

LETTERS OF THE PRESIDENTS

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The 37 different surnames of US presidents can be compared with each other in many different ways. This paper looks at them in one, two, and three dimensions—along a line, on a plane, and in space, showing which ones are neighbors and which ones are outliers.

Presidents Lined Up

Can a name be reduced to a single numeric quantity? Setting A=1, B=2, ... Z=26, add up the numerical scores in a name and divide by the number of letters in the name to obtain the name's density, or average position in the alphabet. It is known that words in general are biased toward the first half of the alphabet, the average letter position being 11.3 rather than the 13.5 if all letters are equally likely. The presidential names are distributed as follows:

7.5-7.99	Adams, Reagan, Garfield
8.0-8.49	Buchanan
8.5-8.99	Harding, Cleveland, Coolidge
9.0-9.49	Pierce
9.5-9.99	
10.0-10.49	Jackson
10.5-10.99	Ford, Carter, Jefferson, Madison
11.0-11.49	Kennedy, Lincoln, Clinton, Fillmore
11.5-11.99	Taft, Hayes, McKinley
12.0-12.49	Grant, Van Buren, Eisenhower
12.5-12.99	Bush, Harrison
13.0-13.49	Nixon, Monroe, Washington
13.5-13.99	Polk, Hoover, Johnson
14.0-14.49	Arthur
14.5-14.99	Truman, Roosevelt
15.0-15.49	Taylor = Wilson
15.5-15.99	
16.0-16.49	Tyler

Of the 37 names, 16 are below the 11.30 average and 21 above it, suggesting that presidential surnames are slightly weightier than normal words.

Presidents on the Plane

If two words share one or more letters, they can be called *chums*, but if they have no letters in common, they are *strangers*. How chummy are the 37 different surnames of American presidents? The table on the next page gives, for each surname, the number of other surnames it shares no letters with (vertical axis) and the number of different letters in the surname (horizontal axis). Obviously, names with few different letters are less likely to be chummy than those with many different letters, and the diagonal pattern clearly illustrates this. (Many names have been abbreviated, but all abbreviations are uniquely identifiable.)

Number of Different Letters in Surname

	3	4	5	6	7	8	9
0					Harr Jef		Washing
1				Taylor	Ma V Hard Ro Ja Cle	Eisenh	
2			Rea Mon Gra Hoo		Fillmore	Garfield	
3			Kennedy	Tr Cli Wilson			
4		Ford	Pie Car		Coolidge	McKinley	
5			Li Jo Hay				
6							
7		Nix Ada	Art Tyl	Buchanan			
8							
9							
10							
11							
12		Polk					
13	Taft						
14							
15							
16							
17							
18							
19		Bush					

V = Van Buren, Ma = Madison, Cle = Cleveland, Ro = Roosevelt, Nix = Nixon,
 Ja = Jackson, Li = Lincoln, Jo = Johnson, Tr = Truman, Cli = Clinton, Pie = Pierce,
 Hay = Hayes, Rea = Reagan, Jef = Jefferson, Hoo = Hoover, Car = Carter
 Mon = Monroe, Gra = Grant, Ada = Adams, Art = Arthur, Tyl = Tyler

The most startling feature of the table is the isolation of Bush; the name shares no letters with 19 others, over half of the total (Carter, Cleveland, Clinton, Coolidge, Fillmore, Ford, Garfield, Grant, Kennedy, Lincoln, McKinley, Monroe, Nixon, Pierce, Polk, Reagan, Taft, Taylor, Tyler). More generally, if one tries to assemble groups of mutual strangers, all groups of size three contain Bush: Bush and Taft are strangers to Coolidge, Kennedy, Lincoln, McKinley, Nixon, Polk and Pierce; Bush and Ford are strangers to McKinley; Bush and Polk are strangers to Grant.

Most of Bush's strangeness can be explained by a simple mathematical model. The letter B does not appear in 34 of the other 36 surnames, the letter U does not appear in 32, the letter S does not appear in 25, and the letter H does not appear in 27. The probability that BUSH is not in another surname is the product $(34)(32)(25)(27)/(36)(36)(36)(36) = 0.44$, and the expected number of names that are strangers to BUSH is $36(0.44) = 15.7$. Thus, Bush is only a little stranger than this multiplicative model of letter-frequencies suggests. His theoretical strangeness exceeds that of Taft (12.7), Polk (11.1) and Adams (9.2). Washington (0.88), Eisenhower (0.76) and Harrison (0.74) are the lowest.

The chummiest surnames, Washington, Jefferson and Harrison, are strangers to none. Historically, there have been eight other surnames that at least temporarily were chummy; Tyler was the first stranger to Adams, Madison and Jackson, Buchanan was the first stranger to Fillmore, Polk was the first stranger to Van Buren, Taft was the first stranger to Monroe, and Bush was the first stranger to Taylor and Cleveland.

One can look at degree of chumminess. Washington shares six letters with Harrison (AHINOS), Harrison six letters with Eisenhower (AHINOR), and Eisenhower six letters with Washington (HINORW). Jefferson, Wilson, Harding and Madison are five-letter chums with one or more of these three, as is Garfield with Harding, Garfield with Fillmore, and Clinton with Lincoln. If one measures chumminess by the sum of all common letters, then the best chums are Eisenhower 107, Harrison 106, and Washington 103. In contrast, the chumminess index of Bush is 25, Taft 30 and Polk 33; none of these is more than a two-letter chum with any other name.

