Appendices

Women Also Know Stuff: Challenging the Gender Gap in Political Sophistication

Appendix A Data Overview

I Open-Ended Items

2018 Cooperative Election Study (CES): The main analysis focuses on a national stratified survey of 1,000 respondents as part of the 2018 CES. Among other items, the study includes the following open-ended questions:

- On the issue of **gun legislation**, please outline the main arguments that come to mind *in favor and against* background checks for all gun sales, including at gun shows and over the Internet.
- On the issue of **abortion**, please outline the main arguments that come to mind *in favor and against* banning abortions after the 20th week of pregnancy.
- On the issue of **immigration**, please outline the main arguments that come to mind *in favor and against* providing a legal status for recipients of the Deferred Action for Childhood Arrivals (DACA) status.
- On the issue of **health cure**, please outline the main arguments that come to mind *in favor and against* repealing the Affordable Care Act (Obamacare).
- On the issue of **trade policies**, please outline the main arguments that come to mind *in favor and against* imposing tariffs on imported steel and aluminum from countries including Canada, Europe, and Mexico.

2020, 2016, & 2012 American National Election Study (ANES): In addition to the original data collection as part of the CES, I apply the measurement approach using three separate waves of the American National Election Study (ANES), each of which consists of a representative survey of about 5000 adults in the months before the US Presidential election in each year. Here, discursive sophistication is evaluated using a set of 8 open-ended questions in which respondents were asked to list anything in particular that they like/dislike about the Democratic/Republican party as well as anything that might make them vote/not vote for either of the Presidential candidates.

2015 YouGov Survey In order to replicate and extend the main analysis, I rely on a separate nationally representative survey employing yet another alternative set of open-ended responses. The data was collected by YouGov in December 2015 and contains responses of 1000 U.S. residents. As part of this study, respondents were asked to describe their attitudes towards two prominent political issues that were discussed frequently in the media. First, they were asked in a closed format whether they favor or oppose stricter gun laws. Subsequently, they were asked to respond to the following two questions:

- Still thinking about the question you just answered, what thoughts came to mind while you were answering that question? Please try to list everything that came to mind.

- Thinking about the mass shootings that have occurred in the U.S. in the last few years, what factors do you think are responsible for the shootings?

Second, the respondents reported on their attitudes towards the Affordable Care Act in a closed format and were then asked to elaborate in their own words by answering the following questions:

- Still thinking about the question you just answered, what thoughts came to mind while you were answering that question? Please try to list everything that came to mind.
- For decades, experts have observed that the United States spends far more per person on health care than any other country. However, the U.S. falls behind on most measures of health care outcomes, such as life expectancy. What factors do you think are responsible for the state of our health care system?

Swiss Referendum Survey Lastly, I examine survey data on Swiss citizens justifying their vote choices on multiple referenda used in a recent analysis by Colombo (2018). The author compiled a data set of cross-sectional surveys administered in Switzerland after national popular votes on multiple policy propositions. The original surveys were conducted as representative samples after each of thirty-four national policy votes that were held between 2008 and 2012 resulting in a total of about 27,000 observations. Respondents who participated in a given referendum (ca. 22,000 in total) were asked to describe the main reason as well as additional justifications for their decision in two separate items.

II Conventional Knowledge Items

- *2018 CES*: Additive index containing 3 items (majority in House, majority in Senate, ideological placement of both major parties)
- *2020 ANES*: Additive index containing 4 items (length of Senate term, federal government spending, majority in House, majority in Senate)
- *2016 ANES*: Additive index containing 4 items (length of Senate term, federal government spending, majority in House, majority in Senate).
- *2012 ANES*: Additive index containing 5 items (number of Presidential terms, size of budget deficit, length of Senate term, meaning of Medicare, federal government spending).
- *2015 YouGov*: Additive index containing 8 items (Speaker of the House, meaning of TPP, Chair of Federal Reserve Board, current unemployment rate, Presidential veto override, meaning of Common Core, leading source of electricity in US, majority in Senate).

Appendix B Detailed Information on Open-Ended Responses and Discursive Sophistication Components

