Appendix

Surveys

Our respondents were empaneled and recruited by the survey firm YouGov. YouGov respondents consent to take periodic, anonymous surveys under the terms described here: `https://today.yougov.com/about/faqs/`. Consent occurs at empanelment. Respondents' participation in response to any specific survey invitation is voluntary and anonymous. Respondents to YouGov surveys are compensated via points which can be redeemed for cash or non-cash rewards as described here: `https://mena.yougov.com/en/account/panel-rewards/`.

	Jan. '16	July '16	Oct./Nov. '16	April '21
Democrat	0.502	0.503	0.524	0.502
Has BA	0.462	0.475	0.489	0.507
Black	0.052	0.049	0.047	0.116
Hispanic	0.027	0.042	0.023	0.062
Race: Other	0.052	0.060	0.062	0.014
White	0.870	0.849	0.868	0.774
Female	0.495	0.483	0.480	0.517

Table A1: Descriptive statistics by survey.

	Jan. '16	July '16	Oct./Nov. '16	April '21
Contributed Money	0.82	0.81	0.82	0.74
Attended campaign event	0.75	0.73	0.71	0.71
Volunteer for campaign	0.60	0.59	0.56	0.50
Made phone calls	0.38	0.37	0.34	0.35
Been paid staffer	0.12	0.15	0.12	0.22
Ran for elected office	0.17	0.18	0.20	0.33
Political party official	0.26	0.24	0.27	0.37

Table A2: Fraction engaging in different activities to qualify for survey inclusion.

Standard Errors

The Bradley-Terry model produces standard errors, and the estimates are about as precise as those produced by NOMINATE. Appendix Figure A2 provides confidence ellipses to present the uncertainty in our estimates, and to compare that uncertainty with the bootstrapped standard

Figure A1: This figure displays a sample pairing as shown to respondents in the 2021 survey.

errors of NOMINATE. The figure indicates that, at the scale at which we wish to make comparisons, our measure is just about as precise as NOMINATE. In some cases, cases, NOMINATE appears to be more precise. In other cases, the Pairwise measure is more precise.

NOMINATE's uncertainty is in part a function of extremity. More extreme cases can be harder to estimate, because there may be little in the roll call record to clarify just how extreme they are. Uncertainty in the pairwise measure is partly a function of how well known the Senator is. Better known actors will be rated more often, and more extreme members may even be better known. See also Appendix Figure A6.
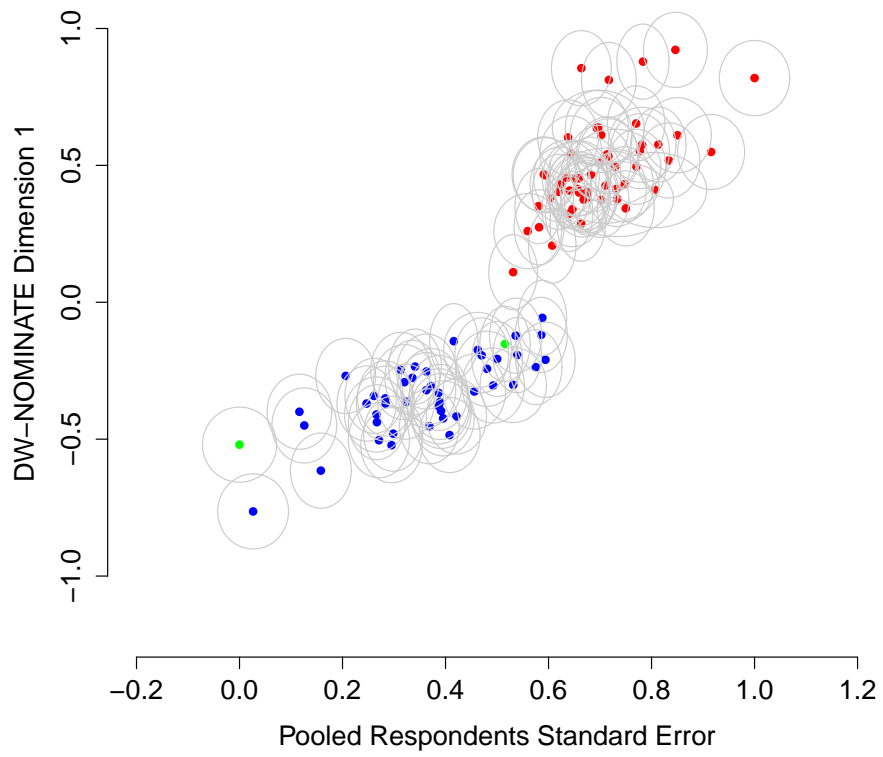
Figure A2: First Dimension NOMINATE vs. Estimated Pairwise Ideology in the 114th Senate with 95% confidence ellipses.

