Correction

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Correction for "Examining long-term trends in politics and culture through language of political leaders and cultural institutions," by Kayla N. Jordan, Joanna Sterling, James W. Pennebaker, and Ryan L. Boyd, which was first published February 11, 2019; 10.1073/pnas.1811987116 (*Proc Natl Acad Sci USA* 116:3476–3481).

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Examining long-term trends in politics and culture through language of political leaders and cultural institutions

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From many perspectives, the election of Donald Trump was seen as a departure from long-standing political norms. An analysis of Trump's word use in the presidential debates and speeches indicated that he was exceptionally informal but at the same time, spoke with a sense of certainty. Indeed, he is lower in analytic thinking and higher in confidence than almost any previous American president. Closer analyses of linguistic trends of presidential language indicate that Trump's language is consistent with long-term linear trends, demonstrating that he is not as much an outlier as he initially seems. Across multiple corpora from the American presidents, non-US leaders, and legislative bodies spanning decades, there has been a general decline in analytic thinking and a rise in confidence in most political contexts, with the largest and most consistent changes found in the American presidency. The results suggest that certain aspects of the language style of Donald Trump and other recent leaders reflect long-evolving political trends. Implications of the changing nature of popular elections and the role of media are discussed.

language analysis | analytic thinking | confidence | political leadership | culture

Most scholars and political commentators on both the left and the right agree that Donald Trump is unlike any previous US president. Few would disagree that President Trump speaks in a simple, straightforward fashion and expresses his views with absolute confidence. Is Trump a major deviation from previous leaders in his linguistic and thinking style, or alternatively, is he in line with broader psychological shifts in leadership both within the United States and in other English-speaking countries?

During his campaign and in the first years of his presidency, many have claimed that Trump's simplicity and directness were keys to his popularity (1). Indeed, successful politicians are generally those who make use of simple rather than sophisticated rhetoric (2). Such a strategy may be a conscious decision to connect with a wider range of voters. For example, Spirling (3) observed that leaders, especially those with the most public exposure, significantly decreased the complexity of their parliamentary debate language in response to the inclusion of less educated voters into the British electorate. Additionally, previous research hints that decreasing one's linguistic complexity as an election approaches is a predictor of getting elected (2, 4).

A second major distinguishing feature of Trump's language is his self-confidence. Confidence is often defined as a subjective sense of conviction about one's beliefs (5, 6). The appearance of confidence when facing a crisis has been recognized as an integral aspect of charismatic leadership (7–9). Expressions of confidence and power tend to be highly overlapping (10, 11) such that people often directly associate one with the other. Recently, researchers developed a language-based measure of the critical combination of power and confidence through language (12). We capitalize on this capability to assess linguistically long-term trends of confidence in political leadership.

We build on an extensive research tradition of exploring political leadership traits. Scholars have explored political leadership traits, such as motivation (13), character (14), and complexity (4). Past work has made use of a wide variety of methods, including systematic coding systems (2, 15), qualitative methods (14), and automated dictionary methods (16). We seek to add to the existing literature by using solely automated methods, which allow us to analyze very large samples of political language, and by focusing on psychological processes, which are more broadly applicable to human psychology, rather than specific leadership traits.

If conveying simple messages with confidence is a powerful way to persuade voters in a democracy, it is incumbent on researchers to determine effective ways to measure these dimensions reliably, quickly, and efficiently. The field of text analysis has expanded considerably in the last two decades in large part because of the ability to collect and analyze very large digital datasets. Whereas many of the greatest breakthroughs have surrounded the analysis of the content of text [e.g., search engines (17, 18), topic modeling (19)], other advances have focused on the ways that words reflect linguistic styles—that is, the ways that people write or talk.

A common distinction in language is between content and function words (20, 21). Content words convey the basic information in everyday language and include nouns, main verbs, adjectives, and most adverbs. Function words help to provide shortcuts and context to communication through the use of very short and common words, including articles, prepositions, personal pronouns, impersonal

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Significance

Donald Trump and a small group of emerging leaders around the world have been labeled as outliers in the ways that they think and communicate with others. Are they really anomalies, or do they fit into larger political trends? This study adds to existing scholarship by analyzing two important psychological dimensions, analytic thinking and confidence, in 12 large corpora of political texts representing political leaders of various levels in both the United States and other countries as well as 4 corpora of cultural texts. Rather than being anomalous, linguistic analyses find that, over the last century, there have been consistent declines in analytic thinking and rises in confidence in the ways that political leaders communicate with the public.

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pronouns, auxiliary verbs, conjunctions, negations, and non-referential adverbs (e.g., so, very). An increasing number of studies have demonstrated that people's thinking and attentional patterns are reflected in their uses of function words. Indeed, several experiments find that different function word categories reflect analytic thinking and clout.