I Distribution of Word Counts & Proportion of Non-Response

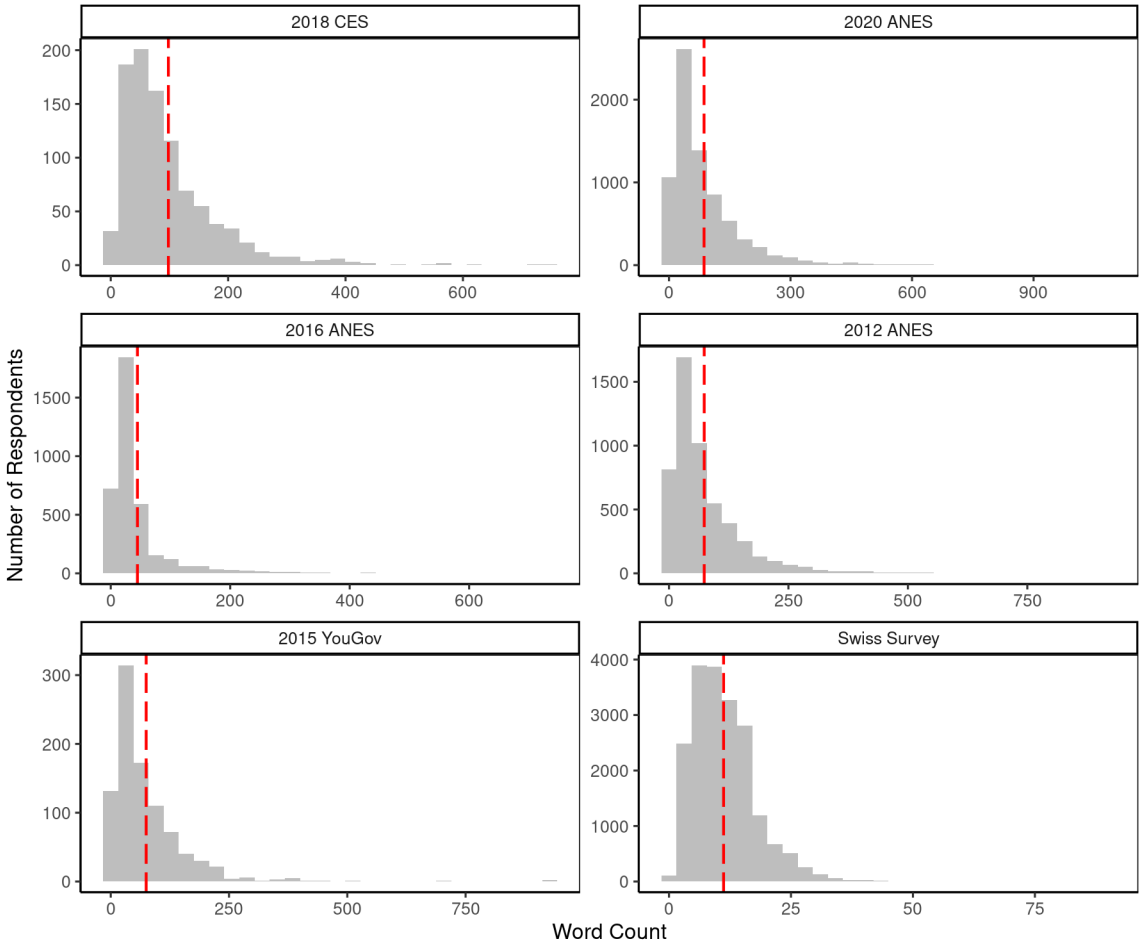


Figure B.1: Total word count across all open-ended responses for each survey participant. The dashed red lines indicate the average response lengths in each survey.

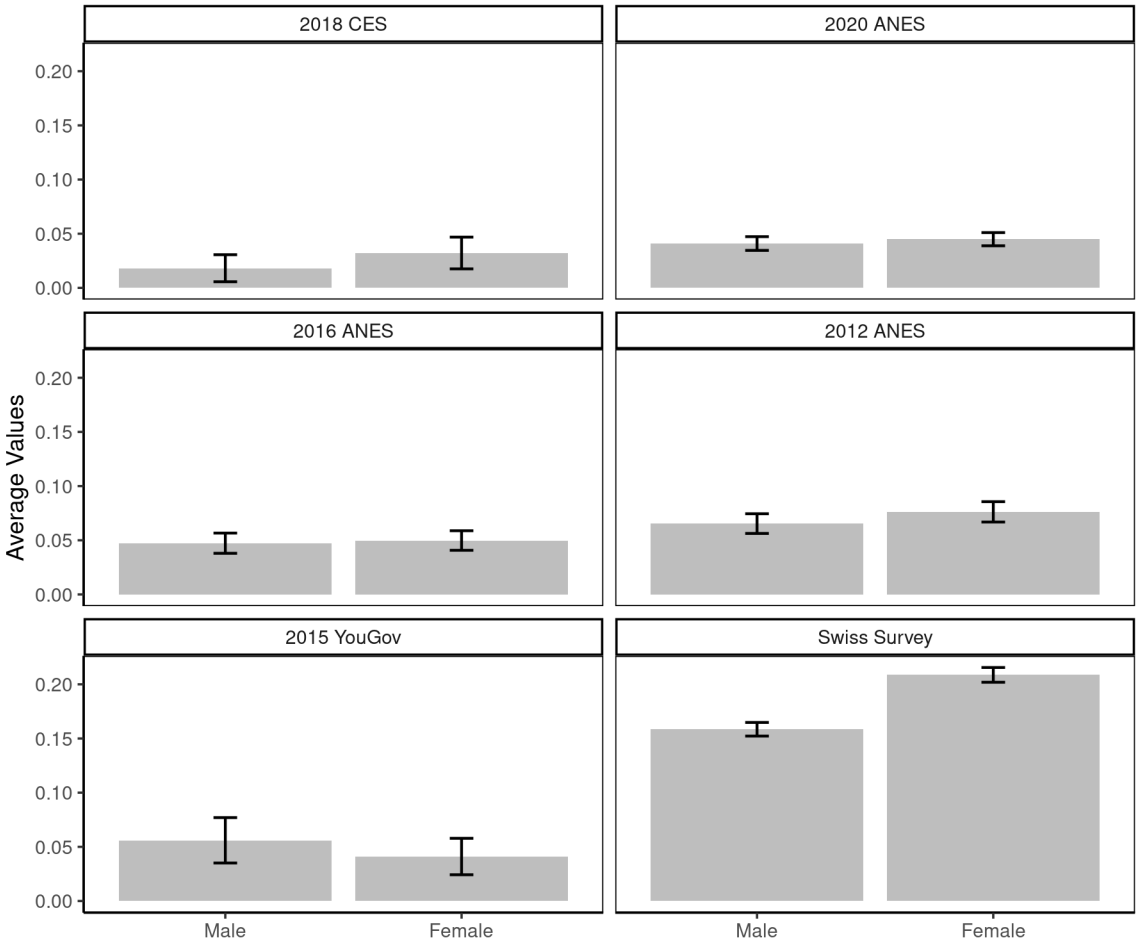


Figure B.2: Proportion of non-response comparing male and female survey participants (including 95% confidence intervals). Gender differences are only significant ($p < .05$) for the Swiss survey. The Swiss survey, however, contains an additional selection mechanism since respondents were only asked the set of open-ended questions if they previously reported that they voted in the respective referendum.

