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# *USING WORDS INSTEAD OF JUMBLED CHARACTERS AS STIMULI IN KEYBOARD TRAINING FACILITATES FLUENT PERFORMANCE*

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Keyboarding skill is an important target for adult education programs due to the ubiquity of computers in modern work environments. A previous study showed that novice typists learned key locations quickly but that fluency took a relatively long time to develop. In the present study, novice typists achieved fluent performance in nearly half the time when words rather than jumbled characters were used as stimuli. This suggests that using real words in the keyboarding program can enhance the efficiency of training.

*Key words:* typing, fluency, adult education, job skills, workforce development

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Keyboarding is an important target skill in adult education curricula because effective keyboarding is a prerequisite for jobs and advanced training programs that require computer skills. A previous study showed that a self-paced computerized keyboarding program was effective in training unemployed drug-dependent adults to become proficient typists (Dillon, Wong, Sylvest, Crone-Todd, & Silverman, 2004). In that study, trainees learned the locations of keyboard keys quickly, but 85.6% of the training time was spent developing fluent (i.e., fast and accurate) typing performance. Increasing the efficiency of fluency training could have substantial practical value because limited time and money are available for job-skills training.

Studies of expert typing performance have found that manipulating the kind of text that is transcribed produces large effects on keyboarding performance. Fendrick (1937) found that words were typed faster than word jumbles (character strings created by randomly arranging the characters of a matched word; hereafter, *jumbles*), and that greater typing skill was correlated with a larger difference in speed when typing words rather than jumbles. Hershman and Hillix (1965) tested expert typists and found that experts typed words faster than randomly arranged characters, and that this difference increased as greater amounts of text were presented. Shaffer and Hardwick (1968) found that professional typists typed words significantly faster than matched jumbles. Although these studies suggest that the kind of text that is being transcribed can have dramatic effects on the speed of typing performance, we could find no studies that have attempted to determine the effects of different kinds of text on the acquisition of typing performance. In light of Fendrick's finding that less skilled yet still-competent typists showed fewer differences in performance when typing words rather than jumbles, it is possible that the different types of text may not affect the acquisition of typing performance. Thus, the purpose of the present study was to determine whether the fluent performance of different types of text would be acquired at differential rates by novice, adult learners.

## METHOD

### *Participants and Setting*

The study protocol was approved by the Western Institutional Review Board and was

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conducted in a therapeutic workplace in Baltimore, Maryland. Unemployed methadone patients ($N = 43$), who were enrolled in a study of employment-based abstinence contingencies for the treatment of cocaine dependence and who completed at least one set of fluency steps, participated in the present study. A description of the study of cocaine dependence is available elsewhere (Silverman et al., 2007). One participant included in the present study was excluded from the cocaine-dependence study but experienced the intervention. All participants were unemployed and living in poverty, and 58% held a high school diploma or equivalent. The mean age of the participants was 45 years (range, 25 to 56). Participants were assigned to a personal cubicle equipped with a computer. Keyboards were enclosed in black plastic covers so that the letters on the keys could not be read while typing. The program was controlled by Web-based software contained in an on-site server (Silverman et al., 2005).

The therapeutic workplace was open for 4 hr each weekday, and participants could work on keyboarding between 10:00 a.m. to 12:00 p.m. Participants typically earned $8.00 per hour and an additional $2.00 per hour in productivity payments. Productivity pay included payments of $0.03 for every 20 correct characters typed, −$0.02 for every two incorrect characters typed, and step-mastery bonuses ranging from $0.25 to $1.25. On any given timing, productivity pay could not fall below $0. Payments were issued as vouchers exchangeable for goods and services. Prior to beginning the study, participants received written and oral instructions that described the payment contingencies and explained how to operate a keyboard and a mouse, use the training program, and use proper keyboarding technique. The participants kept these instructions and a diagram showing the location of all keys at their workstations.

### *Keyboarding Program*

The content of the program was organized into a series of steps. The program began with *new key* steps that introduced the home row characters. This was followed by 20 fluency steps in which no new characters were introduced. Half of the fluency steps consisted of words (hereafter, *word steps*), and the remaining fluency steps consisted of jumbles (hereafter, *jumble steps*). These two kinds of fluency steps were intermixed as described below. Overall, a sequence in which 20 fluency steps followed a variable number of new key steps was repeated four times. Training steps introduced home row, top row, bottom row, and capital letters and common symbols across this repeated sequence. In total, the program consisted of 38 training steps and 80 fluency steps. Only the fluency steps are included in the present analyses.

The steps were delivered in 1-min timings initiated by the participants. During each timing, the letters, words, or jumbles included in the step were displayed randomly with replacement on the computer monitor, and the participant copied the display. Characters typed by the participant appeared just below the line of text that was being copied. New text was presented immediately after the participant finished copying everything on the screen. Mastery criteria for each step included a minimum number of correct characters (60 to 90, depending on the step) and a maximum number of incorrect characters (three to one, depending on the step). After the timing was completed, the number of correct and incorrect characters typed and earnings for that timing were displayed. If the mastery criteria were satisfied, a congratulatory message specifying the bonus earned for step completion appeared, and the participant proceeded to the next step. If the mastery criteria were not met, the criteria and productivity payments arranged for work on that step were displayed and the participant stayed on the same step. A more detailed description of a program with the same essential features is available elsewhere (Dillon et al., 2004).