The eight categories of function words are not independent and indeed, capture an underlying psychological dimension known as analytic thinking. The construct of analytic thinking has a long history in psychological research and theory (22, 23) and is defined as a deliberate mode of thought wherein complex concepts are deconstructed into more manageable components and their interrelations. Analytic thinking is most apparent in verbal behavior through a speaker's use of articles, which signal concepts, and prepositions, which convey relationships between concepts (24, 25). Language containing high rates of articles and prepositions is necessarily "analytic" in nature due to the function of such linguistic devices, whereas language with low rates of articles and prepositions is generally more experiential and narrative in nature (i.e., diagnostic of a personable, intuitive way of communicating ideas and actions). On the opposite end of the spectrum from analytic thinking is a focus on people and actions, indicating a more informal, personable style. Such an informal type of thinking can be measured in language through the use of pronouns, adverbs, negations, auxiliary verbs, and conjunctions.

Past work has validated the use of function words as markers of the analytic thinking dimension, including a study of college admission essays from over 25,000 incoming students. In this work, a factor analysis of the function word categories yielded a single internally consistent factor, with articles and prepositions being positively loaded and the remaining six dimensions being negatively loaded (Cronbach alpha of the dimension = 0.73). Closer inspection of essays high on the factor revealed texts that were formal, hierarchically organized, and impersonal. Essays with low factor loadings tended to be personal stories (26). Initially labeled the categorical-dynamic index, this pole of the psychological dimension was later renamed analytic (27–29). Conversely, individuals scoring low on such measures of analytic thinking have been found to use higher rates of function word categories, such as pronouns, negations, auxiliary verbs, and so on—such linguistic features serve as signifiers of a more "intuitive" style of thinking (30, 31).

The analysis of function words has also been useful in identifying people's relative status or "clout" in a social hierarchy. Research has found that people who have more influence or status in social interactions tend to use function words differently than those of lower status. Across a range of correlational and experimental studies, higher-status people tend to use the words "you" and "we" at higher rates than those in lower standing. At the same time, lower-status individuals consistently use first person singular pronouns and impersonal pronouns at higher rates than higher-status individuals (32–37). These pronoun differences likely reflect speakers' focus of attention. Higher-status individuals tend to be focusing on others in the group, whereas those who are more insecure tend to be more self-focused. For the purpose of this study, the measure of clout was based on a metaanalysis of five studies by Kacewicz et al. (12).

Relevant to this project, the computerized text analysis program Linguistic Inquiry and Word Count (LIWC) (38) was updated in 2015 to include empirically established measures of both analytic thinking and confidence using algorithms based on the projects of Pennebaker et al. (26) and Kacewicz et al. (12). As noted above, people naturally differ in the extent to which they engage in formal, analytic thinking vs. narrative, intuitive thinking as a function of personality, with some people being more analytical than others. Similarly, people tend to speak using analytic language in more formal settings, such as class presentations, than informal ones, such as everyday conversations or when telling a story. Analytic thinkers tend to use more articles and prepositions, whereas intuitive thinkers tend to use more pronouns, auxiliary verbs, and adverbs.

The algorithm developed from the project of Kacewicz et al. (12) is formally referred to as clout. The measure is calculated from the findings that people high in power (e.g., leaders) tend to use we words (i.e., first person plural pronouns) and social words more while using fewer I words, negations, and swear words. As previously stated, power is inextricably linked with confidence, and as shown by the examples in *SI Appendix*, section 1 and Table S2, people high in clout speak with a sense of certainty and authority, whereas people low in confidence sound more tentative and uncertain. Hence, we use the clout metric to discuss the extent to which leaders and others speak/write with a sense of certainty and confidence vs. a sense of hesitation and doubt.

The goal of this project was to apply linguistic analyses to large corpora of texts from the American presidency, non-US leaders, legislative bodies, and cultural contexts spanning multiple decades. Specifically, we sought to address four research questions.

Have there been changes over the last two centuries in the communication style of American presidents specifically in relation to confidence and analytic thinking?

Have there been similar changes in other world leaders outside the United States?

Are there similar patterns for political figures (i.e., legislators) more generally?

Can any broad-scale shifts be explained by changes in culture?

We applied language analysis metrics to a wide range of available texts, such as speeches, interviews, and stories. Study 1 included six presidential corpora spanning from 16 to 228 y, with a total 33,092 texts from all US presidents as well as recent presidential candidates. Study 2 included three corpora of text spanning from 57 to 120 y from political leaders, such as prime ministers or opposition leaders, with a total of 459 texts. Study 3 used four corpora of legislative bodies spanning 8–22 y, with 544,950 total texts. Finally, four corpora including mainstream news media, movie transcripts, and novels were used in study 4 covering from 16 to ~200 y, with a total of 2,165,228 texts.