II Preprocessing and Topic Model Specification

I rely on the structural topic model framework to extract and differentiate considerations mentioned by respondents. I follow the guidelines in Roberts et al. (2014) to preprocess our open-ended responses (lowercasing and stemming as well as removing stopwords, punctuation, numbers, and infrequent terms)[17] and used age, gender, education, party identification, as well as an interaction between education and party identification as covariates for topic prevalence. With the exception of gender, this variable selection is equivalent to the procedure described in Roberts et al. (2014) for open-ended survey responses such as those included in the ANES. I set the number of topics to 25 in order to focus on the differentiation of broader considerations, but we replicate equivalent results with larger numbers of topics below. Figure B.3 displays the resulting topic proportions for all data sets included in the analyses along with the most frequent and exclusive (FREX) terms associated with each topic.

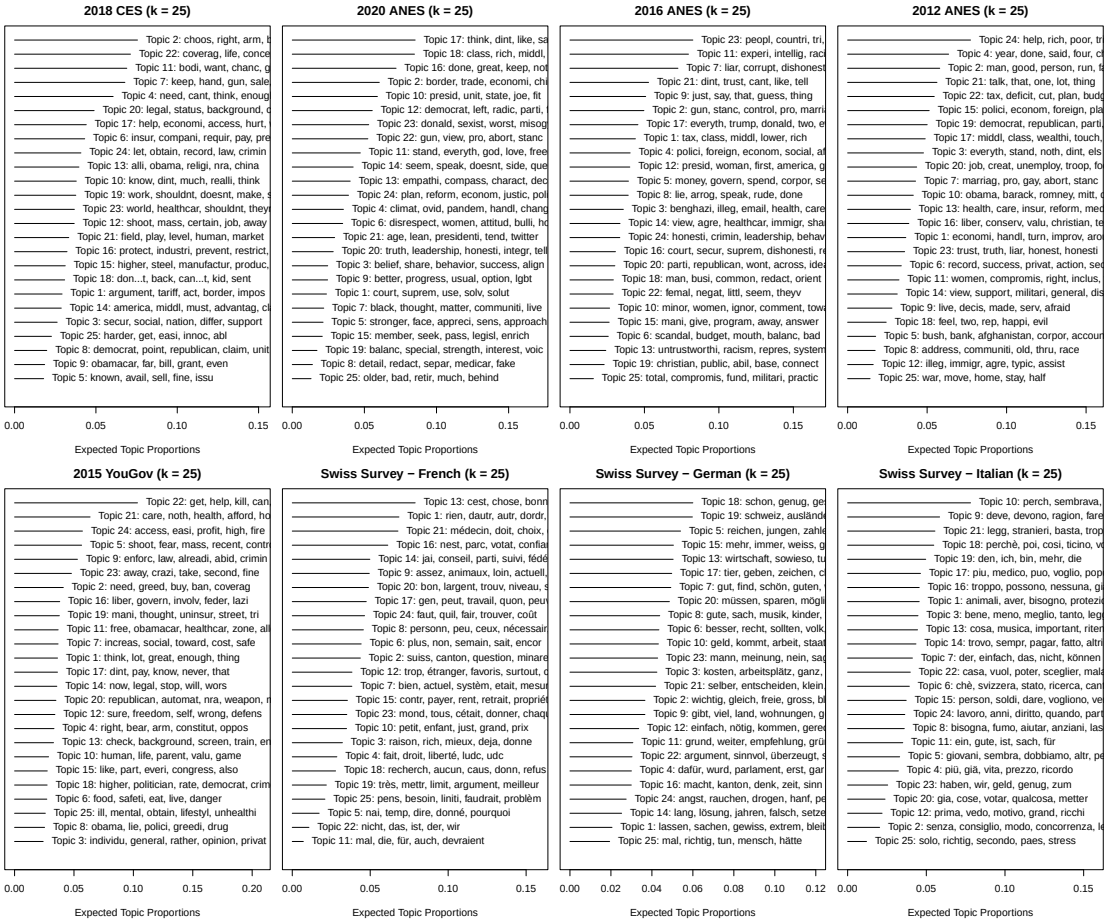
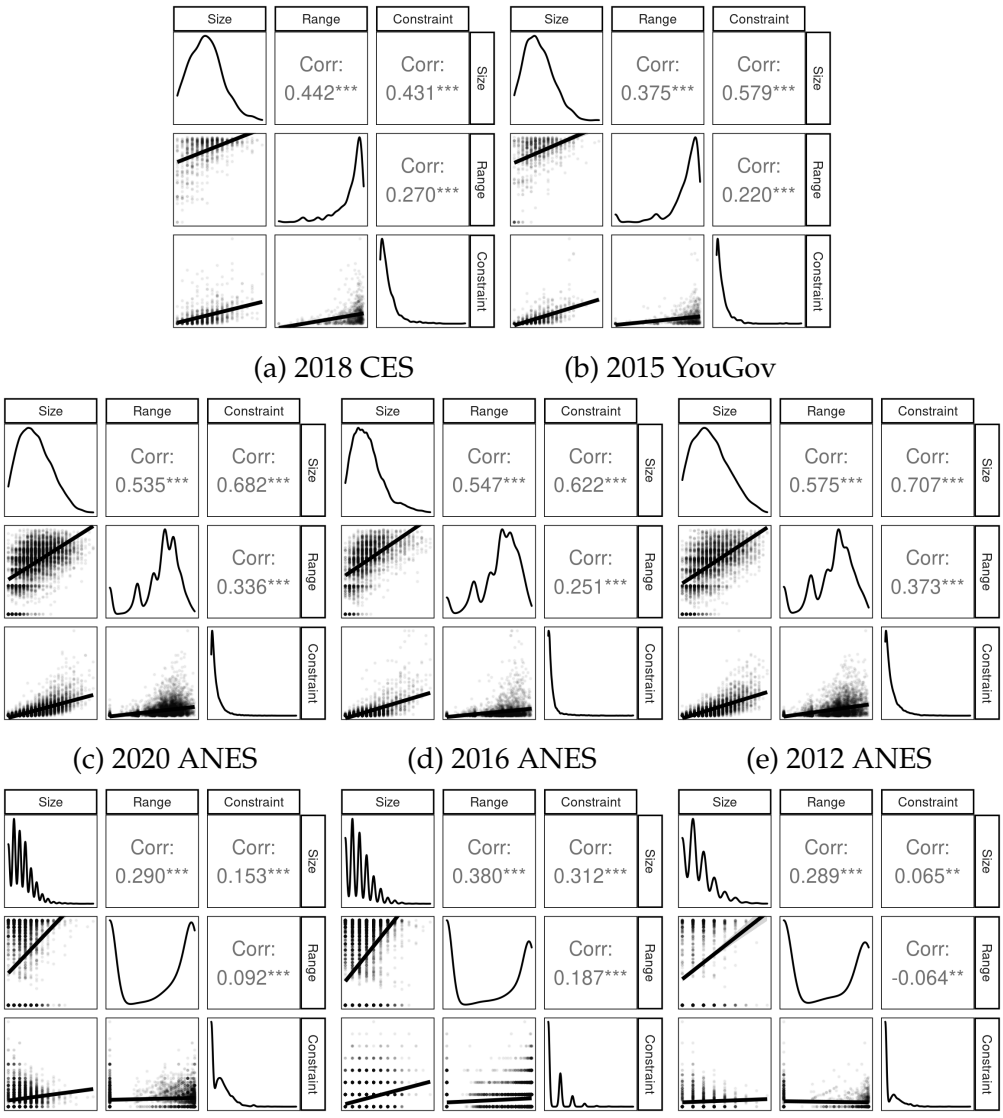


