SUBTRANSPOSALS FROM A TO Z

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Recently, a large publication offered a first-rate word contest, giving word buffs from around the world an opportunity to enjoy their pastime for profit. Some 700 people entered the contest, and the winners included Rod P. Selden and myself. After the contest, Selden (a stranger to me) detailed his approach to the contest in an article in the November 1984 Word Ways. Upon reading his article, l was so intrigued by the differences in our strategies and scores that l contacted him to discuss them further. l then contacted most of the other winners. ln this article, l compare all our strategies.

The Contest

The contest involved "subtransposals" (or "substitute-letter transposals" as Dmitri Borgmann called them in Language on Vacation). Two words having the same number of letters are subtransposals of one another if all but one of their letters are the same, i.e. if one word can be transformed into the other by replacing one of its letters with a different letter and rearranging the new set of letters. For example, PETAL can be subtransposed into TALES by substituting S for P and rearranging the letters. PETAL cannot be subtransposed into PEDAL according to the contest, though, because the letters would not need to be rearranged after substituting D for T. Nor could PETAL be subtransposed into PLATE since both words have exactly the same letters. The object of the contest was to construct as long a chain of subtransposals as possible without substituting any letter of the alphabet more than once and without using any word more than once. The score of a chain of subtransposals was determined by multiplying the number of substituted letters of the alphabet by the length of the words, thus encouraging both a long chain and long words. For example, the score of a chain of 10-letter words that substituted all 26 letters of the alphabet would be 26 x 10 = 260. Webster's Third was the word authority. Only uncapitalized, unpunctuated single words were allowed.

Optimal Word Length

The top two winners used 12- or 13-letter words in their chains; the other winners used 10- or 11-letter words. After the contest ended, several winners improved their chains using longer words. Those improved chains are exhibited in this article, rather than the chains that were entered in the contest. The consensus now

seems to be that 12-letter words score highest, with the contest's rules on acceptable words. A perfect (26-substitution) chain of 12-letter words conforming to all rules was discovered after the contest ended. 13-letter words may score highest if the word constraints are relaxed somewhat, and 14-letter words may score highest if the scoring system is corrected (as the winners agree that it should be) to allow word length to have a greater-than-linear effect on score. Everyone who investigated words longer than 14 letters is convinced that such words are useless for the purposes of the contest.

The winners' chains appear below, sorted by word length; each word is followed by the letter substituted to construct it.

Kyle Corbin, Raleigh NC
13-letter words, 23 substitutions
Letters found in most words: AEELNSSST

CAPITALNESSES		WEALTHINESSES	W	TUNABLENESSES	U
SKEPTICALNESS	K	EARTHLINESSES	R	MUTABLENESSES	M
TYPICALNESSES	Y	VERSATILENESS	V	TAMABLENESSES	A
PLICATENESSES	E	PREESSENTIALS	P	AMIABLENESSES	I
CELESTIALNESS	L	PROLATENESSES	O	MIXABLENESSES	X
DELICATESSENS	D	POTABLENESSES	B	ESTIMABLENESS	T
DEATHLINESSES	H	BLASTOGENESES	G	BEASTLINESSES	S
ETHICALNESSES	C	NOTABLENESSES	N	SIZABLENESSES	Z

Michael Wolfberg, Concord MA
12-letter words, 26 substitutions
Letters found in most words: AEIOCNST

MELIORATIONS		INCREPATIONS	P	INTERCOOLERS	L
ICONOLATRIES	C	INCINERATORS	R	INTERLOCKERS	K
VISCEROTONIA	V	CONTRARIWISE	W	NECROLATRIES	A
EXORCISATION	X	RHETORICIANS	H	CELEBRATIONS	B
CRANIOTOMIES	M	ORCHESTRINAS	S	NEUROBLASTIC	U
GASTROCNEMII	G	CERATORHINES	E	SUBJECTIONAL	J
ROMANTICIZES	Z	SECRETIONARY	Y	DISCOUNTABLE	D
CREMATIONIST	T	REFECTORIANS	F	ELUCIDATIONS	I
INTERACTIONS	N	SEROREACTION	O	EQUINOCTIALS	Q