Communication Style of American Presidents

This research was guided by analyses of language associated with the 2016 presidential election that found that Donald Trump was significantly less analytic than his opponents as well as more confident (39, 40). This project sought to examine Trump's language patterns within a broader context to determine whether he was an aberration or part of a larger trend toward more confident, less analytic leaders.

For these and all subsequent analyses, we relied on the aggregated summary statistics of individual texts (e.g., a speech, debate, or letter). More information about all texts, including sources and content, is presented in *SI Appendix*, section 1. All texts were analyzed using LIWC 2015 (40) to measure analytic thinking and clout, yielding scores ranging from 0 (least analytic/least confident) to 100 (most analytic/most confident). Analytic thinking and clout were then examined for trends over time by correlating the analytic and clout scores with the year of origin for each text. To show trends graphically, simple averages for the analytic and clout measures were computed by year.

Each corpus of text was analyzed separately to control for differences in context and composition. Additionally, the analysis of each corpus separately allowed us to demonstrate the robustness and reliability of the trends, regardless of potential structural and contextual factors that might be driven by any given corpus individually. For example, while the State of the Union (SOTU) addresses changed from a written to a spoken format, the inaugural addresses remained in the spoken speech

Table 1. Correlations over time by corpus

Source and dataset	Analytic	Clout	Years covered	No. of texts
American presidency				
SOTU	−0.71*	0.67*	1789–2018	228
Inaugural addresses	−0.68*	0.80*	1789–2017	58
Public papers	−0.40*	0.43*	1789–2017	32,130
General debates	−0.37*	0.52*	1980–2016	65
Primary debates	−0.17*	0.18*	2000–2016	562
Nomination acceptance speeches	−0.81*	0.61*	1900–2015	49
Non-US leaders				
UK prime ministers	−0.17	0.55*	1895–2015	119
UK party leaders	0.03	0.44*	1897–2016	194
Canadian prime ministers	−0.40*	0.62*	1960–2017	53
Australian prime ministers	−0.41*	0.64*	1903–2016	49
Australian party leaders	−0.63*	0.79*	1903–2017	44
Legislative bodies				
US Senate	−0.09*	0.19*	1994–2016	131,135
US House of Representatives	−0.02*	0.07*	1994–2016	225,945
UK Parliament	−0.05*	0.10*	1998–2016	160,610
Canadian Parliament	−0.04*	0.01	2006–2016	15,386
European Union	−0.08*	0.05*	2007–2015	11,874
Cultural institutions				
Books	−0.03*	−0.01	1789–1976[†]	5,481
Movie subtitles	−0.08*	−0.13*	1930–2014	11,921
New York Times	−0.10*	0.04*	1987–2017	2,141,668
CNN	−0.52*	0.41*	2000–2016	6,158

*Correlations are significant ($P < 0.05$). Exact P values and confidence intervals are reported in *SI Appendix,* section 2.
[†]Years covered for the books corpus reflect authors' birth year rather than publication year due to issues with copyright dates. Corpora for the American presidency include formal addresses, official written communications, and campaign debates. Non-US leader samples reflect formal addresses by prime ministers or opposition party leaders. Corpora for legislative bodies were taken from the recorded speeches and debates within those institutions. For the cultural corpora, transcripts were used for the spoken media (CNN, movies).

format for the entire duration. As long as results are consistent across these different types of text, we can be reasonably certain that the trends are not being driven by such confounding factors.

Over time, analytic thinking has declined in every type of presidential language analyzed: SOTU addresses, inaugural addresses, public papers, campaign debates, and nomination acceptance speeches (r values range from $r = −0.14$ to $r = −0.81$) [correlations for SOTU addresses, inaugural addresses, public papers, and campaign debates were previously reported in Jordan and Pennebaker (39, 40)]. The median correlation of analytic vs. time was $r = −0.54$. In addition, we observed a significant rise in confidence over time across all corpora ranging from $r = 0.16$ to $r = 0.67$, with a median correlation of $r = 0.57$ (Table 1 shows all correlation values). Additional supporting analyses are reported in *SI Appendix,* sections 3 and 5–7.

While the general trends in analytic and clout are apparent, it is less obvious where Trump falls in these trends. To determine whether Trump is truly an outlier or alternatively, a continuation of previous trends, we conducted regression analyses over time for each corpus, initially excluding Trump. We then estimated what his predicted analytic and clout scores should be were they to follow previous presidential trends compared with his actual scores. More details about the regression analysis can be found in *SI Appendix,* section 8.

Trump's actual analytic scores differed from his predicted analytic scores by roughly five points (i.e., ~0.42 SD; as the average LIWC analytic thinking SD = 12.00) in each of the presidential corpora—well within any reasonable margin of expectancy based on previous trends. The only case in which Trump significantly differed from the expected trend was in the debates, where he was much less analytic than what would have been predicted by nearly 30 points. His actual clout scores differed

from his predicted clout scores by four points (i.e., ~0.35 SD; as the average LIWC clout SD = 11.55) on average across all corpora, including the debates.

