

TYPEWRITER WORDS

MICHAEL KEITH
Salem, Oregon

In this article we probe the subject of wordplay based on the typewriter keyboard. Dmitri Borgmann devoted two pages to this topic in *Language on Vacation*; we start by re-examining his findings and then consider some new topics.

For preciseness, I should state that these results are based on a modern QWERTY computer keyboard rather than a typewriter. The organization of the letters is unchanged compared to a common typewriter, but the layout of the punctuation symbols is often different. Here is the configuration of the keys I used, shown as a rectangular grid (i.e., with the slight offset between the rows having been removed):

```

  Q W E R T Y U I O P [
  A S D F G H J K L : '
▪ Z X C V B N M , . / ▪

```

In touch typing, F and J are the "home keys" on which the index fingers sit. Each finger is responsible for typing the key it sits on as well as the ones above and below. In addition, the left forefinger operates T,G,B and the right forefinger operates Y,H,N. The right little finger also operates [and '. In the diagram, ▪ represents a shift key.

We denote the fingers of the left hand by L1 (forefinger) through L4 (little finger), and similarly R1 to R4 for the right hand. There are three rows and ten columns containing letters.

Note that the left hand is responsible for typing 15 different letters while the right hand only gets 11. Even if letter frequencies are taken into account the left hand still ends up typing more letters than the right. One theory for the existence of this phenomenon is that one of the original goals in designing the keyboard was to make it easy to type, but not too easy--otherwise keys on a manual typewriter tend to jam. Since most people are right-handed, forcing them to use their left hand more slows them down. This means that on today's computer keyboards left-handers have a speed advantage!

ROW/COLUMN WORDS

Borgmann considers the fundamental problem of finding the longest word typed entirely on one row of the keyboard, and even with all the time that's elapsed since his 1965 book, and the advent of computers, his results still haven't been bettered.

The longest known words for the top row (all given by Borgmann) are the 11-letter PROPRIETARY, PROTEROTYPE, and RUPTUREWORT while the 11-letter plural coinage KHALAKHKHAS is the longest for the middle row. (That the 10-letter TYPEWRITER also comes from the top row is a very well-known fact.) There isn't much to be done with the bottom row alone; Borgmann gives BZZZBZZZ, and one can also find Z...Z, of whatever length one chooses.

The corresponding problem for columns is less rich because it is much more restrictive. In the third column we can make DEEDED, in the seventh we find MUM, and in the ninth, LOLL.

ISOFINGER WORDS

We now consider some properties that relate to the fingers used when typing. An isofinger word is one (by necessity an isogram) in which each finger is used at most once. The most elegant such words are those with eight letters, so that all of the fingers are used exactly once. Here are the 8-letter isofinger words we found, grouped by the first finger used:

- L4: aphorise
- L3: septimal spicular
- L2: captions captious clasping elapsing esophagi
- L1: biplanes
- R1: harelips jackpots
- R2: implates
- R3: lifespan
- R4: palmiest panelist pantiles parsonic plainest plaudits pleasing
poniards

Isofinger words with initial letters of L4 and R2 are the hardest to find; the two in the list above were supplied by Fred W. Helenius. APHORISES relies on British spelling, while IMPLATES is an inferred plural of the OED word IMPLATE (to install a plate).

We can insist that each finger be used in a single batch of one or more keypresses, after which it cannot be used again; these might be called repeated isofinger words. Here are the longest we found for each starting finger:

- L4: aspergillum
- L3: scalloping
- L2: collapsing
- L1: redisplay triplanes
- R1: unpolarised
- R2: ideographs
- R3: lexigraphy
- R4: patronymics

FINGER-TWICE WORDS

In these, each finger must be used exactly twice in a row before moving on to the next one (and the same finger can be returned to later on). We found several 8-letter examples (DEMURRED, UNDERFED, UNKISSED) with the best being the 10-letter UNDERFLOWS, which also has the nice property of using five different fingers.