Figure B.3: Estimated topic proportions based on the structural topic model. See Appendix I for details on the model specification.

[17] Prior to applying these preprocessing steps, responses are cleaned by removing open-ended item non-response such as 'don't know' and correcting spelling errors using an implementation of the Aspell spell-checking algorithm (`www.aspell.net`).

III Discursive Sophistication Components



(a) 2018 CES (b) 2015 YouGov

(c) 2020 ANES (d) 2016 ANES (e) 2012 ANES

(f) Swiss Survey - French (g) Swiss Survey - German (h) Swiss Survey - Italian

Figure B.4: Correlation matrix of individual components of discursive sophistication. The plots on the diagonal display univariate densities for each component. The panels in the lower triangular display the scatter plot of two measures as well as a linear fit.

Appendix C Robustness Checks

I PreText Analysis

The first component of discursive sophistication (*size*) relies on quantities extracted from structural topic models (Roberts et al., 2014). As with any other text-as-data approach, a necessary first step before estimating the topic model is to preprocess the raw text and convert it into a document term matrix (DTM, see for example Manning et al., 2008). Common preprocessing procedures include stemming and lowercasing, as well as the removal of numbers, punctuation, stopwords, and infrequent terms. However, topic models and other unsupervised learning techniques can be sensitive to these preprocessing choices. To address this issue, Denny and Spirling (2018) recommend that researchers compare DTMs under all possible preprocessing regimes. The authors propose *preText scores* as a measure to quantify the extent to which varying preprocessing regimes may yield unusual results compared to a baseline without any preprocessing. Following the procedure outlined in Denny and Spirling (2018), Figure C.1 displays the results of a linear model regressing preText scores resulting from all possible preprocessing regimes on each individual step for a subset of 500 open-ended responses in each of the surveys included in the analyses. Significant coefficients indicate that the topic model results may be sensitive to the respective preprocessing step.

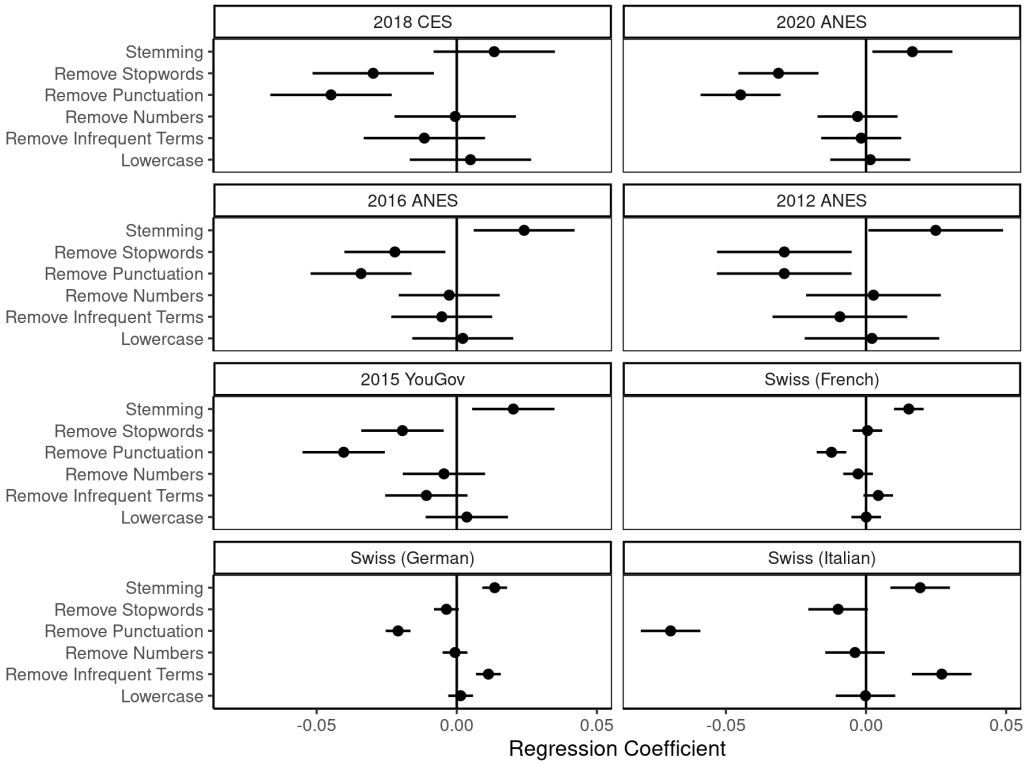


Figure C.1: PreText analysis of preprocessing decisions of open-ended responses across all datasets. Regression coefficients display the effects of each of the six preprocessing choices on the resulting preText score.