The lone domain in which Trump was a true outlier on these metrics was during debates. Given the more off-the-cuff nature of debates, it seems to be the case that Trump's debate performance better represents his natural inclination to a less analytic thinking style, which contrasts with less ad hoc domains, such as prepared speeches. Overall, however, our analysis suggests that Donald Trump—while somewhat more extreme than would have been predicted—conforms to the direction of previous trends and is not an outlier from those trends statistically speaking. Looking closer at these trends (Fig. 1), analytic thinking was very high and stable throughout the 18th and 19th centuries and then began a general decline around 1900. At the same time, confidence began increasing substantially around 1900. Consistent increases in confidence were found across every communication medium from prepared speeches to debates. These results strongly suggest that the recipe that likely helped Trump to become a successful presidential candidate was set in motion almost 100 y before he took office.

To more precisely determine at what point the shifts in communication trends became significant, we conducted additional analyses on the three presidential corpora where an inflection point was evident (e.g., SOTU addresses, inaugural addresses, and public papers). For each of these corpora, we initially restricted the data to only include texts before 1880 and then fit a linear model. We repeated the procedure, adding in the next year's text before refitting the model [using a similar method to that proposed by Simonsohn (41)]. We then identified the year in which the trend became consistently significantly negative for analytic and positive for clout. A table with regression results for each year can be found in *SI Appendix,* section 10. For analytic, the
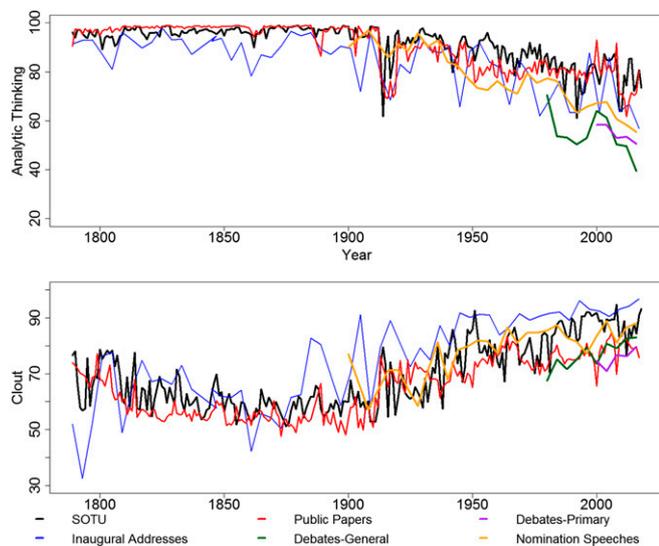
Fig. 1. Yearly averages used for graphs. Analytic ranges are from 0 (most narrative) to 100 (most analytic). Clout ranges from 0 (least confident) to 100 (most confident). The average SD for analytic is 12.00 and the average SD for clout is 11.55 across six presidential corpora. The points on the graph represent slightly different numbers depending on the corpus. For the SOTU addresses, there is a single text represented each year. For the inaugural addresses, there is a single text represented every 4 y of a new inauguration. For public papers, each year there are average analytic and clout scores for all texts available from that year. For nomination acceptance speeches and debates, average analytic and clout scores were calculated from every text available during election years.

downward trends began around Wilson's presidency and Word War I (1914, public papers; 1917, inaugural addresses; 1923, SOTU addresses). For clout, the upward trend started in slightly different years depending on the corpus, but the trend was firmly in place by the Eisenhower presidency (1917 in the inaugural addresses; 1930 in the public papers; 1954 in the SOTU addresses).

Communication Style of Non-US English-Speaking Leaders

To determine how generalizable the US presidential trends might be, we analyzed other leaders, namely prime ministers and opposition party leaders in the United Kingdom, Canada, and Australia. If similar trends were found in these leaders, then the trends discovered for American presidents could not be explained as solely an American phenomenon. Rather, such a finding would suggest a common psychological trend among the most visible political leaders with unilateral decision-making power. One might imagine that possessing particular personality characteristics is more important for leaders who operate under a watching public and have the ability to often act independent of other political institutions.

As depicted in Table 1, trends in the language of other world leaders were generally weaker than those of US presidents. The median correlation of analytic over time was $r = -0.40$, and the median correlation of clout over time was $r = 0.62$. Nevertheless, patterns are generally consistent and significant for Canadian and Australian prime ministers and party leaders and for the measure of clout, for British leaders. The one exception to the trends was the analytic measure for British leaders.