Sanders	0	Reed	0.387	Heller	0.593	Toomey	0.696
Warren	0.026	Menendez	0.389	Tester	0.594	Crapo	0.698
Franken	0.116	Whitehouse	0.391	McCain	0.604	Portman	0.702
Boxer	0.126	Blumenthal	0.395	Murkowski	0.607	Perdue	0.702
Booker	0.158	Hirono	0.408	McConnell	0.62	Tillis	0.711
Feinstein	0.206	McCaskill	0.416	Blunt	0.623	Enzi	0.714
Leahy	0.247	Schatz	0.421	Gardner	0.635	Barrasso	0.716
Murray	0.261	Cardin	0.456	Johnson	0.638	Sasse	0.717
Gillibrand	0.266	Carper	0.463	Alexander	0.64	Vitter	0.729
Brown	0.267	Warner	0.47	Graham	0.641	Roberts	0.732
Markey	0.271	Coons	0.48	Daines	0.644	Wicker	0.733
Schumer	0.283	Casey,	0.492	Hoeven	0.647	Shelby	0.748
Mikulski	0.283	Bennet	0.5	Cassidy	0.651	Grassley	0.75
Baldwin	0.295	King	0.516	Moran	0.656	Scott	0.77
Merkley	0.298	Collins	0.531	Burr	0.659	Cornyn	0.771
Klobuchar	0.313	Heinrich	0.532	Boozman	0.659	Inhofe	0.777
Cantwell	0.32	Heitkamp	0.536	Cochran	0.663	Lankford	0.782
Durbin	0.323	Nelson	0.539	Flake	0.664	Paul	0.783
Reid	0.336	Capito	0.56	Coats	0.668	Thune	0.807
Kaine	0.341	Peters	0.575	Corker	0.671	Rubio	0.813
Wyden	0.363	Ayotte	0.581	Rounds	0.674	Ernst	0.834
Shaheen	0.363	Kirk	0.582	Isakson	0.675	Lee	0.846
Udall	0.369	Donnelly	0.586	Hatch	0.675	Cotton	0.85
Murphy	0.372	Manchin	0.588	Sullivan	0.682	Sessions	0.916
Stabenow	0.387	Fischer	0.591	Risch	0.694	Cruz	1

Table A3: This table lists the perceived ideology score for each US Senator included in at least one of our three 2016 surveys.