KIKUYU (an African language) is a finger-thrice word.

QUICK-CHANGE WORDS

In these words we can use the fingers as often as we wish, but never the same finger twice in a row. Such words are particularly easy to type, and also not hard to find, since this restriction is only slightly stronger than forbidding double letters. Some long words with this property are the 19-letter INCOMPREHENSIBILITY, OVERSIMPLIFICATIONS, and SUPERCONDUCTIVITY.

FINGER-ORDER PROPERTIES

Successive fingers used to type an isofinger word can be required to progress in one horizontal direction across the keyboard (possibly skipping fingers). For left-to-right order, the longest words we found were AWFUL, SCRIP, SCULP, and SETUP. If the fingers are also required to be consecutive (no skipping), then the 4-letter ETUI, SCRY and AXER will do. AXER is remarkable because it uses just the right hand.

For right-to-left order (with skipping) we find more words, with the champion being POINTS. Removing the S yields POINT which uses five consecutive fingers, as does KURDS. POKY uses just the right hand.

We can relax the isofinger property, which means that finger use must still proceed from left to right, but a finger can be used multiple times before moving to the next finger. We now find ACCEEDED, SECEDED (and SECEDER), and TROLLOP. For right-to-left we have a number of 8-letter words such as HUNTRESS, POLLUTED, PRECEDED, UNHEEDED, and UNNEEDED. Note that HUNTRESS proceeds from right to left with respect to fingers, but does not proceed across the keys from right to left only.

HAND-USE PROPERTIES

The classic problem here is one-hand words. Again, Borgmann has never been surpassed. For the left hand, he gives the 14-letter AFTER-CATARACTS and TESSERADECADES, as well as the mammoth 19-letter coinage TESSARESCAEDCAEDRA (a variant spelling for "14-sided polyhedra"). For the right hand the winner is the 13-letter PHYLLOPHYLLIN (a pigment).

An interesting variation not in Borgmann's book is the alternating hand word, in which the hands are used in an LRLR... or RLRL...

pattern. Some common long words of this kind are the 12-letter AUTHENTICITY and 13-letter DISMANTLEMENT, but the longest appears to be the 14-letter biological term LEUCOCYTOZOANS. Such words can be typed extremely rapidly since the two hands can overlap their motions in time. This is precisely the situation that causes manual typewriters to jam, but fortunately we don't have to worry about this on a computer.

ADJACENT KEYS

In an adjacent-key word we start on a given key, use it as many times as we want, then move to an adjacent key, use it as many times as we want, move again, and so on. The longest known such words are the 9-letter specimens ASSESSEES, REDRESSER (and REDRESSES), and SEERESSES. If key repetition is not allowed, then the longest we found have six letters: DESERT, RESEWS, SWEDES, and, putting in its second appearance, KIKUYU.

SCAN ORDER

We can consider the entire keyboard as a single ordered set of keys, in the usual left-to-right and top-to-bottom reading order, and require that we always step forward when moving to a new key. The longest such word seems to be WETTISH, while the longest words in reverse order include BOURREE and CHAPPIE.

COLUMN PROPERTIES

Focusing just on which column each letter comes from leads to some new properties. An isocolumn word is similar to an isofinger word, except in this case we require that each of the 10 columns be used no more than once. Amazingly, we are able to find some 10-letter isocolumn words: ANGIOSPERM, PLEASURING, and REIMPLANTS.

A column palindrome is a word whose column numbers form a palindrome, though the word itself is not an alphabetic palindrome. Our best examples are the 9-letter SULFUROUS and the very appropriate CROSSWORD.

A prime-column word numbers the columns 1 through 10 and only uses prime-numbered (2,3,5,7) columns. We found the 9-letter DESUETUDE, SUBJECTED, SUCCEEDED, SUCCESSES, SUCCUMBED, and SUGGESTED.

ONE-FINGER WORDS

These are words typed with just one finger. Except for L1 and R1 this is the same problem as words confined to one column of keys. L1 has no vowels and hence no non-trivial words; for R1 there are several 6-letter examples (HUMHUM, HUMMUM, MUUMUU).

