QWERTY: A System of Logic and Symmetry?

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***Abstract*-We may be able to finally say that we have cracked the code to the QWERTY keyboard design by finding both a logical and symmetrical mapping of the alphabet to the keys. We distinguish letters in the alphabet that have a right boundary characteristic. We use these letters to structure a pair of matrices whose column-selected sets directly map to a collage of symmetric QWERTY keyboard patterns. These matrix-selected sets can be used for teaching the QWERTY, for combining QWERTY sets with different soft keyboards, and possibly for assisting research related to cognitive informatics.**

I. INTRODUCTION

How could we possibly think of a QWERTY keyboard layout as having logic and symmetry? Believe it or not, what led us down this path was trying to find some visual characteristics of letters that could help teach our daughter the alphabet. An obvious pattern in the alphabet unfolded involving letters with a right boundary characteristic. We split the alphabet into two sub-matrices, with the stride between letters with a Right Boundary Demarcation Letter (RBDL) increasing from three to four in the second sub-matrix. The set of RBDL in the column of the first sub-matrix directly correlated to every other key in the QWERTY home row up to the letter 'k.' We then forced the RBDL as a vector into the diagonals of the two sub-matrices to see what properties accompany a RBDL-focused alphabet matrix. As a result, we obtain twelve equally-spaced QWERTY patterns.

Although the teaching of QWERTY's history contains the technical issue of clearing the jams in the mechanical typewriter [1], we lack knowledge of how the letters were selected to be dispersed over our legacy QWERTY keyboard structure. Now with a connection to a defined RBDL matrix structure, teaching these matrix-selected sets can make the QWERTY keyboard easier to learn, make it contribute to combined keypad development, and make it a useful tool for further cognitive research.

II. INITIAL RBDL-QWERTY HOME ROW CONNECTION

We need to take an almost artistic view of the letters to initially determine the set of right boundary demarcation letters (RBDL). This is not a new concept. For centuries, communicating and understanding cultures has been done by using a written language's visual, symbolic, and artistic forms [2]. If we look at a vertical line as the boldest demarcation for ending a thought and add an arrow or flag from our English direction of reading (left), we now have the basic RBDL visual property. We are looking for an arrow (or flag waving) on the left-most body of a pole that indicates the point to either start or to stop. The letter "d" is a good example.

a	b	c		
d	e	f		
g	h	i		
j	k	l		
m	n	o	p	q
	r	s	t	u
	v	w	x	y
	z			

Fig. 1. Resultant RBDL Perpendicular Matrix Combination

The steps that initially connect us to the QWERTY are simple. We use the lower-case handwritten English Alphabet. This paper uses courier font in matrices to best demonstrate this visual property. Next, we traverse the alphabet and select the set of RBDL; we include the letter "m" only because it marks the middle. Our set of RBDL = {a, d, g, j, m, q, u, y}.

The result of using the set of RBDL to determine our matrix structure is a set of perpendicular matrices (Fig. 1). This matrix structure starts with a stride of three and increases the stride to 4 for the second sub-matrix (after the letter "m"). In Fig. 1, we have the 4x3 matrix and the 3x4 matrix in white boxes with its RBDL in grey-shaded boxes.

The first column of the first sub-matrix gives us our first connection to the QWERTY keyboard. The set {a, d, g, j} is also on the home row of the keyboard with a stride of two between the letters (Fig. 2). This seems too concrete to only be coincidental. We also see other sets from other columns that also provide some insight on the possible selection and placement of letters on the QWERTY.

In the three other selected sets for Fig. 2 ({x, p}, {o, w}, and {m, q}), we start to see the QWERTY keyboard as containing balanced, or symmetrical sets mostly selected from columns (Fig. 2). If we can extract patterns from a hard-wired legacy keyboard design (QWERTY), we can use those patterns in studies involving soft keyboard designs or as a tool to transition between the two designs. Current soft keyboard designs focus on building keyboards from the "[m]ost commonly used sequences" like "THE" and "ING" [3].

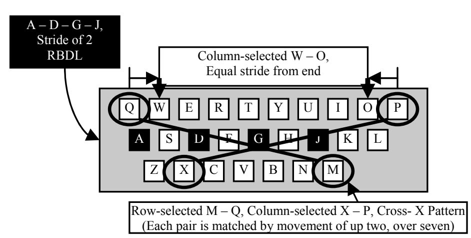

Fig. 2. Initial Perpendicular Matrix Symmetric Sets

T. Sobh (ed.), *Innovations and Advanced Techniques in Computer and Information Sciences and Engineering*, 183–186.

In the second sub-matrix, when we select two pairs from the outer rows of the same columns ({x, p}, {o, w}), we see items from columns pushed to opposite ends of the keyboard. When we look at the set {x, p} along with the row relationship of set {m, q}, we see a cross pattern that "almost" fits perfectly. We could say this is a pattern of the pairs, where the connection between the pair goes up two rows on the keyboard and left (or right) seven strides. We get pattern-matching, but the location of "x" makes the overall QWERTY pattern look like an improperly buttoned shirt.