Together, the results of study 2 provide evidence that the trends found in the American presidency generally extend to other leaders of large English-speaking democracies. A more consistent decline in analytic communication style begins around 1980, and overall, trends are much stronger for Canadian and Australian leaders compared with British leaders (*SI Appendix*, section 2 has a graphical representation). For clout, the direction and strength of the trend among non-US leaders mirror that among US presidents.

The results from non-American leaders provide evidence that the simple, confident rhetorical style observed in recent American presidents is an increasingly important marker of leadership globally (or at least in other English-speaking democracies).

Political Communication Style

Turning to political leadership more generally, rank-and-file legislators often deal with many of the same issues as presidents and prime ministers but in a less public as well as a more deliberative and cooperative environment. Their elections and constituencies are typically composed of smaller regions of their countries, where they personally and directly interact with a higher percentage of likely voters. While the legislative corpora span a smaller timeframe of 20 y or so, any reliable trends should be apparent given the strength of the trends found in political communications thus far.

For each of these legislative bodies, written transcripts of the debates and speeches given within the institution were used to measure our constructs of interest. The directions of the trends in both analytic and confident language were the same as those for US presidents and non-American leaders but were much weaker in magnitude. For analytic thinking, correlations over time range from $r = -0.02$ to $r = -0.09$, with a median of $r = -0.05$. For confident language, the trends are marginally stronger, ranging from $r = 0.01$ to $r = 0.19$, with a median of $r = 0.07$ (Table 1). The trends are consistently strongest in the US Senate and UK Parliament and weaker for the US House of Representatives, potentially related to length of terms (5–6 vs. 2 y). Additional supporting analyses of the Congressional corpus are reported in *SI Appendix*, section 4.

The trends for legislators are subtler and slower moving compared with those of US presidents and other non-American leaders (*SI Appendix*, section 2 has a graphical representation.). Potential reasons for the effect size reduction in the legislator corpora are that legislators are under far less constant public scrutiny, work as a body rather than individually, and have smaller, more homogenous constituencies to represent. However, the consistency of the communication patterns in legislative bodies with trends in other leadership suggests a wider political phenomena impacting multiple levels and forms of political leadership.

Cultural Shifts

Finally, we sought to determine whether the trends found across political contexts might reflect a broader cultural phenomenon, whereby people are using less analytical and more confident language more generally. In some ways, it could be argued that the mass media, like national political figures, must appeal to large numbers of people and communicate complex ideas while sustaining an audience's attention. If changes in the language of mass media and/or the population in general have changed significantly over the last century, the shifts in the language of political figures may not be due to political factors but rather, may be due to more general cultural changes in language.

To explore broader language shifts, several large corpora were analyzed, focusing on the correlations of analytic and clout language with year. As shown in Table 1, a large sample of 5,481 English language novels with authors born between 1789 and 1976, 11,921 texts of movie subtitles between 1930 and 2014, and 2,141,668 *New York Times* articles from 1987 to 2017 found relatively weak, inconsistent correlations between year and the measures of analytic thinking and clout. The striking exception was with the transcripts of 6,158 aired CNN programs from 2000 to 2016, which revealed robust shifts congruent with those of US presidents. A predominant focus on and entanglement with politics since its introduction in 1980 may help to explain why CNN broadcasts show similar trends to other political people and institutions.

Taken together, the cultural corpora would suggest that our findings in previous studies reflect a primarily political phenomena.

However, the pattern is more complex, particularly when it comes to news media that might face many of the same challenges as political figures in terms of keeping the interests and attention of large audiences in the face of ever-increasing alternatives. More than entertainment, providing simple, authoritative accounts of events may be more appealing to news audiences.

Discussion

Across multiple large corpora of American and other English-speaking elected leaders, we found strong, consistent evidence for decreases in formal (analytic) language and increases in confident (clout) language over time. The strongest trends were found within the American presidency; however, politicians across multiple political contexts have been increasingly communicating to audiences with informal and confident language. Even media outlets with a focus on politics display these trends.

Taken together, the trends discovered in this research suggest that voters may increasingly be drawn to leaders who can make difficult, complex problems easier to understand with intuitive, confident answers. The findings confirm that President Trump and leaders like him did not emerge out of nowhere but rather, that they are the most recent incarnation of long-term political trends (at least when it comes to the traits measured in this study).

Political communication involves many strategic choices; politicians employ speechwriters, advisors, and consultants to try to get voters to see them how they want to be seen. While analytic thinking and confidence are generally stable psychological traits, the realities of the political realm may shift these constructs to capture more conscious stylistic choices. However, the trends that we have discovered reveal important underlying psychological processes, regardless of whether they are traits or styles.