II Discursive Sophistication for Varying Model Specifications

According to the analysis in Figure C.1, our results may be particularly sensitive to stemming and the removal of stopwords or punctuation. Denny and Spirling (2018), however, emphasize that the most important consideration in choosing preprocessing steps are theoretical. Given that the purpose of our topic model is to extract considerations related to political preferences, there are no theoretical reasons to incorporate punctuation since it does not contain any relevant content. It is less obvious from a theoretical perspective whether to use stemming or to remove stopwords from our open-ended responses, although it might be preferable in order to increase computational efficiency. Following Denny and Spirling (2018), I proceed by assessing to what extent discursive sophistication varies across the alternative preprocessing regimes identified as potentially influential. In addition, I consider another crucial modeling choice when working with topic models: determining the total number of topics k to be estimated.

Figure C.2 examines whether the proposed measure of discursive sophistication is sensitive to changing the number of topics k, stemming, and the removal of stopwords. The y-axis depicts the preferred preprocessing regime including all steps discussed above while the x-axis plots discursive sophistication resulting from alternative specifications. The panels on the left compare the preferred specification to discursive sophistication based on a larger number of topics ($k = 35$). The center panels does not use stemming as part of the preprocessing. The panels on the right do not remove stopwords prior to estimating the topic model. Across all data sets, discursive sophistication scores are highly correlated and therefore insensitive to preprocessing choices. Thus, the substantive results discussed in the main text are robust for alternative preprocessing regimes or varying numbers of topics.

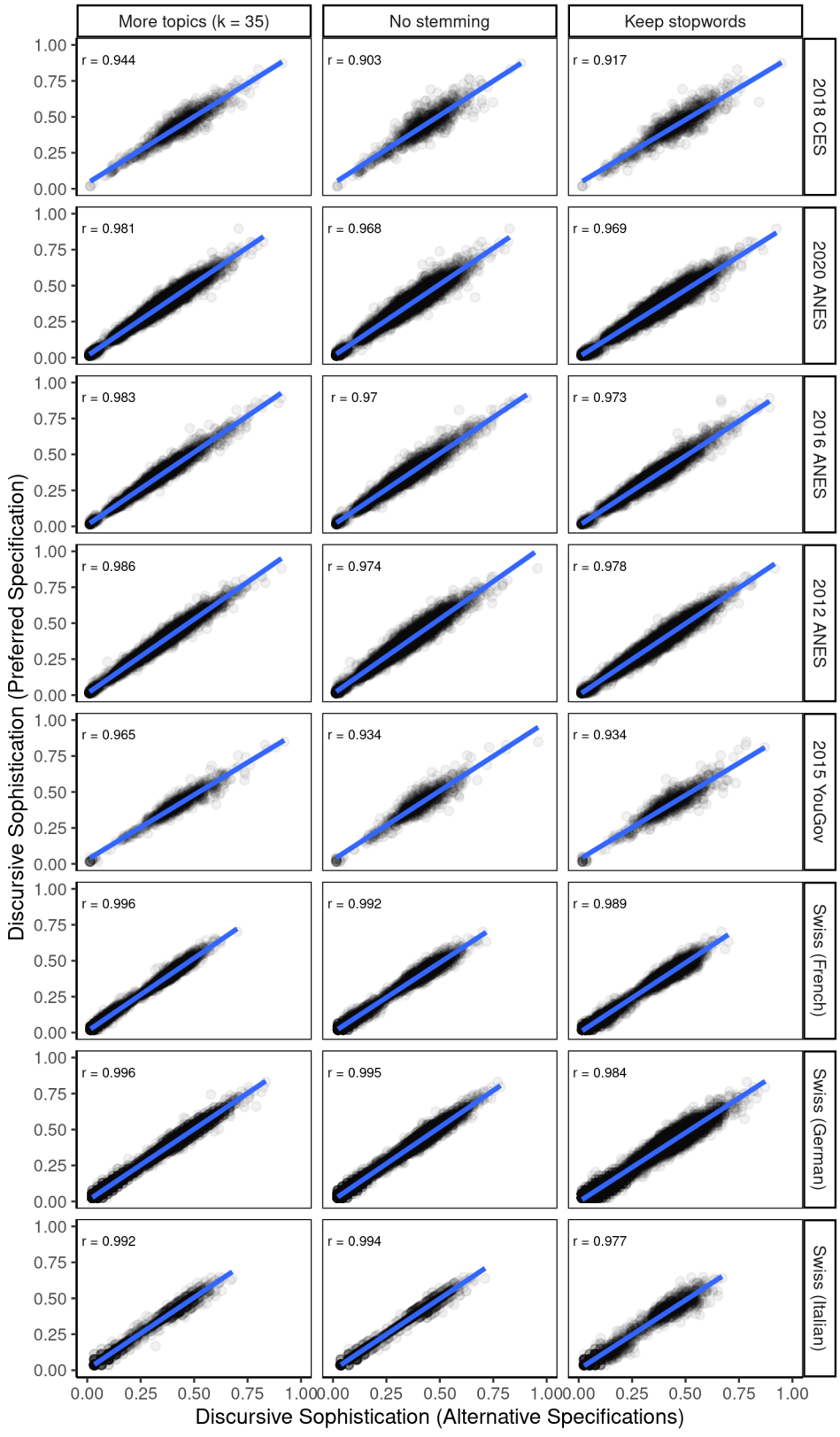


Figure C.2: Robustness of discursive sophistication measure for different preprocessing choices and topic model specifications.