Correlations with Alternate Measures

	PERCEIVED	PERCEIVED wave 1	PERCEIVED wave 2	PERCEIVED wave 3	Dem. PERCEIVED	Dem. PERCEIVED wave 1	Dem. PERCEIVED wave 2	Dem. PERCEIVED wave 3	Rep. PERCEIVED	Rep. PERCEIVED wave 1	Rep. PERCEIVED wave 2	Rep. PERCEIVED wave 3	CCES	Dem. CCES	Rep. CCES	RECIPIENT CFSCORE	CONTRIBUTOR CFSCORE	NOMINATE DIM 1	NOMINATE DIM 2
PERCEIVED	1.00	0.98	0.98	0.99	1.00	0.96	0.96	0.97	0.93	0.91	0.90	0.96	0.89	0.88	0.89	0.85	0.82	0.90	0.31
PERCEIVED wave 1	0.98	1.00	0.96	0.96	0.95	1.00	0.93	0.92	0.85	0.98	0.85	0.90	0.89	0.89	0.89	0.85	0.83	0.90	0.27
PERCEIVED wave 2	0.98	0.96	1.00	0.97	0.95	0.93	0.99	0.95	0.84	0.88	0.98	0.90	0.90	0.90	0.90	0.87	0.85	0.91	0.31
PERCEIVED wave 3	0.99	0.96	0.97	1.00	0.97	0.93	0.95	0.99	0.83	0.86	0.87	0.97	0.88	0.88	0.88	0.84	0.81	0.89	0.26
Dem. PERCEIVED	1.00	0.95	0.95	0.97	1.00	0.95	0.95	0.96	-0.09	0.60	0.59	0.76	0.73	0.77	0.72	0.65	0.63	0.79	0.23
Dem. PERCEIVED wave 1	0.96	1.00	0.93	0.93	0.95	1.00	0.93	0.92	0.24	0.83	0.82	0.89	0.80	0.83	0.80	0.73	0.71	0.84	0.17
Dem. PERCEIVED wave 2	0.96	0.93	0.99	0.95	0.95	0.93	1.00	0.95	0.32	0.83	0.83	0.85	0.77	0.81	0.76	0.72	0.71	0.83	0.24
Dem. PERCEIVED wave 3	0.97	0.92	0.95	0.99	0.96	0.92	0.95	1.00	0.16	0.70	0.70	0.79	0.77	0.80	0.77	0.70	0.70	0.81	0.19
Rep. PERCEIVED	0.93	0.85	0.84	0.83	-0.09	0.24	0.32	0.16	1.00	0.87	0.87	0.90	0.60	0.51	0.63	0.52	0.41	0.66	0.06
Rep. PERCEIVED wave 1	0.91	0.98	0.88	0.86	0.60	0.83	0.83	0.70	0.87	1.00	0.86	0.89	0.68	0.64	0.70	0.62	0.54	0.73	0.01
Rep. PERCEIVED wave 2	0.90	0.85	0.98	0.87	0.59	0.82	0.83	0.70	0.87	0.86	1.00	0.88	0.74	0.66	0.76	0.69	0.62	0.75	0.09
Rep. PERCEIVED wave 3	0.96	0.90	0.90	0.97	0.76	0.89	0.85	0.79	0.90	0.89	0.88	1.00	0.73	0.66	0.76	0.65	0.54	0.75	-0.01
CCES	0.89	0.89	0.90	0.88	0.73	0.80	0.77	0.77	0.60	0.68	0.74	0.73	1.00	0.99	1.00	0.97	0.95	0.95	0.20
Dem. CCES	0.88	0.89	0.90	0.88	0.77	0.83	0.81	0.80	0.51	0.64	0.66	0.66	0.99	1.00	0.97	0.96	0.94	0.95	0.22
Rep. CCES	0.89	0.89	0.90	0.88	0.72	0.80	0.76	0.77	0.63	0.70	0.76	0.76	1.00	0.97	1.00	0.97	0.95	0.95	0.21
RECIPIENT CFSCORE	0.85	0.85	0.87	0.84	0.65	0.73	0.72	0.70	0.52	0.62	0.69	0.65	0.97	0.96	0.97	1.00	0.96	0.95	0.16
CONTRIBUTOR CFSCORE	0.82	0.83	0.85	0.81	0.63	0.71	0.71	0.70	0.41	0.54	0.62	0.54	0.95	0.94	0.95	0.96	1.00	0.92	0.22
NOMINATE DIM 1	0.90	0.90	0.91	0.89	0.79	0.84	0.83	0.81	0.66	0.73	0.75	0.75	0.95	0.95	0.95	0.95	0.92	1.00	0.16
NOMINATE DIM 2	0.31	0.27	0.31	0.26	0.23	0.17	0.24	0.19	0.06	0.01	0.09	-0.01	0.20	0.22	0.21	0.16	0.22	0.16	1.00

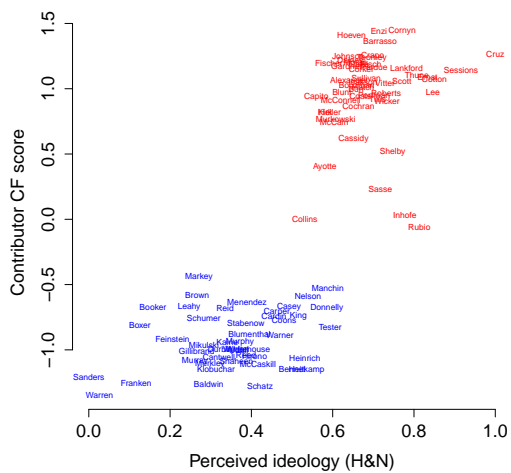Table A4: Correlations across ideology-related measures

Figure A3: Contributor-based Campaign Finance Scores vs. Estimated Pairwise Ideology in the 114th Senate.
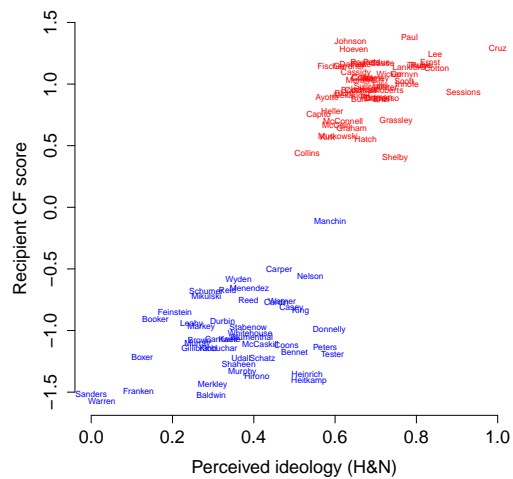