TWO-FINGER WORDS

These words use just two different fingers. There are 28 different possibilities, and the table below shows the longest words we found for each case.

L4 L3	sass saws
L4 L2	acceded
L4 L1	braggart
L4 R1	unhuman
L4 R2	kaka
L4 R3	all (Zola, if proper names allowed)
L4 R4	papa
L3 L2	exceeded excesses
L3 L1	
L3 R1	hussy hymns mushy mussy shuns shush sunny
L3 R2	kiwis Swiss
L3 R3	lolls slows solos wools
L3 R4	
L2 L1	brevetted regretted
L2 R1	henchmen unheeded unneeded
L2 R2	decided deicide
L2 R3	coddled decoded doodled
L2 R4	peeped
L1 R1	thrummy unburnt unfunny untruth
L1 R2	titbit
L1 R3	forgot grotto
L1 R4	
R1 R2	minimum
R1 R3	homonym
R1 R4	humpy jumpy nymph puppy
R2 R3	kill look olio
R2 R4	kip pip
R3 R4	loop plop poll polo pool poop

ELLISON WORDS

The writer Harlan Ellison has written about 70 very fine books, every one of them typed (reportedly very fast) using a one-finger-on-each-hand style of typing. We ask: which words would be easiest for Harlan Ellison to type? Although one can model this question in several ways, it seems clear that letters should alternate between hands and the linear distance traveled by the fingers of each hand should be minimized. Since the amount of offset between keyboard rows does not seem to be standard, we simplify and assume the keys are arranged on a square grid with unit spacing. The two fingers being used are allowed to roam over the whole keyboard (for example, the right hand is not required to stay on the right side), but crossing hands makes typing difficult, so we insist that each letter typed by the right hand be in a column to the right of the preceding and succeeding letters typed by the left hand. Here are the best examples we found for 4 through 13 letters:

4	dodo papa tutu (0.00)	9	abatement (1.12)
5	dodos ninon (0.20)	10	maharajahs (0.88)
6	banana (0.17)	11	prohibitory (1.15)
7	austere (0.77)	12	monotonicity (1.19)
8	terebene (0.53)	13	mononucleosis (1.05)

The score (in parenthesis) is the total linear distance traveled by the fingers, normalized by dividing by the length of the word; lower is better. Perfect Ellison words (a score of zero) exist up to four letters at least; are longer ones possible? (If the plural of SO-SO were allowed, it would be a 5-letter example.)

ARCHY WORDS

Don Marquis' fictional philosopher, archy the cockroach, typed his lower-case missives by hurling his small body at the keys one at a time. Which words would be the easiest for archy to type? Clearly, those for which the total amount of linear movement from one key to the next is minimized. We call such words archy words. These are also the easiest words for a one-finger typist to type. Here are the best archy words we found for 4 through 13 letters:

4	deed deer free loop poll pool reed tree weed (0.50)
5	deeds erred freed freer reeds weeds (0.60)
6	assess (0.64)
7	address dessert redress referee reseeds tressed (0.83)
8	assessed (0.78)
9	addressee (0.80)
10	addressees (0.87)
11	readdresses (1.08)
12	underdressed (1.25)
13	inheritresses (1.63)

Note the appearance of the long reversal pair DESSERT/TRESSED.

MISPLACED-HAND WORDS

Suppose, as a touch typist, you intend to type a certain word but one or both of your hands is in the wrong place on the keyboard. In which cases will you end up typing a different valid word? There are many possibilities to consider here: each hand could be off by one key in any of eight directions (orthogonally or diagonally), or possibly by more than one key. The two most common errors seem to be (a) just the left hand off by one key to the left, and (b) both hands off by one key to the left.