Thomas Rotta, Scottville MI
12-letter words, 24 substitutions
Letters found in most words: AEIOCNRST

SUBFORNICATE		RHETORICIANS	I	ERADICATIONS	D
SORBEFACIENT	E	CONTRARIWISE	W	STENOCARDIAC	C
EXORBITANCES	X	INCINERATORS	N	DECLARATIONS	L
CEREBRATIONS	R	INCREMATIONS	M	INTERCOASTAL	T
CARTOONERIES	O	RIFACIMENTOS	F	RELUCTATIONS	U
COPARTNERIES	P	ROMANTICIZES	Z	COUNTERVAILS	V
SECRETIONARY	Y	GASTROCNEMII	G	NEUROBLASTIC	B
CERATORHINES	H	CAROTINEMIAS	A	SUBJECTIONAL	J
ORCHESTRINAS	S				

Mike Weepie, Cedar Rapids IA
11-letter words, 25 substitutions
Letters found in most words: AEINRST

RESISTANCES		REGIMENTALS	L	AFTERNIGHTS	F
STREAKINESS	K	EVERLASTING	V	FEATHERINGS	E
JANITRESSES	J	EASTERLINGS	S	REFASTENING	N
TARRINESSES	R	WESTERLINGS	W	GENERATIONS	O
REASSERTING	G	GENERALISTS	A	RESIGNATION	I
INTERGRADES	D	PLASTERINGS	P	ANCESTORING	C
STREAMERING	M	PANEGYRISTS	Y	ENUNCIATORS	U
BEMASTERING	B	SPATTERINGS	T	QUATERNIONS	Q
MAGNETIZERS	Z	STRAIGHTENS	H		

Rod P. Selden, Dayton WA
10-letter words, 26 substitutions
Letters found in most words: EION

UNPOETICAL		ALECTORIUS	U	REFACTIONS	F
PHONETICAL	H	QUERCITOLS	Q	ZIRCONATES	Z
PLEONASTIC	S	UNCLOISTER	N	CARBONIZES	B
CINEPLASTY	Y	CENTRIOLES	E	BLAZONRIES	L
NYCTALOPES	O	MORENCITES	M	BANDOLIERS	D
NEOPLASTIC	I	REJECTIONS	J	GIRANDOLES	G
PSALTERION	R	PRENOTICES	P	OVERLADING	V
LORANSKITE	K	RECAPTIONS	A	OVERDATING	T
CLARIONETS	C	CONTRAWISE	W	OVERTAXING	X

Cynthia Wimer, Sierra Madre CA
10-letter words, 26 substitutions
Letters found in most words: EINRT

INTERSTICE		DENIGRATES	G	WATERLINES	L
INTERJECTS	J	INTERSTAGE	T	INSERTABLE	B
INTERCASTE	A	SMATTERING	M	INTERLACES	C
TICKEATERS	K	REGISTRANT	R	CANTILEVER	V
EXTRICATES	X	SHATTERING	H	CENTRALIZE	Z
EXTRADITES	D	INTEGRATES	E	NEUTRALIZE	U
STRAITENED	N	FERGANITES	F	QUATERNIZE	Q
STYRENATED	Y	INTERPAGES	P	EQUESTRIAN	S
REINSTATED	I	WINTERPEAS	W	QUESTIONER	O

Common Letters

Each of the winners' word chains have the following character-istics: all words in the chain contain nearly the same letters, most of which are common and easy to use. In fact, in each chain us-ing words longer than 10 letters (including the 15-letter word chain shown below), the difference in the number of letters in the words and the number of common letters found in nearly all words is only four (i.e. all but four of the letters remain the same from the beginning of the chain to the end). Whenever the winners intro-duced an uncommon letter (B, F, J, K, M, P, Q, V, W, X, Y, Z) into their chains, they usually removed it with the next one or

two substitutions. This adherence of the winners' words to a set of common letters prevented the chains from moving away from the mainstream of subtransposal words. The mainstream seems to consist of words that have few (zero, one, or sometimes two) uncommon letters, making the words "nearer" to other subtransposable words than are words with several uncommon letters. Mainstream words also tend not to have too many repeated letters. E, I, R, and S are the most frequently repeated letters in the chains of the winners, though other common letters are repeated in a few words. Uncommon letters are not repeated in any of the winners' words.