From a psychometric perspective, analytic thinking and clout may be considered as uncannily stable were they primarily capturing stylistic tendencies as opposed to deeper traits. In *SI Appendix*, section 5, we show that American presidents are highly consistent across time and context, with Cronbach's alpha values upward of 0.80. Such consistency would suggest that our analytic and clout constructs are, at the very least, trait like. From a pragmatic perspective, leadership success is heavily influenced by how leaders are perceived by others (1). If a politician wants voters to perceive them as a highly analytic thinker, they would need to carefully alter their language composition. The changes that politicians and other leaders make to their public personalities and styles may indeed by more important to understanding them than determining what their "true" psychological traits are. In the political context, it is difficult to separate politicians' rhetoric from what they actually think and believe. However, even if it were the case that the analytic and clout metrics were capturing conscious stylistic decisions on the part of political leaders, such choices nevertheless can be thought of as reflecting deeper psychological processes (e.g., the choice to convey particularly thinking styles) that have important implications for political behavior and leadership.

As stated previously, the trends in communication styles for American presidents solidified between the first World War and the beginning of the Cold War—a time period of immense political and technological changes not only for the United States but also, for the global community. From sweeping changes in communication technologies, such as the radio, to increasing presidential power, US presidents of the early 20th century began to take on the roles commonly seen in today's presidents, such as guiding legislative agendas, campaigning for themselves and their policies, and speaking directly to the American people (42, 43). For other leaders, the start of the trend is somewhat less clear but likely began around the same time as the changes in the American presidency. For legislative leaders, the same trends appear with small but steady shifts since at least the mid-1990s. We did not find consistent evidence that these trends were mirrored in our more cultural corpora. In fact, in only one case—

CNN—did we find patterns similar to what we observed in the political leader texts.

There are a number of reasons why the shifts in political language may be occurring. One possibility is the rise of populism throughout Europe and the United States, which could have necessitated a shift to a more accessible way of communicating (44).* If changes in style can be linked to increases in populism in recent decades, then perhaps a null finding among cultural outlets makes sense. It is not that the population is decreasing in their general analytic thinking and becoming more confident but rather, that they are increasingly looking toward powerful leaders who embody an intuitive, straightforward, and sure approach to society's problems.

Additionally, changes to communication technology and mass media present new opportunities and challenges for the president and other leaders in persuading the public and communicating their messages (42, 45). The style used by early presidents who communicated through writing in newspapers and in-person speeches to small audiences likely was increasingly ineffective in the face of mass communication technologies, such as radio, television, and the internet today. In the face of technological shifts, presidents who exhibited a narrative, confident thinking style may have increasingly been better suited for the complex, public-oriented office of the presidency.

A third reason could be linked to the increasing complexity faced by political leaders (43). From the rise of globalization and international relations to complex domestic issues, like health care, technology, and infrastructure, the issues faced by modern presidents and other leaders are different from those faced by 19th century leaders. As everyday life becomes more complex and uncertain, a leader who is communicating an intuitive, sure solution for society's ails may be especially appealing.

Finally, important potential drivers of the trends in leaders' communication style are shifts in societal norms and values regarding political leadership roles. Scholars have identified general trends of "informalization" in Western society, wherein accepted norms have become increasingly less strict in terms of manners and emotional expression (46, 47). Long-term shifts away from strongly hierarchical, aristocratic systems in the United States and other nations may have significantly filtered into expectations for political elites, which could manifest in their language patterns as well. Interestingly, however, we found no evidence of changes in cultural forms (e.g., books, movies) that we found for political leaders. Cultural shifts may have outsized impacts on political leaders, however, with voters increasingly shunning professorial, aristocratic, or elitist politicians, leading to a less analytic, more confident, and informal style of communication in successful political candidates.

While our research leveraged one of the most comprehensive sets of political corpora to date, there are several limitations to our findings as well as fruitful areas for continued research. We do not measure populism, media exposure, or uncertainty levels throughout a society to see whether changes in these factors correlate with the relevant linguistic patterns. Along the same lines, additional work must be done to better understand why we observe different trends in nations with differing forms of government, such as the United Kingdom, Canada, and Australia, than we do in the United States. Furthermore, in capturing societal language patterns in general, we are still only focusing on the language of cultural elites: news articles, movie transcripts, and books. Additional research should be performed to better understand how linguistic trends unfold in more ecologically representative samples, such as population patterns in social media language, online forums, and local news outlets.

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Ultimately, we believe that this research can be further leveraged to better understand broad sociopolitical trends, particularly in terms of the how psychological properties of government elites may reflect deeper population-level trends. By taking advantage of advances in data analytics, such as automated text analysis, we can analyze very large datasets and gain a better understanding of the trends and changes in the political environment. Modern methods, such as psychological language analyses used in this study, are particularly valuable for the measurement of psychological trends in political leadership, which can help to inform and provide large-scale empirical support for existing theories. While lay and expert perspectives alike may identify politicians like Donald Trump as deviations from the norm, it is imperative for scientists and researchers to also better understand those processes by which such leaders may, in fact, fall within the expectancies of ongoing trends. Such assumption testing through the quantification of political leaders' traits is critical for testing our intuitions in a rigorous yet broad-gauged manner.

