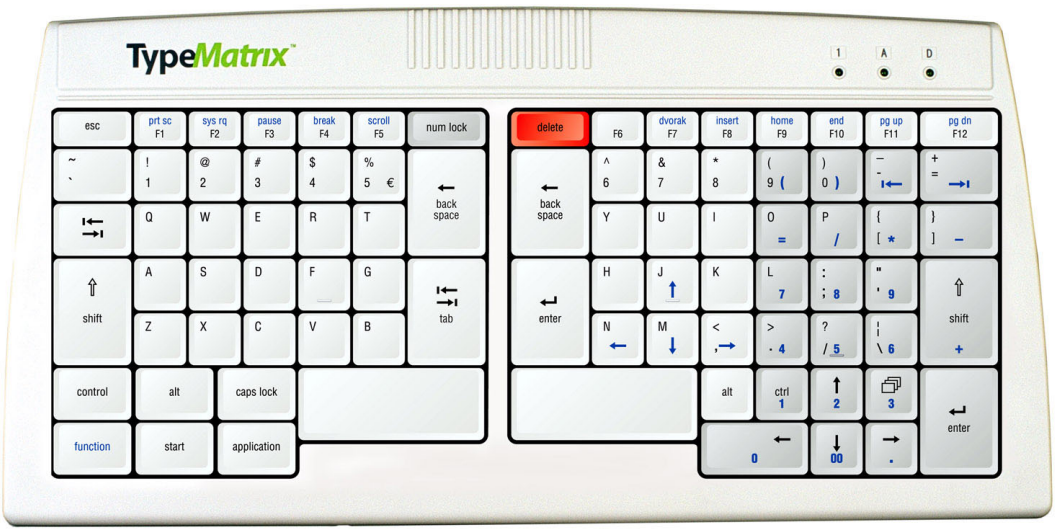
BEST Associates

Back In **E**mployment **S**afely **T**rained

An Evaluation of the
TypeMatrix™ Ergonomic Keyboard

TypeMatrix™



Evaluation of
TypeMatrix“ Ergonomic Keyboard

Over the past several decades in the office environment, Repetitive Strain Injury (RSI) has been attributed to computer keyboard and mouse usage. Several reasons have been cited:

- physical design of the keyboard,
- location of the keyboard and its relationship to the mouse, as well as
- static, awkward and fatiguing postures of the worker.

The purpose of this study was two fold:

- first, to determine if a neutral posture could be more easily maintained using the TypeMatrix“ keyboard (Qwerty layout), and
- secondly, for those participants who complained of forearm/wrist/hand pain tingling/numbness, to determine if there was a lessening of symptoms after using this alternatively designed keyboard.

The Study

Typing: an Overview

Keyboarding is a complex process dependent upon the variables of different typists: their skills, the keyboard they use, and their physical ergonomic setup, to say nothing of their physiological makeup. Attempts are made to control these variables, and this involves a well thought out balance between the following:

- Tension (job related) and relaxation (exercise);
- Eliminating unnecessary finger movements;
- Using the shortest, most direct motion paths to the next key;
- Decreasing the amount of force (effort) to strike keys;
- Decreasing the number of starts and stops as speed increases;
- Establishing neutral postures at the workstation.

The stroking or keying motion is not an isolated motion; it requires an interval of time between two successive strokes. The time factor is set by the typist. The keyboard, on the other hand, sets the interval of time between the release of one key and the engagement of the next. The rhythm of the typist and the keyboard must be in sync, otherwise the typist will fatigue. This is why we often hear from good typists that they prefer one keyboard over another. The specific keyboard used also changes the tactile response that the operator feels. Some call this a personal preference. I believe it is a compatibility issue between the worker and the machine, in this case the typist and the keyboard.

The critical point in key stroking is the unfelt force as the finger strikes the key. Almost all motion disappears when the finger releases the key. The very nature of key stroking is an orderly continuous process depending upon the short time interval required by the keyboard and the longer one required by the typist.

The task of studying typing behavior and evaluating keyboard efficiency has been done by many researchers in the past. The early engineers and designers had the motivation to search for the optimal arrangements of letters and numbers on the keyboard. Yet, until recently, few have considered the removal of the staggered column layout found on the standard keyboard, a design inherited from the original mechanical typewriter. The TypeMatrix" keyboard has accomplished this with the ortho-linear (matrix) design.

I applied the following principles when comparing the TypeMatrix" keyboard to the keyboards used by the participants prior to start of this study:

- Simple motion patterns and simple processes by the user are easier to master than complicated ones;
- Simple motion patterns and simple processes are easier to execute than complicated ones;
- Short movements expend less energy than long ones;
- Unnecessary motions create fatigue;
- Rhythmic motion patterns and sequences are less fatiguing than uneven ones.

Split vs. Fan Keyboard

Current literature and keyboard manufacturers describe keyboards that pivot around one point, whether fixed or variable, as split keyboards. In my opinion these boards are similar to oriental hand fans and should not be called split boards but rather fan boards. A split board either physically breaks into several pieces, or the alphanumeric portions of the keyboard are separated in the keyboard layout.

