- must</p>

1096	<p>1 show specific intent to impose a burden on</p> <p>2 Petitioners and those similarly situated</p> <p>3 because of how Petitioners voted or the</p> <p>4 political party to which Petitioners belong.</p> <p>5 Accordingly, they must show more</p> <p>6 than political considerations in the use of</p> <p>7 partisan data reflecting citizens' voting</p> <p>8 history and party affiliation impacted the</p> <p>9 drawing of Pennsylvania's Congressional</p> <p>10 districts.</p> <p>11 It is insufficient for Petitioners</p> <p>12 to just show that the Pennsylvania</p> <p>13 General Assembly was aware of the likely</p> <p>14 impact of the 2011 Plan and that certain</p> <p>15 districts were safe Democrat districts or</p> <p>16 safe Republican districts.</p> <p>17 On the contrary, they must show a</p> <p>18 specific intent -- they must show a specific</p> <p>19 intent for a particular group of voters to</p> <p>20 achieve electoral success because of the</p> <p>21 views they had previously -- previously</p> <p>22 expressed. And we do not believe that the</p> <p>23 Petitioners have submitted sufficient</p> <p>24 evidence on those grounds either.</p> <p>25 Thank you.</p>	1098	<p>1 direction, against Democrats -- Democratic</p> <p>2 voters, by which I mean people likely to</p> <p>3 vote Democratic, and not against Republican</p> <p>4 voters, by which I mean people not likely to</p> <p>5 vote Republican.</p> <p>6 So it's a content discrimination,</p> <p>7 that is, discrimination based on the content</p> <p>8 of your views and beliefs.</p> <p>9 THE COURT: Counsel, can I just ask</p> <p>10 for clarification?</p> <p>11 MR. GERSCH: Certainly, Your Honor.</p> <p>12 THE COURT: Your political group</p> <p>13 that you're identifying, is it registered</p> <p>14 Democrats or is it voters in Pennsylvania</p> <p>15 who have and likely vote for Democrats?</p> <p>16 MR. GERSCH: It's the latter.</p> <p>17 THE COURT: Okay. So you're not</p> <p>18 making a freedom of association claim based</p> <p>19 on party affiliation?</p> <p>20 MR. GERSCH: Well, I wouldn't say</p> <p>21 that party affiliation is irrelevant, but we</p> <p>22 don't think that's the test.</p> <p>23 THE COURT: Okay. I just wanted to</p> <p>24 be clear.</p> <p>25 MR. GERSCH: When you have a</p>
1097	<p>1 THE COURT: Thank you.</p> <p>2 Petitioners' response?</p> <p>3 MR. GERSCH: Thank you, Your Honor.</p> <p>4 Let me start out by saying, there's</p> <p>5 a very good practical reason to deny this</p> <p>6 motion, which is that if you grant it, when</p> <p>7 this case gets to the Pennsylvania</p> <p>8 Supreme Court, our evidence will be in and</p> <p>9 their's will not be, which I'm not sure is</p> <p>10 to anyone's advantage.</p> <p>11 On the merits of the motion, our</p> <p>12 first claim, which I think they almost</p> <p>13 forgot, is a claim of freedom of expression,</p> <p>14 freedom of association.</p> <p>15 Voting is core freedom of</p> <p>16 expression, core expression. Affiliating</p> <p>17 with the party of your choice is core</p> <p>18 political -- is core association.</p> <p>19 All of these, we submit, are</p> <p>20 protected under the Pennsylvania</p> <p>21 Constitution.</p> <p>22 The 2011 Map, Act 131, burdens both</p> <p>23 of these things. It's both viewpoint</p> <p>24 discrimination, that is, discrimination</p> <p>25 based on speech that goes only in one</p>	1099	<p>1 situation like this, viewpoint</p> <p>2 discrimination, content discrimination, it's</p> <p>3 well established that this triggers strict</p> <p>4 scrutiny.</p> <p>5 As a practical matter, no one ever</p> <p>6 wins against strict scrutiny.</p> <p>7 In this case, they have less than no</p> <p>8 chance, because strict scrutiny means they</p> <p>9 carry the burden. They carry the burden,</p> <p>10 and they're not going to put on a factual</p> <p>11 case explaining why it is that the</p> <p>12 Government needs to do this for any kind of</p> <p>13 compelling reason.</p> <p>14 They're going to put on experts.</p> <p>15 They're going to put on experts who will</p> <p>16 critique our experts. But they're not going</p> <p>17 to put on any factual case that they can</p> <p>18 meet a strict scrutiny standard.</p> <p>19 We have an alternative First</p> <p>20 Amendment claim. It's a retaliation theory.</p> <p>21 This is based on the case that the</p> <p>22 Republicans have brought in Maryland against</p> <p>23 the Maryland districting. And that's that</p> <p>24 the redistricting in 2011 constitutes</p> <p>25 intentionally discriminatory action based on</p>