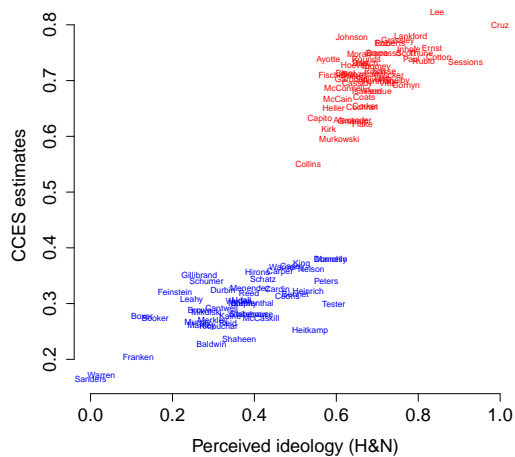Figure A4: Receipient-based Campaign Finance Scores vs. Estimated Pairwise Ideology in the 114th Senate.

Figure A5: CCES perceived ideology vs. Estimated Pairwise Ideology in the 114th Senate. Democrats in Blue. Republicans in Red.

Who Doesn't Rank Pairs?

Activists only contribute to the pairwise estimates when they are able to evaluate a given pairing, so we also analyzed who among the activists was more or less likely to say that they weren't familiar with both politicians. In Table A5, we report regressions in which the dependent variable is the fraction of all pairings for which each respondent said she wasn't familiar with one or both. For the three 2016 surveys, women are more likely to report not being able to evaluate pairings, while those with Bachelor's degrees and Democrats are less likely to say that they are unfamiliar with at least one of the politicians. While there is no effect of being very conservative or liberal—labeled "extreme ideology"—strong partisans are between 0.06 and 0.11 less likely to say that they aren't able to assess a given pair. Such effects for strength of partisanship are notable, but substantively modest; the pairwise measure is not driven simply by strong partisans.

In 2021, the task changed, as we included high-profile figures outside the Senate (such as Kamala Harris and Mike Pence) while also allowing more cross-party comparisons. Possibly as a result, the baseline rate of respondents being unable to evaluate a given pair dropped from 40 percent to 25 percent. As Table A5 illustrates, the correlates of being unfamiliar changed somewhat as well. While men and strong partisans continued to report higher levels of familiarity, younger respondents did, too.

	Winter 2016	Summer 2016	Fall 2016	Spring 2021
Intercept	0.474*	0.406*	0.415*	0.170*
	(0.057)	(0.058)	(0.058)	(0.043)
Black	0.077	0.063	0.126	−0.018
	(0.066)	(0.067)	(0.065)	(0.042)
White	0.046	0.045	0.046	−0.038
	(0.048)	(0.046)	(0.044)	(0.036)
Hispanic	−0.062	−0.099	0.022	−0.071
	(0.078)	(0.070)	(0.080)	(0.046)
Has BA	−0.073*	−0.077*	−0.088*	−0.020
	(0.021)	(0.022)	(0.021)	(0.016)
Female	0.130*	0.114*	0.104*	0.092*
	(0.021)	(0.022)	(0.021)	(0.016)
Age 30-44	−0.004	0.051	0.040	0.084*
	(0.049)	(0.039)	(0.054)	(0.027)
Age 45-64	−0.029	0.078*	0.046	0.200*
	(0.034)	(0.036)	(0.040)	(0.025)
Age 65+	−0.059	0.075*	0.035	0.176*
	(0.037)	(0.038)	(0.042)	(0.026)
Democrat	−0.095*	−0.082*	−0.096*	−0.003
	(0.022)	(0.022)	(0.022)	(0.016)
Strong Partisan	−0.093*	−0.108*	−0.056	−0.070*
	(0.029)	(0.031)	(0.029)	(0.023)
Extreme Ideology	0.000	−0.007	−0.015	0.001
	(0.022)	(0.024)	(0.022)	(0.017)
R^2	0.082	0.075	0.071	0.129
N	989	972	1024	1110

$^*p < 0.05$

Table A5: This table displays regressions of the fraction of pairings for which each respondent indicated she was not familiar with one or both politicians.

Figure A6: This figure illustrates the fraction of pairings involving each Senator in which a respondent is tied (y-axis)—meaning she could not rate the pairing—by the pairwise perceived conservatism score (x-axis).