For the left hand off by one to the left, we found the following word pairs with three or more letters. The first word in each pair is the intended word, while the second is what actually gets typed.

din sin, dip sip, doe sow, don son, dun sun, eon won, ern wen, err wee,
 fin din, fir die, for doe, fry dey, fun dun, fur due, gin fin, got for,
 gun fun, gut fur, hid his, hoe how, ivy icy, kif kid, not nor, off odd,
 out our, sit air, tip rip, toe row, tor roe, tum rum, tun run

bibs viva, bids visa, bird vies, dill sill, dims sima, dogs sofa, dots sora,
 duff sudd, dump sump, dunk sunk, fibs diva, fill dill, find dins,
 foot door, fops dopa, ford does, fort doer, foxy dozy, full dull,
 fund duns, funk dunk, furl duel, gill fill, golf fold, gout four,
 grid feis, gull full, hoof hood, host hoar, list liar, lout lour, mild mils,
 mood moos, moot moor, nips nipa, pips pipa, pout pour, pups pupa,
 putt purr, send awns, serf awed, skin akin, sloe alow, slum alum,
 smit amir, stum arum, till rill, tody rosy, toed rows, toil roil, toll roll,
 took rook, tuff rudd

bills villa, briny veiny, bulbs vulva, dotty sorry, dully sully, folly dolly,
 fully dully, gully fully, gunny funny, middy missy, muddy mussy,
 mutts murra, thrum rheum, tummy rummy, tunny runny

dimplly simply, hollos holloa, minims minima, motion morion

ERR/WEE and SERF/AWED are the only pairs in which every letter changes (which is because they are typed entirely with the left hand).

Here is the list for both hands off by one to the left (in which every letter by necessity changes):

dim sun, dot sir, err wee, fir due, for die, fur dye, got fir, goy fir,
 gyp fro, him fun, hit fur, hoc fix, hot fir, hoy fir, log kif, mid nus,
 nor vie, per owe, pit our, sod ais, sot air, soy air, use yaw

bobs viva, bore view, fits dura, fobs diva, ford dies, fury dyer,
 lory kier, nods visa, ruts eyra, serf awed, sits aura, surd ayes,
 tiff rudd, used yaws, bored views, escort waxier

The right hand off by one to the right produces even more word pairs because, as noted earlier, this leaves a large number of common letters assigned to the left hand unaffected. Rather than give the whole list, here are just the 7-letter and 8-letter pairs we found:

adducts addicts, beaners beamers, budders bidders, butters bitters,
 crenate cremate, decided decoded, decider decoder, decides decodes,
 diggers doggers, drivers drovers, duffers differs, excused excised,
 excuses excises, gibbets gobbets, hitters jotters, judders kidders,
 natters matters, restuff restiff, rewrite rewrote, skaters slaters,
 soarers sparers, stuffer stiffer, titters totters, tricars trocars

adducted addicted, bestride bestrode, butterer bitterer,
 deciders decoders, nattered mattered

Word Ways readers are invited to try to improve on these results, in particular to find longer pairs for any of these cases.

The following enigmatic poem turns into a different, somewhat darker verse if it is typed with the left hand off by one key to the left:

In briny din I limp;
 I look on ivy bulbs,
 I tip, I pout, I toil.
 O, opium fort...
 On dogs I hop, on foot I furl;
 I'm dotty.

In veiny sin I limp;
 I look on icy vulva,
 I rip, I pour, I roil.
 O, opium doer...
 On sofa I hop, on door I duel;
 I'm sorry.

A strange variation on this game is made possible by the computer keyboard being a separate object attached to the computer by a cord: we can type with the keyboard upside down. In doing so, we place our fingers on the usual home keys (except that L1 goes on J and R1 goes on F, instead of vice versa) and type away. This transformation eliminates A,E,Q,W from any possible word pairs and interchanges the letters B-Y, C-I, D-K, F-J, G-H, L-S, M-R, N-T, O-X, P-Z, and U-V. This is a much harder problem than the others--in fact, we have only been able to find two non-trivial word pairs: CUB-IVY and SCRY-LIMB. Can you find any others?