1100	<p>1 past speech.</p> <p>2 And this is a more individualized</p> <p>3 inquiry. And just to give examples, Robert</p> <p>4 Smith -- Petitioner Robert Smith, Petitioner</p> <p>5 Lisa Isaacs, several other Petitioners, have</p> <p>6 testified that they would have been -- there</p> <p>7 was a good chance they would have been in a</p> <p>8 different district, a district where their</p> <p>9 votes would have mattered more, but for the</p> <p>10 conduct of -- of the</p> <p>11 Legislative Respondents. And we'll make</p> <p>12 that showing as to every Petitioner. Not</p> <p>13 that specific showing. We'll make a showing</p> <p>14 of harm as to each Petitioner.</p> <p>15 Then our secondary claim is an equal</p> <p>16 protection claim under Pennsylvania's laws.</p> <p>17 In that regard -- let me get that -- we need</p> <p>18 to show intentional discrimination against</p> <p>19 an identifiable group. And the fact I</p> <p>20 think -- I think the claim of intentional</p> <p>21 discrimination is similar to, but not</p> <p>22 exactly the same, as the First Amendment.</p> <p>23 But, basically, the notion is they are</p> <p>24 purposefully seeking to -- to -- to dilute</p> <p>25 the votes of Democratic voters.</p>	1102	<p>1 about the degree to which when you are</p> <p>2 denied the opportunity to get a candidate --</p> <p>3 in this case, a candidate that would favor</p> <p>4 the Democratic -- the Democratic candidate,</p> <p>5 you essentially don't get the kind of</p> <p>6 representation that people thought you were</p> <p>7 getting back -- historically in time.</p> <p>8 Historically in time, the notion was</p> <p>9 a Pennsylvania Congressman would have</p> <p>10 certain interests that would -- that he</p> <p>11 would represent the district as a whole.</p> <p>12 Now, people are -- the Congressmen are</p> <p>13 tending to vote much more on nationalized</p> <p>14 issues, and you don't get that</p> <p>15 representation.</p> <p>16 I'm not going to summarize all of</p> <p>17 Professor Warshaw's testimony.</p> <p>18 On the facts, we think that there's</p> <p>19 ample evidence, overwhelming evidence: the</p> <p>20 shape of the maps, the election results and,</p> <p>21 of course, the many metrics: Dr. Chen's</p> <p>22 metrics, Dr. Pegden's metrics, the</p> <p>23 efficiency gap metrics. We think that</p> <p>24 the -- the evidence in this case is</p> <p>25 overwhelming.</p>
1101	<p>1 With respect to identifiable group,</p> <p>2 I think the work of Professor Chen shows</p> <p>3 that you can identify and make a showing</p> <p>4 that you can predict who will vote</p> <p>5 Democratic and you will come up with what</p> <p>6 these people came up with, which is a 13-5</p> <p>7 split over and over and over again.</p> <p>8 And other evidence in the record as</p> <p>9 well.</p> <p>10 With respect to effect -- and here,</p> <p>11 I have to find the piece of paper that was</p> <p>12 given to me --</p> <p>13 Excuse me.</p> <p>14 -- with respect to effect, here, we</p> <p>15 would argue and we will -- it will be our</p> <p>16 position in the Supreme Court that the Court</p> <p>17 is not required to strictly follow Erfer,</p> <p>18 and our test is that the 2011 Plan</p> <p>19 materially disadvantaged Democratic</p> <p>20 candidates of their choice.</p> <p>21 If we have to meet the test that was</p> <p>22 laid out in Erfer, which is a tough test,</p> <p>23 the "Are you shut out of the political</p> <p>24 process?" in that regard, we will be relying</p> <p>25 on the testimony of Dr. Warshaw, who talked</p>	1103	<p>1 And on that, unless the Court has</p> <p>2 further questions, I'll sit down.</p> <p>3 THE COURT: Thank you.</p> <p>4 MR. GERSCH: Thank you.</p> <p>5 MR. LEVINE: Your Honor, the</p> <p>6 Lieutenant Governor would join with the</p> <p>7 Petitioners' position as well.</p> <p>8 THE COURT: I realize the</p> <p>9 Lieutenant Governor is in a unique position</p> <p>10 in this case.</p> <p>11 Legislative Respondents' motion</p> <p>12 will be denied.</p> <p>13 Any other motions?</p> <p>14 (Pause.)</p> <p>15 THE COURT: Hearing none, the hour</p> <p>16 is late, in the sense that I had planned to</p> <p>17 go till 7:00 tonight. And it doesn't look</p> <p>18 like, in the 2 minutes that I have on my</p> <p>19 watch, we should start any new witnesses.</p> <p>20 So we will begin again tomorrow at</p> <p>21 9:30. And we'll be in recess till then. So</p> <p>22 we will now go off the record.</p>

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1 THE CLERK: The Commonwealth Court
2 is now adjourned.

3 - - -

4 (Whereupon, the trial adjourned at
5 6:58 p.m., to reconvene on Thursday,
6 December 14, 2017, at 9:30 a.m.)
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COMMONWEALTH OF PENNSYLVANIA:

I, Cindy L. Sebo, a court reporter within
and for the Jurisdiction aforesaid, do hereby certify
that the foregoing proceeding were pursuant to notice,
at the time and place indicated; that the testimony
of said was correctly recorded in machine shorthand
by me and thereafter transcribed under my supervision
with computer-aided transcription; that the proceedings
are true record of the testimony given; and that
I am neither of counsel nor kin to any party in said
action, nor interested in the outcome thereof.



Cindy L. Sebo, RMR, CRR, RPR, CSR,
CCR, CLR, RSA, LiveDeposition
Authorized Reporter, and Notary Public