

(W)HOLESOME FUN

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Word squares continue to constitute one of the grand research topics of recreational linguistics. The search for a universally acceptable 10-square is still one of the Holy Grails of word play. Like any substantial research topic, the idea of "word squares" suggests a further plethora of interesting related topics by modifying and relaxing its definition.

In a previous **Word Ways** article, "Word Squares? No, Oblongs" (August 2001), I explored one variant of word squares, namely, word rectangles whose dimensions differ greatly from each other. The present article will explore another variant: namely, word squares with a central hole. Various names suggest themselves for these figures: for instance, "word donuts," "holy squares," "depleted squares," or "word hollows." Consider a few examples:

H	A	I	R	S
A	S	S	E	T
I	S			N
R	E	N	A	L
S	T	O	L	E

S	H	E	A	R	S
H	E	L	M	E	T
E	L				G
A	M				A
R	E	G	A	L	E
S	T	O	N	E	D

B	I	S	H	O	P	S
I	N	T	E	R	I	M
S	T	U	M	B	L	E
H	E	M				I
O	R	B	I	T	A	L
P	I	L	L	A	G	E
S	M	E	L	L	E	D

A	I	R	W	A	V	E	S
I	D	E	A	L	I	S	T
R	E	C	R	E	A	T	E
W	A	R					T
A	L	E					I
V	I	A	T	I	C	A	L
E	S	T	I	M	A	T	E
S	T	E	E	P	L	E	S

S	E	P	A	R	A	T	O	R
E	M	A	N	A	T	I	V	E
P	A	R	A	P	E	T	E	D
A	N	A						I
R	A	P						L
A	T	E						L
T	I	T	I	L	L	A	T	E
O	V	E	R	E	A	T	E	R
R	E	D	E	E	M	E	R	S

T	H	E	M	A	T	I	C	S
H	E	X	A	G	O	N	A	L
E	X	O	N	E	R	A	T	E
M	A	N						N
A	G	E						I
T	O	R						M
I	N	A	N	I	M	A	T	E
C	A	T	E	N	A	T	E	S
S	L	E	E	K	N	E	S	S

S	I	N	F	U	L	N	E	S	S
I	D	E	A	T	I	O	N	A	L
N	E								L
F	A								E
U	T								S
L	I								W
N	O								O
E	N								M
S	A	L	E	S	W	O	M	A	N
S	L	A	T	H	E	R	I	N	G

What distinguishes these examples? All share five essential features. First, the enclosing shape for each is a square. Secondly, each contains an interior hole. Additionally, the uninterrupted columns and rows form words. Fourthly, the rows and columns which are interrupted by spaces also form words on either side of the spaces. Finally, the words reading across are the same as the words reading down.

Notice that each interior hole satisfies two additional conditions: the hole is both square and equidistant from all four edges of the larger square. Of course, either condition could logically be

removed, to enlarge the number of solutions. We could, in theory, make the hole itself non-square, or locate it near one corner. To me, the resulting word sets would be less esthetically pleasing, or would trivialize the concept. So I exclude those extensions from my term "word hollows."

We can distinguish the shapes of the various examples above by just two numbers: their exterior size and their hole size. I will therefore refer to word hollows like the first example above as *5-1 word hollows*, and those like the second example as *6-2 word hollows*.

Word squares can sometimes be converted to word hollows. The squares below become word hollows when the letters in the inner squares are removed. In the final two examples, word hollows are formed by removing either the innermost square or the letters in both inner squares.