III Controlling for Personality and Verbal Skills

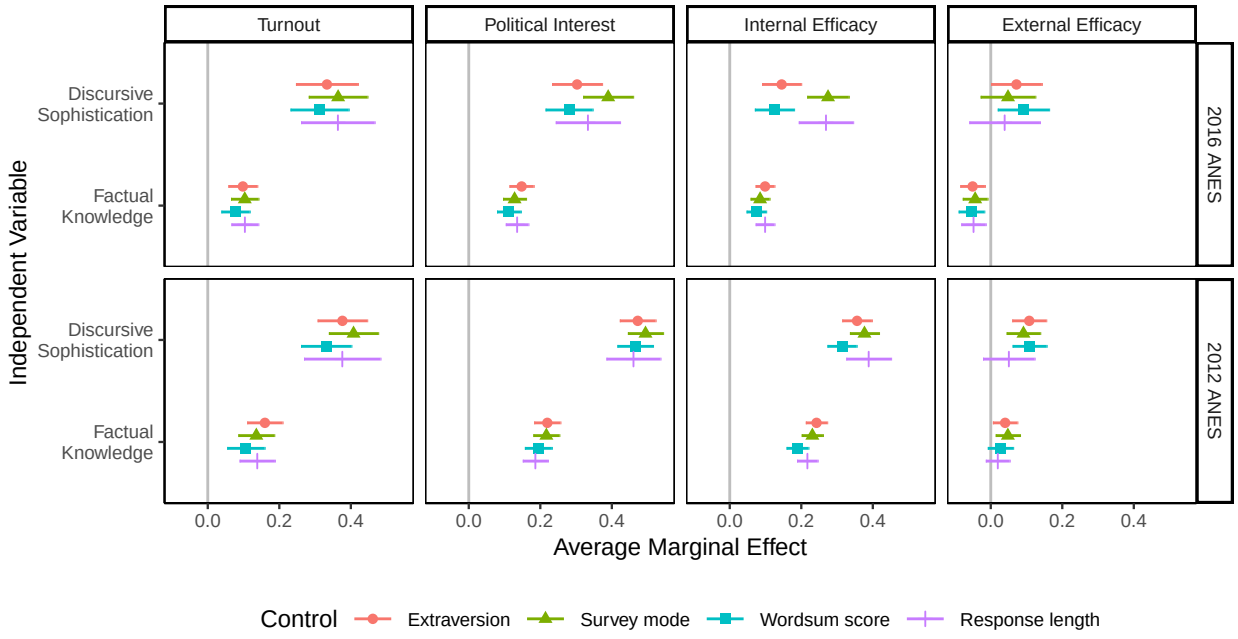


Figure C.3: Effects of sophistication on internal efficacy, external efficacy, non-conventional participation, and turnout in the 2012 and 2016 ANES. For each dependent variable, the figure displays the average marginal effects (AME) for each sophistication measure (including 95% confidence intervals). Model estimates are based on logistic regression (turnout) or OLS (political interest, internal efficacy, external efficacy). Compared to the specification used in Figure 3 (controlling for gender, education, income, age, race, and church attendance), the models displayed here include additional controls for personality (extraversion), survey mode (online vs. offline), verbal skills (Wordsum score), and overall verbosity (response length).

Description of additional control variables:

- *Extraversion*: Part of the Ten Item Personality Inventory (TIPI) measuring the "Big Five" personality traits.
- *Survey Mode*: Dichotomous indicator for face-to-face vs. online samples of the ANES surveys.
- *Wordsum vocabulary scores*: Modified version of the GSS wordsum vocabulary test consisting of 10 terms.
- *Response length*: Total number of words in the collection of open-ended responses by each individual.

Appendix D Tables of Model Estimates

I Figure 3: Effects of sophistication on turnout, political interest, internal efficacy, and external efficacy

Table D.1: Effects of sophistication on turnout, political interest, internal efficacy, and external efficacy in the 2018 CES. Standard errors in parentheses. Estimates are used for Figure 3 in the main text.

	Dependent variable:							
	Turnout		Political Interest		Internal Efficacy		External Efficacy	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Discursive Soph.	2.793***		0.400***		0.445***		−0.046	
	(0.738)		(0.073)		(0.066)		(0.075)	
Factual Knowledge		2.189***		0.303***		0.241***		0.002
		(0.258)		(0.025)		(0.024)		(0.028)
Female	−0.484**	−0.313	−0.086***	−0.062***	−0.062***	−0.043**	0.016	0.016
	(0.184)	(0.195)	(0.017)	(0.017)	(0.016)	(0.016)	(0.018)	(0.018)
College Degree	0.758***	0.558**	0.058**	0.034	0.068***	0.056***	0.041*	0.038*
	(0.200)	(0.211)	(0.019)	(0.018)	(0.017)	(0.016)	(0.019)	(0.019)
Household Income	1.084*	0.682	0.180***	0.129**	0.125**	0.087*	0.034	0.032
	(0.446)	(0.476)	(0.042)	(0.040)	(0.039)	(0.038)	(0.044)	(0.044)
Age	0.045***	0.039***	0.004***	0.003***	0.002***	0.002***	−0.001	−0.001
	(0.006)	(0.006)	(0.0005)	(0.0005)	(0.0004)	(0.0004)	(0.001)	(0.001)
Black	−0.670*	−0.801**	−0.055	−0.061*	0.013	0.004	−0.026	−0.024
	(0.262)	(0.273)	(0.029)	(0.027)	(0.026)	(0.025)	(0.030)	(0.029)
Church Attendance	0.598*	0.700*	0.035	0.040	−0.012	−0.006	0.085**	0.084**
	(0.274)	(0.290)	(0.025)	(0.024)	(0.023)	(0.022)	(0.026)	(0.026)
Constant	−2.541***	−2.557***	0.215***	0.226***	0.257***	0.313***	0.325***	0.307***
	(0.435)	(0.375)	(0.042)	(0.033)	(0.039)	(0.031)	(0.044)	(0.036)
Observations	868	868	867	867	866	866	866	866
R^2			0.225	0.311	0.179	0.227	0.021	0.021
Log Likelihood	-403.885	-372.851						

Note: *p<0.05; **p<0.01; ***p<0.001

Table D.2: Effects of sophistication on turnout, political interest, internal efficacy, and external efficacy in the 2020 ANES. Standard errors in parentheses. Estimates are used for Figure 3 in the main text.