Materials and Methods

In the study of the American presidency, six corpora were collected. Additional descriptive information can be found in *SI Appendix*, section 1 and Table S1. In the study of non-US leaders, annual speeches made by UK prime ministers and opposition leaders, speeches and interviews from 12 Canadian prime ministers, and election speeches of Australian prime ministerial candidates were collected. Winning and losing candidates were analyzed separately (51). Four corpora of texts from legislative bodies were collected, including speeches from the US House of Representatives and the US Senate spanning 1994–2016, debate from the UK Parliament's House of Commons between 1998 and 2016, Canadian Parliamentary speeches from 2006 to 2016, and speeches from the European Union encompassing speeches made by national leaders as well as European Union officials from 2007 to 2015. For consistency with other datasets, only speeches given in English were included. For each of these corpora, a minimum word count of 100 words was set. Four corpora representing different cultural institutions and contexts were collected, including a corpus of 5,418 public domain books, 11,921 English-language movie subtitle files, 2,141,668 individual *New York Times* articles from 1987 to 2017, and daily CNN transcripts combining various programs covering 1997–2016. More information regarding the data and methods is in *SI Appendix*, section 1.

1. Ahmadian S, Azarshahi S, Paulhus DL (2017) Explaining Donald Trump via communication style: Grandiosity, informality, and dynamism. *Pers Individ Dif* 107:49–53.
2. Thoemmes FJ, Conway LG (2007) Integrative complexity of 41 US presidents. *Polit Psychol* 28:193–226.
3. Spirling A (2016) Democratization and linguistic complexity: The effect of franchise extension on parliamentary discourse, 1832–1915. *J Polit* 78:120–136.
4. Conway LG, III, et al. (2012) Does complex or simple rhetoric win elections? An integrative complexity analysis of US presidential campaigns. *Polit Psychol* 33:599–618.
5. Gross S, Holtz R, Miller N (1995) Attitude certainty. *Attitude Strength: Antecedents and Consequences*, eds Petty RE, Krosnick JA (Erlbaum, Mahwah, NJ), pp 215–245.
6. Petty RE, Briñol P, Tormala ZL, Wegener DT (2007) The role of meta-cognition in social judgment. *Social Psychology: A Handbook of Basic Principles*, eds Higgins ET, Kruglanski AW (Guilford, New York), 2nd Ed, pp 254–284.
7. Bligh MC, Kohles JC (2009) The enduring allure of charisma: How Barack Obama won the historic 2008 presidential election. *Leadersh Q* 20:483–492.
8. Shamir B, House RJ, Arthur MB (1993) The motivational effects of charismatic leadership: A self-concept based theory. *Organ Sci* 4:577–594.
9. Shamir B, Howell JM (1999) Organizational and contextual influences on the emergence and effectiveness of charismatic leadership. *Leadersh Q* 10:257–283.
10. Gonzaga GC, Keltner D, Londahl EA, Smith MD (2001) Love and the commitment problem in romantic relations and friendship. *J Pers Soc Psychol* 81:247–262.
11. Guinote A, Judd CM, Brauer M (2002) Effects of power on perceived and objective group variability: Evidence that more powerful groups are more variable. *J Pers Soc Psychol* 82:708–721.
12. Kacewicz E, Pennebaker JW, Davis M, Jeon M, Graesser AC (2014) Pronoun use reflects standings in social hierarchies. *J Lang Soc Psychol* 33:125–143.
13. Winter DG (2005) Things I've learned about personality from studying political leaders at a distance. *J Pers* 73:557–584.
14. Barber JD (1992) *The Presidential Character: Predicting Performance in the White House* (Prentice Hall, Englewood Cliffs, NJ).
15. Hermann MG (2005) Assessing leadership style: A trait analysis. *The Psychological Assessment of Political Leaders*, ed Post JM (University of Michigan Press, Ann Arbor, MI), pp 178–212.
16. Hart RP, Childers JP, Lind CJ (2013) *Political Tone: How Leaders Talk and Why* (University of Chicago Press, Chicago).
17. Pelham BW, et al. (2017) Searching for God: Illness-related mortality threats and religious search volume in Google in 16 nations. *Pers Soc Psychol Bull* 44:290–303.
18. Stephens-Davidowitz S (2014) The cost of racial animus on a black candidate: Evidence using Google search data. *J Public Econ* 118:26–40.
19. Slapin JB, Proksch SO (2008) A scaling model for estimating time-series party positions from texts. *Am J Pol Sci* 52:705–722.
