

## Dvorak typewriter words

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In the November 1999 *Word Ways* Mike Keith explored the subject of wordplay based on the typewriter keyboard—that is, words which can be typed with certain well-defined restrictions, such as using only one keyboard row, or alternating hands for each successive letter [1]. Keith's findings were based on QWERTY, the most common keyboard layout in the English-speaking world. In this article we improve upon some of Keith's QWERTY records, and repeat most of his original challenges with another popular English keyboard layout, the Dvorak Simplified Keyboard.

The Dvorak Simplified Keyboard, or *Dvorak* for short, was introduced in the 1930s and was carefully engineered to overcome QWERTY's many shortcomings. It places the most common letters on the home row, where the fingers rest, and the least common letters on the bottom row, which is the hardest to reach. The keys are also arranged in such a way that successive letters are usually typed with alternating hands. These features are believed to result in faster, more rhythmic typing, with fewer errors and less fatigue. Today Dvorak enjoys official recognition from the American National Standards Institute and is supported by all major computer operating systems. Its popularity is hard to gauge in absolute numbers, but it is undoubtedly the most common English layout after QWERTY, and has a number of famous and not-so-famous proponents (including the present author).

For ease of reference, the illustrations below show the American QWERTY layout and the Dvorak variant most commonly encountered today.

~	!	@	#	\$	%	^	&	*	(	)	-	+	←
`	1	2	3	4	5	6	7	8	9	0	=	=	Backspace
Tab	Q	W	E	R	T	Y	U	I	O	P	{	}	
↔	↔										[	]	\
Caps Lock	A	S	D	F	G	H	J	K	L	:	"	↵	Enter
⬆										;	'	↵	↵
Shift		Z	X	C	V	B	N	M	<	>	?	Shift	↵
⬆									,	.	/	⬆	↵
Ctrl		Alt								Alt			Ctrl

~	!	@	#	\$	%	^	&	*	(	)	{	}	←
`	1	2	3	4	5	6	7	8	9	0	[	]	Backspace
Tab	"	<	>	P	Y	F	G	C	R	L	?	+	
↔	'	,	.								/	=	\
Caps Lock	A	O	E	U	I	D	H	T	N	S	-	↵	Enter
⬆											-	↵	↵
Shift	:	Q	J	K	X	B	M	W	V	Z	Shift	↵	↵
⬆	:										⬆	↵	↵
Ctrl		Alt								Alt Gr			Ctrl

### Row and column words

Keith first considers the longest words which can be typed entirely on one row or column. For the QWERTY top row he cites the 11-letter PROPRIETORY, PROTEROTYPE, and RUPTUREWORT, and for the middle row the 11-letter KHALAKHKHAS. (All these were originally reported by Dmitri Borgmann [2].) The Dvorak keyboard has nothing so long on the top row; the best we can manage is the 6-character GLYCYL. However, with access to the five primary vowels, Dvorak easily bests QWERTY on the middle row with the 19-letter INSTANTANEOUSNESSES.

Neither keyboard layout provides much to work with on the bottom row. For QWERTY Borgmann offered the onomatopoeic BZZBZZ, which we note can also be produced on Dvorak. We can produce some further examples if abbreviations (including those for proper names) are permitted. Dvorak gives us

WWW, KKK, BMX, BMW, BBB, and BBQ. Television aficionados will be pleased with QWERTY's offerings of CNN, NBC, CBC, and BBC.

With a maximum of three distinct letters each, the keyboard columns likewise don't give us much to work with. The longest QWERTY word reported by Keith was DEEDED; the longest two words we found for Dvorak were PUKU and KUKU.

### **Isofinger words**

Keith defines an *isofinger word* as one in which each finger is used at most once. Since the thumbs are relegated to the space bar, the longest isofinger words have eight letters. Keith gives nearly two dozen such words, and a follow-up article by Rex Gooch [3] provides over a hundred more. Dvorak isofinger words of length 8 are similarly common, so for want of space we won't list them all here. Some of the more familiar ones include AEROBICS, ASTEROID, BANQUETS, CONJUGAL, IDOLATOR, NOTEPADS, OUTRAGES, PORTABLE, SYCAMORE, SEDATION, TAILORED, VIOLATED, and WORKABLE.