	Dependent variable:							
	Turnout		Political Interest		Internal Efficacy		External Efficacy	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Discursive Soph.	3.263***		0.450***		0.094***		0.067**	
	(0.313)		(0.022)		(0.017)		(0.026)	
Factual Knowledge		1.167***		0.174***		0.048***		0.070***
		(0.155)		(0.011)		(0.008)		(0.012)
Female	0.365***	0.416***	−0.056***	−0.041***	−0.023***	−0.018***	0.021**	0.028***
	(0.084)	(0.084)	(0.006)	(0.006)	(0.004)	(0.004)	(0.007)	(0.007)
College Degree	0.803***	0.854***	0.030***	0.033***	−0.010*	−0.010*	0.074***	0.068***
	(0.098)	(0.098)	(0.006)	(0.006)	(0.005)	(0.005)	(0.007)	(0.007)
Household Income	1.356***	1.449***	0.030**	0.036***	0.015*	0.015*	0.062***	0.058***
	(0.141)	(0.140)	(0.010)	(0.010)	(0.007)	(0.007)	(0.011)	(0.011)
Age	0.032***	0.032***	0.004***	0.004***	0.0004***	0.0003*	0.0002	−0.00002
	(0.003)	(0.003)	(0.0002)	(0.0002)	(0.0001)	(0.0001)	(0.0002)	(0.0002)
Black	0.230	0.117	0.016	0.008	−0.012	−0.013	0.027*	0.028*
	(0.137)	(0.134)	(0.010)	(0.010)	(0.008)	(0.008)	(0.012)	(0.012)
Church Attendance	0.558***	0.567***	−0.013	−0.010	−0.031***	−0.031***	0.013	0.014
	(0.143)	(0.141)	(0.009)	(0.009)	(0.007)	(0.007)	(0.010)	(0.010)
Constant	−1.871***	−1.519***	0.329***	0.387***	0.568***	0.576***	0.237***	0.231***
	(0.166)	(0.158)	(0.012)	(0.012)	(0.010)	(0.009)	(0.015)	(0.014)
Observations	6,370	6,370	6,964	6,964	6,317	6,317	6,315	6,315
R^2			0.165	0.149	0.018	0.019	0.038	0.042
Log Likelihood	-1,990.469	-2,017.154						

Note: *p<0.05; **p<0.01; ***p<0.001

Table D.3: Effects of sophistication on turnout, political interest, internal efficacy, and external efficacy in the 2016 ANES. Standard errors in parentheses. Estimates are used for Figure 3 in the main text.

	Dependent variable:							
	Turnout		Political Interest		Internal Efficacy		External Efficacy	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Discursive Soph.	3.623***		0.305***		0.155***		0.080*	
	(0.445)		(0.033)		(0.028)		(0.036)	
Factual Knowledge		1.069***		0.131***		0.098***		−0.050**
		(0.205)		(0.016)		(0.013)		(0.017)
Female	0.159	0.155	−0.067***	−0.064***	−0.057***	−0.055***	0.0004	−0.002
	(0.111)	(0.110)	(0.008)	(0.008)	(0.007)	(0.007)	(0.009)	(0.009)
College Degree	0.720***	0.832***	0.067***	0.076***	0.075***	0.078***	0.056***	0.063***
	(0.136)	(0.134)	(0.009)	(0.009)	(0.008)	(0.008)	(0.010)	(0.010)
Household Income	0.787***	0.859***	0.048**	0.046**	0.053***	0.049***	0.054**	0.064***
	(0.199)	(0.197)	(0.015)	(0.015)	(0.013)	(0.013)	(0.017)	(0.017)
Age	0.025***	0.023***	0.004***	0.004***	0.001***	0.001***	−0.0001	0.00002
	(0.003)	(0.003)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0003)	(0.0003)
Black	1.014***	0.934***	0.021	0.016	0.042***	0.039**	−0.015	−0.017
	(0.232)	(0.229)	(0.015)	(0.015)	(0.012)	(0.012)	(0.016)	(0.016)
Church Attendance	1.020***	1.079***	0.005	0.011	−0.012	−0.009	0.080***	0.080***
	(0.186)	(0.186)	(0.012)	(0.012)	(0.010)	(0.010)	(0.013)	(0.013)
Constant	−1.248***	−0.734***	0.322***	0.352***	0.420***	0.426***	0.299***	0.339***
	(0.216)	(0.200)	(0.018)	(0.017)	(0.015)	(0.014)	(0.020)	(0.019)
Observations	3,562	3,562	3,582	3,582	3,104	3,104	3,106	3,106
R^2			0.144	0.139	0.099	0.105	0.037	0.038
Log Likelihood	-1,129.717	-1,150.989						

Note: *p<0.05; **p<0.01; ***p<0.001

Table D.4: Effects of sophistication on turnout, political interest, internal efficacy, and external efficacy in the 2012 ANES. Standard errors in parentheses. Estimates are used for Figure 3 in the main text.