C	A	S	T	O	R
A	S	H	O	R	E
S	H	E	R	P	A
T	O	R	O	I	D
O	R	P	I	N	E
R	E	A	D	E	R

M	A	C	A	D	A	M
A	V	A	R	I	C	E
C	A	P	E	L	E	T
A	R	E	N	A	T	E
D	I	L	A	T	O	R
A	C	E	T	O	N	E
M	E	T	E	R	E	D

S	A	T	R	A	P	S
A	L	I	E	N	E	E
T	I	P	S	T	E	R
R	E	S	P	I	R	E
A	N	T	I	M	A	N
P	E	E	R	A	G	E
S	E	R	E	N	E	R

T	E	M	P	E	R	A
E	L	O	I	N	E	R
M	O	N	S	T	E	R
P	I	S	M	I	R	E
E	N	T	I	C	E	S
R	E	E	R	E	C	T
A	R	R	E	S	T	S

How common are word hollows? As an experiment, I combined several standard word lists to make composite candidate lists of words of length 5 through 15. The resulting word lists included more than 20,000 words of each length; the lists were intended to be robust but not exhaustive. For 2, 3, and 4 letter words, I used the OSPD3 Scrabble dictionary. Using these word lists in computer searches, I found that "smaller" word hollows number in the thousands or greater. By the term "smaller" I mean the word hollows whose outer dimension is less than 9.

"Very hollow" squares of all sizes form a special category. These are the word hollows whose shorter words are all of length 2. For outer sizes up to 11, this type of hollow is common. For instance, a word list of 24,000 eleven-letter words produced more than a thousand (1,122) "very hollow" (11-7) squares. But a word list of 22,000 twelve-letter words generated only 20 "very hollow" (12-8) squares. From a word list of some 18,000 thirteen-letter words I found only 4 "very hollow" (13-9) squares. I found no "very hollow" squares of dimension 14. "Very hollow" squares include:

T	R	E	S	P	A	S	S	I	N	G
R	A	D	I	A	T	I	O	N	A	L
E	D								T	O
S	I								I	S
P	A								O	S
A	T								N	A
S	I								A	R
S	O								L	I
I	N								I	S
N	A	T	I	O	N	A	L	I	S	T
G	L	O	S	S	A	R	I	S	T	S

P	S	E	U	D	O	A	N	E	M	I	A	S
S	O	M	N	A	M	B	U	L	A	N	C	E
E	M										E	X
U	N										T	A
D	A										A	G
O	M										M	E
A	B										I	N
N	U										N	A
E	L										O	R
M	A										P	I
I	N										H	A
A	C	E	T	A	M	I	N	O	P	H	E	N
S	E	X	A	G	E	N	A	R	I	A	N	S

Leaving aside the "very hollow" category above, word hollows of outer length 9 or longer are rare enough to be interesting. From the candidate list of some 23,000 nine-letter words I found no 9-1 word hollows, and only 244 of the 9-3 word hollows. Two of the 9-3 word hollows are shown in the first set of word hollows above. From the candidate list of 25,000 ten-letter words I found no 10-4 letter word hollows. The only length-10 word hollows were of the "very hollow" (10-6) category.

Due to time constraints, I performed only a partial, not a systematic, search for 10-2 word hollows. No 10-2 word hollows were found. This result and the absence of 9-1 hollows, mentioned above, leads me to believe that a much larger underlying word list will be required to find any 10-2 hollows. I was able to devise the following near-miss for a 10-2 word hollow. The words "AUTONOMICA" and "CICATRIZES" were both found in an electronic version of Stedman's medical dictionary. The final word combination therein, "SCALED CESS," may be imagined to refer to a graduated tax, since one meaning of cess is a form of tax.

A	N	A	P	H	A	S	I	C	S
N	E	U	R	O	G	E	N	I	C
A	U	T	O	N	O	M	I	C	A
P	R	O	G	E	N	I	T	A	L
H	O	N	E			C	I	T	E
A	G	O	N			Y	A	R	D
S	E	M	I	C	Y	C	L	I	C
I	N	I	T	I	A	L	I	Z	E
C	I	C	A	T	R	I	Z	E	S
S	C	A	L	E	D	C	E	S	S

One word of advice to computer enthusiasts: systematic searches for word hollows can be significantly speeded up by introducing an auxiliary list whose entries are the candidate words with their middle letters transposed to the end. And whether you eschew computers or enjoy them, happy hunting in the hollows!