The letters AEOS and ANOS collectively appear in all 37 surnames, so a short name is not necessarily a guarantee of strangeness. Anyone for President O'Shea?

Presidents in Space

If one slices up a cube into 27 subcubes, there exists an internal subcube surrounded by 26 others. These can be characterized by a porcupine of arrows (vectors) going from the center of the internal subcube to the centers of the surrounding ones. As there are 26 letters in the alphabet, each vector can be uniquely labeled with a letter. This concept is spelled out in more detail under Word Worms (page 248) in my book *Making the Alphabet Dance* (1996). The assignment of letters to vectors can be made in various ways, but a reasonable one is

A B C	J K L	R S T
D E F	M N	U V W
G H I	O P Q	X Y Z

which leads to the following (x y z) components defining each vector:

A	1	1	1	F	1	-1	0	J	0	1	1	N	0	-1	0	R	-1	1	1	V	-1	0	0
B	1	0	1	G	1	1	-1	K	0	0	1	O	0	1	-1	S	-1	0	1	W	-1	-1	0
C	1	-1	1	H	1	0	-1	L	0	-1	1	P	0	0	-1	T	-1	-1	1	X	-1	1	-1
D	1	1	0	I	1	-1	-1	M	0	1	0	Q	0	-1	-1	U	-1	1	0	Y	-1	0	-1
E	1	0	0																	Z	-1	-1	-1

Each surname terminates at a point in space determined by summing the components of its letters; thus, P (0 0 -1) + O (0 1 -1) + L (0 -1 1) + K (0 0 1) yields POLK (0 0 0)—Polk is a stay-at-home surname, returning to its start. In contrast, T (-1 -1 1) + Y (-1 0 -1) + L (0 -1 1) + E (1 0 0) + R (-1 1 1) yields TYLER (-2 -1 2), which by the Pythagorean Theorem ends up a distance equal to the square root of $4 + 1 + 4$, or 3 units away from its start.

The diagram below shows how a central core of 13 surnames which are tightly tied to each other. The second component of a surname is given on the x-axis, and the third component on the y-axis. If the first component is 0, the name is plotted on the page; if the first component is 1, the name (in boldface) should be viewed as one unit above the page, and if the first component is 2, the name (in italic) should be viewed as two units above the page. Twelve names appear; the thirteenth, Ford (1 2 0), is underneath Madison (2 2 0).

		Second Component of Vector			
		0	1	2	3
	5		Carter		
Third	4		Jackson		
Component	3	Van Buren			
Of Vector	2		Grant		
	1		Bush	Harrison	
	0	Polk	Hayes	<i>Madison</i>	
	-1		Johnson		Monroe
	-2				Hoover

One can move from one surname to an adjacent one by changing each component at most one unit.

The remaining 24 surnames can be related to the above diagram as follows:

- Up and to the right of Jackson are Adams (2 4 3) and Reagan (3 3 2)
- To the left of Van Buren are Taft (0 -2 3) and Tyler (-2 -1 2)
- Beneath Grant are Taylor and Roosevelt (both -2 1 2), Truman (-2 2 3), Arthur (-2 3 3)
- Above Grant are Jefferson (2 0 2), Buchanan (4 0 3) and Cleveland (4 -2 4)
- Down and to the left of Polk are Wilson (-1 -3 0)
- Up and to the left of Polk are Nixon (0 -1 -3), Washington (1 -2 -2), Eisenhower (2 -1 -1), Kennedy (2 -1 0), Pierce (3 -1 0) and Fillmore (2 -1 -1)

- To the left of Fillmore are McKinley (2-3 1), Lincoln (2-5 1) and Clinton (1-5 1)
- Above Madison are Harding (4 2-1), Coolidge (5 1-2) and Garfield (5 1 1)

Two surnames, Roosevelt and Taylor, end up at the same point (-2 1 2). Polk is the least peripatetic of the names, ending up where he started (0 0 0). On the other hand, the most far-ranging surnames are Cleveland who ends up 6 units from the origin, followed by Coolidge and Lincoln $\sqrt{30}$ units from the origin. The two surnames farthest apart appear to be Clinton and Adams, $\sqrt{86}$ units apart. Wilson (-1-3 0) is the most isolated surname; the nearest neighbors are Washington (1-2-2) and Tyler (-2-1 2), both 3 units away.

How does Kerry fare? At 15.4, he has a much greater density than average, exceeded only by Tyler (Bush is above average in this regard). Kerry fails to match letters with 12 of the 37 other surnames, being equaled by Polk and exceeded only by Taft (14) and Bush (20) in what would now be a 38-name group. If president, Kerry would end Washington's role as a chum to all other presidents, since he and Washington share no letters. Kerry's vector components are (-2 2 2); the presidents he most resembles are Roosevelt, Truman and Taylor, all only a unit away, and the most distant one is Lincoln $\sqrt{66}$. (Bush most resembles Grant and Harrison, and is also most distant from Lincoln $\sqrt{40}$.)