The keyboard design types that were in use by the participants prior to the study were:

- Conventional flat keyboard
- Fixed angle fan board
- Adjustable angle fan board

The open angle of the fixed fan keyboard was typically 25 degrees and the adjustable angle fan board ranged from 14 degrees to 30 degrees. Slope angles ranged from 0 degrees to 15 degrees. All the keyboards had the QWERTY layout of keys.

Observable wrist and forearm postures of participants when using the three designs included:

- Pronation of forearms
- Ulnar deviation of wrists
- Unbalanced motion of fingers
- Extension of wrists

Note: The wrists came closer to a neutral posture as the opening angle of the adjustable fan boards increased. However, there was noticeable rotation of elbows and shoulders when fan boards were used.

Eliminating issues with the following accommodations:

1. Participants work stations adjusted according to the criteria specified for video display terminals as per the American National Standard for Human Factors Engineering of Video Display Terminal Work Stations (ANSI-HFS-100-1988) (see profiles). The height of the keyboard tray was adjusted so that participants forearms and wrists were parallel to the floor, and their elbow angles were approximately 90 degrees — 95 degrees. The height of the monitor was adjusted so that eye declination angle to the middle of the screen was 30 degrees. Also, bifocal, trifocal and progressive lens users had the height of their monitors properly adjusted to eliminate neck extension and flexion. Chairs were adjusted for height and support of the natural lordotic curves of their spines. Footrests, new chairs, wrist rests, Vu Rysers and retractable keyboard/mouse trays were provided as needed to establish neutral non-fatiguing postures. The TypeMatrix“ alternative keyboard was provided and used in the comparative study.

2. Provided a Stretch-It “ Exercise program

3. Provided nursery rhymes to be typed in a relaxed environment

4. Provided an ergonomically designed alternative keyboard (TypeMatrix“) for comparison to the current keyboard being used.

Accommodations one, two and three were done consistently so that the only variable of concern would be the keyboard being used.

Evaluation Procedure (Instructions given to participants)

Using your keyboard and the TypeMatrix“ alternative keyboard, please type the attached nursery rhymes as follows:

- Type on each keyboard for six 20-minute sessions with a 5-minute break between sessions, the first two being practice sessions.
- Enter text as quickly and efficiently as possible.
- *Do not* correct any errors made.
- Print out each session.
- Immediately following the last text entry (session 6) for each keyboard, answer the question on the questionnaire provided.
- Attach the printouts to the appropriate keyboard questionnaire.
- Submit your printouts (12) and two questionnaires in the self-addressed envelope provided.

Conclusion

When using the TypeMatrix“ keyboard the following wrist, forearm and shoulder postures were observed:

- Minimal to no forearm pronation
- Minimal to no ulnar deviation
- Minimal to no shoulder or elbow rotation
- Minimal to no wrist extension
- Balanced motion of fingers

due to the unique design features of:

- The enter and back space functions being large keys and in the center of keyboard, thus utilizing the stronger index fingers and eliminating the stressing and reaching of the weaker smaller digits,
- The split keyboard layout which places the hands and shoulders into a neutral position without elongating the keyboard,
- The smaller footprint of the keyboard which allows the keyboard and user to be easily centered in front of the monitor; it also eliminates shoulder rotation and abduction, as well as ulnar deviation of the wrist when using the numeric keypad and mouse,
- The ortho-linear (matrix) key arrangement of the columns which allows the fingers to stretch a consistent minimum distance when traveling to keys above and below the home row,

Repetitive Strain Injury (RSI) symptoms

- Of the 26 female and 17 male participants, 16 females and 8 males reported symptoms of RSI at the beginning of the study.
- Of these, 15 females (94%) and 6 males (75%) reported significantly lessened pain and symptoms after 5 weeks.
- After six months since the survey began, 41 out of 43 participants (95%) are still using the TypeMatrix“ keyboard with excellent results.

In my opinion, these results, and others not mentioned here but noted in the study itself, indicate that the TypeMatrix“ keyboard is a much more ergonomic keyboard than the types of keyboards previously used by the participants of this study. The advantages include:

- reduction or elimination of the positions and motions known to cause injury,
- an acceptable adaptation time interval, and
- the possibility for greater typing efficiency (as measured by speed and accuracy).