	Dependent variable:							
	Turnout		Political Interest		Internal Efficacy		External Efficacy	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Discursive Soph.	2.978***		0.480***		0.357***		0.108***	
	(0.289)		(0.025)		(0.021)		(0.024)	
Factual Knowledge		1.249***		0.213***		0.234***		0.028
		(0.198)		(0.018)		(0.015)		(0.017)
Female	0.025	0.062	−0.074***	−0.061***	−0.063***	−0.050***	0.016*	0.017*
	(0.083)	(0.083)	(0.007)	(0.007)	(0.006)	(0.006)	(0.007)	(0.007)
College Degree	0.552***	0.625***	0.044***	0.055***	0.048***	0.049***	0.037***	0.041***
	(0.108)	(0.107)	(0.008)	(0.008)	(0.007)	(0.007)	(0.008)	(0.008)
Household Income	1.216***	1.188***	0.022	0.019	0.048***	0.034**	0.013	0.015
	(0.150)	(0.151)	(0.013)	(0.013)	(0.011)	(0.011)	(0.012)	(0.012)
Age	0.029***	0.027***	0.003***	0.003***	0.001**	0.0001	−0.0003	−0.0003
	(0.002)	(0.003)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Black	0.714***	0.839***	0.027**	0.047***	0.037***	0.059***	0.083***	0.086***
	(0.118)	(0.119)	(0.009)	(0.010)	(0.008)	(0.008)	(0.009)	(0.009)
Church Attendance	0.637***	0.681***	0.008	0.015	0.003	0.009	0.049***	0.050***
	(0.126)	(0.125)	(0.010)	(0.010)	(0.008)	(0.008)	(0.010)	(0.010)
Constant	−1.745***	−1.545***	0.291***	0.312***	0.413***	0.394***	0.310***	0.324***
	(0.161)	(0.168)	(0.015)	(0.016)	(0.012)	(0.013)	(0.014)	(0.015)
Observations	4,714	4,714	5,002	5,002	4,994	4,994	4,983	4,983
R^2			0.164	0.126	0.126	0.117	0.038	0.034
Log Likelihood	-1,900.648	-1,935.980						

Note: *p<0.05; **p<0.01; ***p<0.001

II Figure 4: Expected information retrieval in the 2015 YouGov Study as a function of political sophistication

Table D.5: Effects of sophistication on information retrieval in the 2015 YouGov study. Standard errors in parentheses. Estimates are used for Figure 4 in the main text.

	Dependent variable:	
	Information Retrieval	
	(1)	(2)
Discursive Soph.	0.348***	
	(0.050)	
Factual Knowledge		0.170***
		(0.026)
Female	0.022	0.052***
	(0.012)	(0.012)
College Degree	0.031*	0.019
	(0.014)	(0.014)
Household Income	−0.030	−0.070*
	(0.030)	(0.030)
Age	0.001**	0.001*
	(0.0004)	(0.0004)
Black	−0.035	−0.038
	(0.021)	(0.021)
Church Attendance	−0.065***	−0.059***
	(0.017)	(0.017)
Constant	0.651***	0.695***
	(0.028)	(0.025)
Observations	792	792
R^2	0.110	0.104
Note:	*p<0.05; **p<0.01; ***p<0.001	

III Figure 7: The gender gap in political sophistication after controlling for common determinants.

Table D.6: Effects of gender on discursive sophistication in the CES, ANES, and YouGov study. Estimates are used for Figure 7 in the main text.

	Dependent variable:				
	Discursive Sophistication				
	2018 CES	2020 ANES	2016 ANES	2012 ANES	2015 YouGov
	(1)	(2)	(3)	(4)	(5)
Female	−0.003	−0.007*	−0.004	−0.00002	0.009
	(0.008)	(0.003)	(0.004)	(0.004)	(0.008)
College Degree	0.049***	0.058***	0.053***	0.068***	0.019
	(0.009)	(0.003)	(0.005)	(0.005)	(0.010)
Household Income	0.018	0.059***	0.048***	0.061***	−0.001
	(0.020)	(0.005)	(0.008)	(0.007)	(0.021)
Age	0.001***	0.001***	0.0004**	0.001***	0.001**
	(0.0002)	(0.0001)	(0.0001)	(0.0001)	(0.0003)
Black	−0.037**	−0.037***	−0.019**	0.003	−0.052***
	(0.013)	(0.005)	(0.007)	(0.005)	(0.015)
Church Attendance	0.008	0.005	0.010	0.011	−0.007
	(0.012)	(0.005)	(0.006)	(0.006)	(0.012)
Constant	0.374***	0.253***	0.259***	0.248***	0.364***
	(0.015)	(0.006)	(0.008)	(0.008)	(0.015)
Observations	868	6,965	3,582	5,004	792
R^2	0.074	0.109	0.076	0.092	0.036
Note:					*p<0.05; **p<0.01; ***p<0.001

Table D.7: Effects of gender on factual knowledge in the CES, ANES, and YouGov study. Estimates are used for Figure 7 in the main text.

	Dependent variable:				
	Factual Knowledge				
	2018 CES	2020 ANES	2016 ANES	2012 ANES	2015 YouGov
	(1)	(2)	(3)	(4)	(5)
Female	-0.083^{***}	-0.104^{***}	-0.026^{**}	-0.059^{***}	-0.158^{***}
	(0.022)	(0.006)	(0.009)	(0.006)	(0.016)
College Degree	0.143^{***}	0.129^{***}	0.057^{***}	0.101^{***}	0.111^{***}
	(0.023)	(0.007)	(0.009)	(0.006)	(0.019)
Household Income	0.191^{***}	0.117^{***}	0.120^{***}	0.153^{***}	0.233^{***}
	(0.053)	(0.011)	(0.016)	(0.010)	(0.041)
Age	0.005^{***}	0.004^{***}	0.002^{***}	0.003^{***}	0.003^{***}
	(0.001)	(0.0002)	(0.0002)	(0.0002)	(0.0005)
Black	-0.031	-0.051^{***}	-0.010	-0.088^{***}	-0.085^{**}
	(0.036)	(0.011)	(0.015)	(0.008)	(0.029)
Church Attendance	-0.007	-0.006	-0.023	-0.010	-0.051^{*}
	(0.032)	(0.010)	(0.013)	(0.008)	(0.023)
Constant	0.458^{***}	0.320^{***}	0.372^{***}	0.460^{***}	0.486^{***}
	(0.041)	(0.013)	(0.017)	(0.011)	(0.029)
Observations	868	6,965	3,582	5,004	792
R^2	0.183	0.172	0.067	0.239	0.275
Note:					*p<0.05; **p<0.01; ***p<0.001