One of our goals should be to find symmetric patterns that can also be studied and compared to new keyboard patterns for performance of short term memory and long term memory, along with "[s]kill identification" [4]. Our hope is that the fully-deployed QWERTY may also become a greater tool for cognitive sciences. Is there a way to structure the RBDL-driven matrix to maximize QWERTY keyboard pattern matching? Yes. We will see that accomplished by using RBDL to force diagonal vectors as much as possible.

III. THE DRAFT QWERTY RBDL DIAGONAL MATRIX

If we were dealing with a numerical matrix, we could attempt typical matrix functions: such as diagonal, identity, eigenvectors, complements, determinants, or products [5]. Unfortunately, we have letters, all unique letters at that. So, let's build a matrix by forcing the set of RBDL on the diagonal to see if there are intrinsic QWERTY patterns communicated. Fig. 3, Fig. 4, and Fig 5 show the result.

Now things really get exiting! In our draft QWERTY RBDL diagonal matrix, there are twelve sets of characters that produce symmetrically distributed patterns on the QWERTY keyboard. We will see that the "ubiquitous" standard of the QWERTY is not a "frozen accident," but a frozen symmetrical design that we can reuse (references [6] and [7]). Let's use it to help transition to other soft keyboard approaches where "[t]he design is nearly symmetrical, making it suitable for either hand" [8].

We have the following three categories of patterns for ease of traceability, because displaying and overlaying all twelve patterns would be overwhelming: First Diagonal Sub-Matrix Symmetric Sets; Second Diagonal Sub-Matrix Symmetric Column-Selected Sets; Symmetric Structure and Perimeter Sets.

a	b	c	d
e	f	g	h
i	j	k	l
m	n	o	p
	q	r	s
	t	u	v
	w	x	y
	z		

Fig. 3. Draft QWERTY RBDL Diagonal Matrix

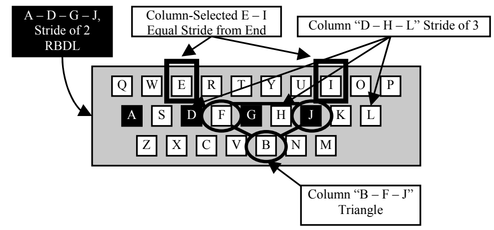

Fig. 4. First Diagonal Sub-Matrix Symmetric Sets

A. *First Diagonal Sub-Matrix Symmetric Sets*

Fig. 4 contains four sets of selected from the first sub-matrix of Fig. 3. We have already addressed the initial RBDL set {a, d, g, j}. We also need to note that two of these sets are not only symmetric sets on the keyboard, but also are entire column selections.

This indicates both a planned selection and a planned distribution. The {d, h, l} column-set having a keyboard stride of three allows it to start on "d" and also allows it to overlay the initial RBDL set. Why did column-set {e, i} not include the letter "a"? I have no idea. The letter "a" seems to be in a class all its own as a starting point both in the matrix and on the keyboard home row.

B. *Second Diagonal Sub-Matrix Symmetric Column-Selected Sets*

Now we will focus on the 3x4 sub-matrix covering the letters from "n" to "y." Fig. 5 has the QWERTY mapping for the second half of the matrix in Fig. 3. We select three pairs of letters and one set of two pairs of letters. We select from row one and from row the set of pairs {{n, w}, {o, x}} (we will visit {p, y} later), which forms the balanced "X" pattern in Fig. 5. We could look at the in-order pairs of {n, o} and {w, x} and also notice that these are one stride from the end. However, selecting in-order sets has not helped produce symmetric sets in the past – otherwise we already could read obvious and complete in-order patterns from our QWERTY keyboards.

The next pair is in the center column on the two middle rows. The pair {r, u} is symmetrically selected and found symmetrically placed in the top row of the QWERTY keyboard. We also have a set of two pairs {{q, t}, {p, y}} that

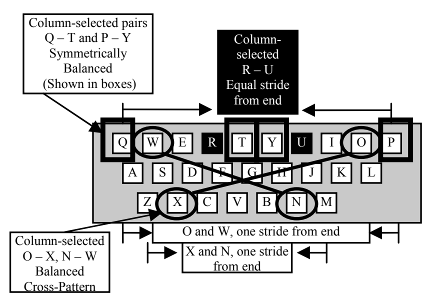

Fig. 5. Second Diagonal Sub-Matrix Symmetric Column-Selected Sets