20. Gamon M (2004) Linguistic correlates of style: Authorship classification with deep linguistic analysis features. *Proceedings of the 20th International Conference on Computational Linguistics* (Association for Computational Linguistics, Stroudsburg, PA), pp 611–617.
21. Miller GA (1995) WordNet: A lexical database for English. *Commun ACM* 38:39–41.
22. Epstein S, Pacini R, Denes-Raj V, Heier H (1996) Individual differences in intuitive-experiential and analytical-rational thinking styles. *J Pers Soc Psychol* 71:390–405.
23. Evans JSBT (2003) In two minds: Dual-process accounts of reasoning. *Trends Cogn Sci* 7:454–459.
24. Davies M (2011) Concept mapping, mind mapping and argument mapping: What are the differences and do they matter? *High Educ* 62:279–301.
25. Huddleston R, Pullum GK (2002) *The Cambridge Grammar of the English Language* (Cambridge Univ Press, Cambridge, UK).
26. Pennebaker JW, Chung CK, Frazee J, Lavergne GM, Beaver DI (2014) When small words foretell academic success: The case of college admissions essays. *PLoS One* 9: e115844.
27. Boyd RL, Pennebaker JW (2015) Did Shakespeare write double falsehood? Identifying individuals by creating psychological signatures with text analysis. *Psychol Sci* 26:570–582.
28. McHaney R, Tako A, Robinson S (2018) Using LIWC to choose simulation approaches: A feasibility study. *Decis Support Syst* 111:1–12.
29. Kovanović V, et al. (2018) Understand students' self-reflections through learning analytics. *Proceedings of the 8th International Conference on Learning Analytics and Knowledge* (Association for Computing Machinery, New York), pp 389–398.
30. Cichocka A, Bilewicz M, Jost JT, Marrouch N, Witkowska M (2016) On the grammar of politics—or why conservatives prefer nouns. *Polit Psychol* 37:799–815.
31. Dzogang F, Lightman S, Cristianini N (2018) Diurnal variations of psychometric indicators in Twitter content. *PLoS One* 13:e0197002.
32. Cassell J, Huffaker D, Tversky D, Ferriman K (2006) The language of online leadership: Gender and youth engagement on the internet. *Dev Psychol* 42:436–449.
33. Chung C, Pennebaker JW (2007) The psychological functions of function words. *Soc Commun* 1:343–359.
34. Dino A, Reysen S, Branscombe NR (2009) Online interactions between group members who differ in status. *J Lang Soc Psychol* 28:85–93.
35. Sakai EY, Carpenter BD (2011) Linguistic features of power dynamics in triadic dementia diagnostic conversations. *Patient Educ Couns* 85:295–298.
36. Drouin M, Boyd RL, Hancock JT, James A (2017) Linguistic analysis of chat transcripts from child predator undercover sex stings. *J Forensic Psychiatry Psychol* 28:437–457.
37. Sell J, Farreras IG (2017) LIWC-ing at a century of introductory college textbooks: Have the sentiments changed? *Procedia Comput Sci* 118:108–112.
38. Pennebaker JW, Booth RJ, Boyd RL, Francis ME (2015) Linguistic Inquiry and Word Count: LIWC 2015 (Pennebaker Conglomerates, Austin, TX), Version 1.3.1.
39. Jordan KN, Pennebaker JW (2016) How the candidates are thinking: Analytic versus narrative thinking styles. Available at https://wordwatchers.wordpress.com/2016/01/21/how-the-candidates-are-thinking-analytic-versus-narrative-thinking-styles/. Accessed January 21, 2016.
40. Jordan KN, Pennebaker JW (2017) The exception or the rule: Using words to assess analytic thinking, Donald Trump, and the American presidency. *Transl Issues Psychol Sci* 3:312–316.
41. Simonsohn U (2018) Two-lines: A valid alternative to the invalid testing of U-shaped relationships with quadratic regressions. *Adv Methods Pract Psychol Sci*, 10.2139/ssrn.3021690.
42. Greenberg D (2016) *Republic of Spin: An Inside History of the American Presidency* (WW Norton & Company, New York).
43. Milkis SM, Nelson M (2011) *The American Presidency: Origins and Development, 1776-2011* (CQ Press, Washington, DC).
44. Bakker BN, Rooduijn M, Schumacher G (2016) The psychological roots of populist voting: Evidence from the United States, the Netherlands and Germany. *Eur J Polit Res* 55:302–320.
45. Kernell S (2006) *Going Public: New Strategies of Presidential Leadership* (CQ Press, Washington, DC).
46. Lieberson S (2000) *A Matter of Taste: How Names, Fashions, and Culture Change* (Yale Univ Press, New Haven, CT).
47. Wouters C (1986) Formalization and informalization: Changing tension balances in civilizing processes. *Theory Cult Soc* 3:1–18.