*Repeated isofinger words* allow a finger to be used in a single batch of one or more keypresses before moving on to the next finger. The longest such words reported by Keith have 11 letters: ASPERGILLUM, PATRONYMICS, and UNPOLARISED. To this list we can add POLYHYBRIDS, MULTIACCESS, MISALLOTTED, MARROWSKIED, KILOGRAMMES, HYMNOLOGIES, HAPLOLOGIES, CALLITHUMS, and GODESSSHIP. (The last of these is remarkable in its own right as one of the few English words with a triple S.) Dvorak repeated isofinger words are somewhat rarer, with only three examples of length 11: RAMBOUILLET, HORRIPILATE, and ATTORNEYISM.

### **Finger-twice words**

A *finger-twice word* uses each finger exactly twice before moving on to the next one, though the same finger can be returned to later on. Keith names the ten-letter UNDERFLOWS as the longest such word. The Dvorak keyboard is not so

well-endowed here, yielding only the six-letter SLEEPY, PUTTEE, PURREE, SLEEKY, and KISSEE.

### **Quick-change words and alternating hand words**

Keith defines a *quick-change word* as one where the same finger is never used twice in a row. He gives several 19-letter examples, though we found many more of equal or greater length. The longest such word in QWERTY is the 27-letter HONORIFICABILITUDINITATIBUS, which coincidentally is a quick-change word in Dvorak too. It also happens to be the longest word typed with alternating hands on Dvorak, nearly double the length of QWERTY's 14-letter LEUCOCYTOZOANS.

### **Finger-order properties**

Keith also considers isofinger words whose successive fingers progress in one horizontal direction across the keyboard. Such words are particularly hard to find on the Dvorak keyboard. If we relax the restriction such that each finger can be used multiple times before moving on to the next finger, the longest words we can produce are PUPPY (left to right, no skipping columns), OPPUGNS (left to right, skipping columns permitted), YIPPEE (right to left, no skipping columns), and SHIPPEE (right to left, skipping columns permitted). However, none of these are longer than their QWERTY counterparts as reported by Keith.

### **Hand-use properties**

Keith cites Borgmann's AFTERCATARACTS and TESSERADECADES as the longest words which can be typed entirely with the left hand. Dvorak is unable to surpass these; we find only the eight-letter PEEKAPOO, JIPIJAPA, and EPOPOEIA. For right-hand words Borgmann gives the 13-letter PHYLLOPHYLLIN. With no vowels on its right half we assumed Dvorak would be doomed to utter failure here, but it surprised us with the respectable

six-letter CRWTHS.

### **Adjacent keys**

In an *adjacent-key word* the key for each letter must be the same as or adjacent to its predecessor. For QWERTY Keith gives the nine-letter ASSESSEES, REDRESSER, REDRESSES, and SEERESSES; to this we add REDRESSED. For Dvorak the longest such word we found is the seven-letter YUPPIFY.

For the case where moving to an adjacent key is a hard requirement (that is, immediate repetition of the same letter is disallowed), Keith offers the six-letter DESERT, RESEWS, SWEDES, and KIKUYU. However, we can do better: there is also the eight-letter SAWDERED and the seven-letter SEWERED, RESEWED, and RESAWED. For Dvorak, the longest such words are PIUPIU and KIKUYU. This gives KIKUYU the distinction of being the longest word which can be typed with strictly adjacent keys on both keyboard layouts.

### **Scan order**

Keith considers the case where the keyboard is viewed as an ordered set of keys read in the usual left-to-right and top-to-bottom order. He finds the longest word which can be typed in this order (allowing repetitions) to be WETTISH; going in reverse he finds BOURREE and CHAPPIE. For Dvorak, the longest such words going forwards have six letters, and there are 33 of them: CLOOTS, CLOUDS, CLOUTS, COOEED, COOEES, CREEDS, CROONS, CROUTS, FLEETS, FLOODS, FLOUTS, FLUIDS, FOEHNS, FRAUDS, FREETS, FREITS, FRITTS, FRUITS, GLEEDS, GLEETS, GLOUTS, GRAINS, GREEDS, GREENS, GREETs, GROINS, GROUTS, PLAIDS, PLAINS, PLAITS, PREENS, PYLONS, and PYRANS. Going backwards we can produce 34 six-letter words: DUALLY, KNAGGY, KNARRY, KNOLLY, MEALLY, QUAGGY, QUARRY, SHAGGY, SHEAFY, SHELFY, SHELLY, SHERRY, SHOALY, SNAGGY, SNEERY, SNELLY, SNIFFY, SNUFFY, STAGGY, STARRY, STEELY, STILLY, STUFFY, STUGGY, THEALL, THEORY, WHALLY, WHEELY, WHERRY, WHIFFY, WHILLY, WHIRRY, WHOLLY,

and WOOLLY. If proper names are permitted, then we can make one seven-letter specimen: the name THIERRY.