It's no coincidence that the winners' words are similar in terms of the letters they contain. With only one exception, each of the winners compiled a list of words having all or nearly all of a certain set of common letters, and they chose words for their chains from those lists. None of the winners' sets of letters were exactly the same, but all except one were variations on the set AEINRST. Perhaps that explains why nearly half of the words in Wolfberg's and Rotta's chains were the same, and why those two winners chose the word CONTRARIWISE to use the difficult letter W, just as Rod Selden chose the very similar word CONTRAWISE.

Artificial Length

Most of the winners' words are simply forms of shorter words made longer by using prefixes and/or suffixes. The vast majority of the words end in –S; other frequent affixes in the words are –TION, –ING, –ER, –OR, –IST, IN–, INTER– and RE–. Most of the winners did not intentionally choose these artificially long (and logologically unaesthetic) words; they simply could not avoid them since such words make up the majority of long words.

However, two of the winners (Cynthia Wimer and I) did intentionally use artificially long words. Their chains are the first and last ones above. Mrs. Wimer, an expert in Scrabble crossword game, knew that the letters INTER occurred in a huge number of words, often as affixes (INTER–, IN–, RE–, ER–). She thus concentrated her efforts on words containing those letters and those affixes (although she did not actually make a list of such words). In constructing my own chain, I, too, considered the prefix INTER–, but I decided that the suffix –NESSES was better. I had begun work on the contest by easily constructing a complete chain of 9–letter words without long affixes. I then reasoned that the best approach to a contest involving long subtransposals was to use words having the same long affix, thus requiring fewer letters to be rearranged when subtransposing one word to another. After thoroughly reviewing several affixes, I found –NESSES to be the best. No other affix of such length is found in so many words (several thousand). In addition, its letters are very common, allowing all six to appear in many words that don't contain the suffix itself. I first made a list from Webster's Third of all 15-letter words having those six letters. There were nearly 1000 such words. After spending countless hours removing subtransposably isolated words from the

list and constructing chains from the remaining 200 words, l found that the longest chain had only a dismal 11 substitutions. It appears below. l next tried 13-letter words and through the same procedure found that the longest chain had 23 substitutions (it appears at the beginning of this article).

Kyle Corbin, Raleigh NC
15-letter words, 11 substitutions
Letters found in most words: ABEEELNRSSS

UNCREATEDNESSES		DISCERNABLENESS	C	PRAISABLENESSES	S
UNRELATEDNESSES	L	INCURABLENESSES	U	GRASPABLENESSES	G
ENDURABLENESSES	B	INSUPERABLENESS	P	SEPARABLENESSES	E
UNDESIRABLENESS	I	INSEPARABLENESS	A	SPEAKABLENESSES	K

Computer Assistance

Many people may be surprised that the winners who used computers did not outscore all the other winners. Computers are often misconceived as all-knowing, all-powerful, and magically able to find the best solution to any problem. But programming experts are painfully aware of how ill-suited even the most advanced computers are for many tasks requiring human ingenuity. In word contests, it is often just as quick and easy to work by hand than to type hundreds or thousands of words into a computer and to write a correct and efficient program to analyze the words. Perhaps that is why the winners who did not find their best word chains until after the contest ended (Wolfberg and Rotta) were the ones who used computers (though the chains they found before the contest ended were still good enough to win). This is not to say that computers are useless in word contests – their extreme speed and error-free operation are indeed quite valuable to computer experts who can encode a good strategy in machine language. Expertise in logology, however, can be much, much more valuable.

Future Work

Complete 26-substitution chains of words having lengths up to and including 12 letters have been created. The obvious next step is a complete chain of 13-letter words. The winners who have attempted to create such a chain agree that it cannot be done using the rules of the contest. However, I feel certain that complete 13- and 14-letter word chains can be created if the following types of words are allowed (in decreasing order of acceptability):

1) words from dictionaries other than Webster's Third
2) capitalized words
3) non-rearranged subtransposals (as JEALOUS to ZEALOUS)
4) first-rate coinages

A complete chain of 13-letter words should be possible with the first rule alone, but all four rules will probably be necessary for a complete chain of 14-letter words.