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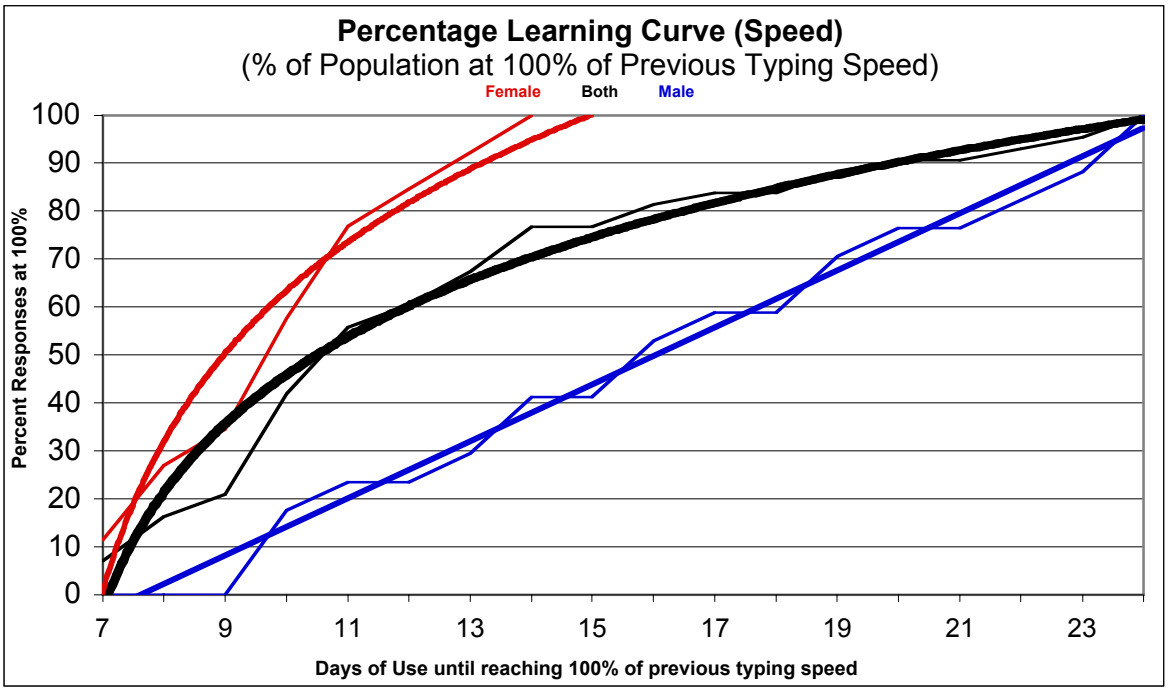
Executive Director


Percentage Learning Curve (Speed)
(% of Population at 100% of Previous Typing Speed)
Female
Both
Male
Percent Responses at 100%
100
90
80
70
60
50
40
30
20
10
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7
9
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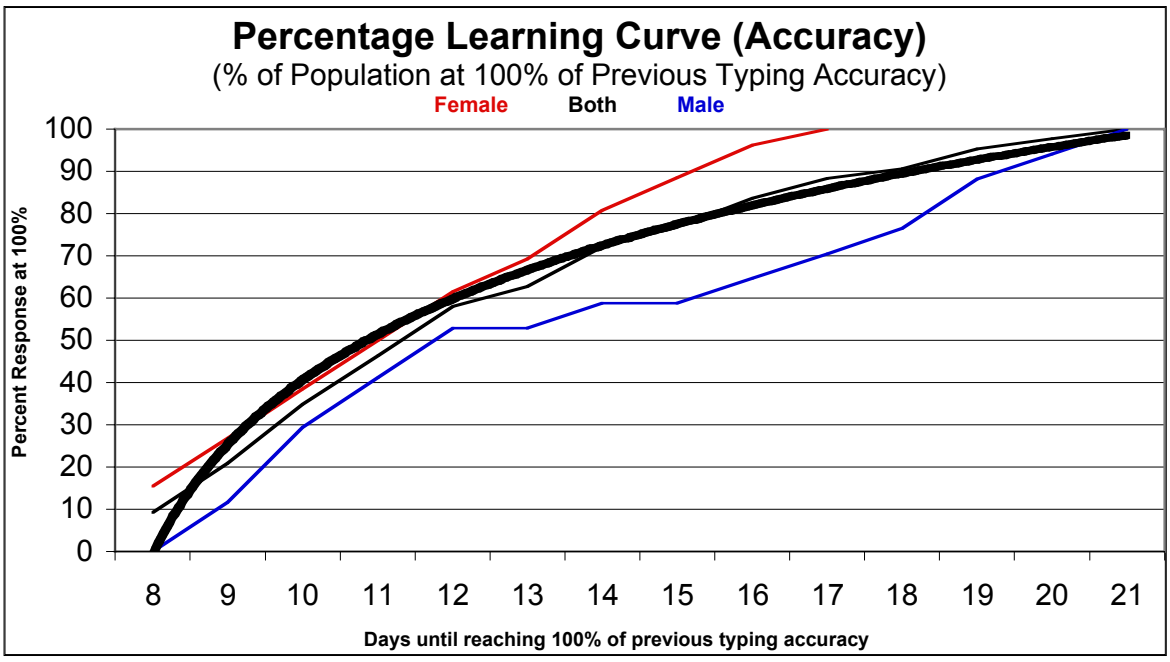
21
23
Days of Use until reaching 100% of previous typing speed


Percentage Learning Curve (Accuracy)
(% of Population at 100% of Previous Typing Accuracy)
Female
Both
Male
Percent Response at 100%
100
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80
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40
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Days until reaching 100% of previous typing accuracy