### **Isocolumn words**

An *isocolumn word* is a word in which each column of the keyboard is used exactly once. Since our keyboards spread the alphabet across ten columns, the longest such words have ten letters. For the QWERTY keyboard Keith finds ANGIOSPERM, PLEASURING, and REIMPLANTS, to which we can also add BLEPHARISM, STEPFAMILY, RESAMPLING, PROTAMINES, PALUSTRINE, PROZYMITES, EPURATIONS, and EUPHORBIAS, for a total of eleven words. On this challenge Dvorak is the more productive layout, yielding 19 ten-letter words: PROFILGATE, PROCLAIMED, OUTLEADING, MODULATIVE, MENDACIOUS, IMPORTABLE, HYPERFOCAL, HYDROSPACE, FUMATORIES, DISCOURAGE, DECAGYNOUS, DEACONSHIP, COMPLAINED, BECLOAKING, AUTHORIZED, AUTHORISED, APHRODITES, AMBROTYPES, and ADEMPTIONS.

### **One-finger words**

As the name suggests, *one-finger words* are typed with just one finger. The longest Keith finds are the six-letter HUMHUM, HUMMUM, and MUUMUU; for Dvorak the equally sized KIKUYU and PIUPIU make a reappearance.

### **Archy words**

Imagine the rows of the keyboard to be shifted horizontally such that they form a perfectly rectangular grid. Keith defines *archy words* as those with the lowest average Euclidean distance between successive keys on this grid. (The name is derived from Archy, a fictional cockroach who wrote by hurling himself at the keys of his typewriter.) Keith gives QWERTY archy words of length 4 to 13, though in many cases we can improve upon his results:



- For words of length 7, Keith gives six words (ADDRESS, DESSERT, REDRESS, REFEREE, RESEEDS, and TRESSED) with the average distance 0.83. Surprisingly, he overlooks SEERESS (distance 0.69), which in its plural form was among his longest adjacent-key words.
- For length 8, Keith gives us ASSESSED (distance 0.78), but misses REWEDDED (0.75).
- For length 10, Keith finds READDRESSES (1.08) but overlooks the marginally better READDRESSSED (1.04).
- For length 13, Keith comes up with INHERITRESSES (1.63). Our best is DETRACTRESSES (1.42).

Our list of Dvorak archy words of length 4 to 13 is as follows:

- 4: IFFY, JEEP (0.60)
- 5: PUPPY (0.60)
- 6: YIPPEE (0.64)
- 7: YUPPIFY (0.89)
- 8: PYXIDIUM (1.27)
- 9: YUPPIFIED (1.30)
- 10: YUPPIFYING (1.35)
- 11: BOOKKEEPING (1.53)
- 12: BOOKKEEPINGS (1.67)
- 13: WHIPPOORWILLS (1.97)

It's unsurprising that Dvorak archy words have greater distances, since the layout was designed to maximize the alternation between typing hands.

### **Misplaced-hand words**

The final, and by far the longest, section of Keith's original article deals with words produced through a certain class of typographical error—specifically, where one or both hands are shifted horizontally on the keyboard. This turns out to be a very productive and extensible transformation, as evidenced by a lengthy follow-up article by Susan Thorpe [4]. For this reason we don't explore shifts

and other classes of typos here, but reserve this for a future article.

### References

1. Mike Keith. "Typewriter words." *Word Ways* 32:4, pp. 270–277. November 1999.
2. Dmitri A. Borgmann. *Language on Vacation: An Olio of Orthographical Oddities*. Charles Scribner's Sons, 1965.
3. Rex Gooch. "Typewriter words: All fingers used." *Word Ways* 33:1, pp. 71–72. February 2000.
4. Susan Thorpe. "New categories of typewriter words." *Word Ways* 33:1, pp. 73–74. February 2000.