*Fluency Step Construction and the Order of Presentation of Fluency Steps*

The fluency steps were created using four lists of common words that were derived from characters that had been introduced only at that point in training (e.g., the first list included words that could be typed using only keys available on the home row). No word was included on more than one list. The characters within each word in each list were processed with a random sequence generator to create the jumbles. The generator was unconstrained, and 58 (5%) of the 1,167 jumbles were words. Word steps were constructed by selecting words on the relevant list, and a matched jumble step was created using jumbles that corresponded to each word included in a word step. This procedure insured that the characters, the average number of characters per component, and the number of components were held constant across the two types of steps. A predetermined order of word and jumble steps was generated pseudorandomly such that no more than three steps of one type could be presented successively. A second version of the program then was created in which the order of presentation of word and jumble steps was reversed.

*Design*

This study employed a crossover design because the primary purpose was to investigate how a key design feature of our training program would affect the overall efficiency of our program at the group level. The logic of this design is similar to other group designs, but instead of controlling for participant differences by random assignment to the experimental conditions, each participant serves as his or her own control (Ratkowsky, Evans, & Alldredge, 1993). Because each participant repeatedly experienced both kinds of fluency steps, we controlled for order effects by alternately assigning participants to the two versions program. Wilcoxon signed-rank tests were used to analyze the data because the data were not normally distributed.

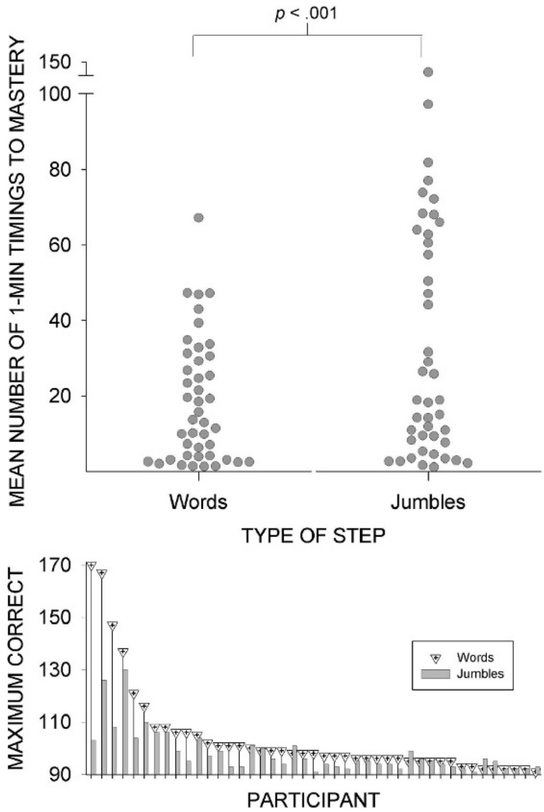


Figure 1. Top panel shows the number of 1-min timings required to meet fluency criteria on word and jumble steps. Each symbol shows the mean value for an individual participant across all steps completed by that participant. The bottom panel shows the maximum number of characters typed in a 1-min timing on word steps (triangles) and jumble steps (bars) for each participant. Data are organized in descending order of the maximum number of characters typed in a 1-min timing on word steps.

## RESULTS AND DISCUSSION

Fluency was acquired more rapidly when words were used as stimuli than when jumbles were used (Figure 1, top; $Z = -4.86$; $p < .001$). Group medians for the number of 1-min timings to mastery were 13.7 and 18.9, and group means were 18.6 and 33.6 for words and jumbles, respectively. The highest number of correct responses in a single timing was greater on word steps than on jumble steps (Figure 1, bottom; $Z = -3.88$, $p < .001$). Group medians for the highest number of correct responses on a single timing were 98 and 95, and group means were 104 and 98.2 for words and jumbles, respectively. Most participants (31 of 43; 72.1%) were faster on word steps than on jumble steps. The differences were typically small, although some participants were substantially faster on word steps. For the eight participants who were faster on jumble steps, the difference was minimal. These results are consistent with prior studies in which individuals with well-established typing skills typed words faster than jumbles or random characters (Fendrick, 1937; Hershman & Hillix, 1965; Shaffer & Hardwick, 1968). This study extends the finding to the acquisition of typing fluency by novice typists. Note that the order of presentation did not significantly affect median timings to mastery ($p = .19$) or the highest number of correct responses in a timing ($p = .29$).

The differences in fluency training time in this study have practical value. The fluency training portion of the program typically includes 40 total steps. The difference in average completion time in this study was 15 min per step. This means that for the program as a whole, using word-based steps reduced the average number of 1-min timings by 600 (i.e., $40 \times 15$). Our participants averaged 33 1-min timings per hour of training. Thus, using word-based fluency training required 18.2 fewer hours of training time ($600 \div 33 = 18.2$). In Dillon et al. (2004), trainees took an average of 51.5 hr to complete fluency training. When applied to the present results, this suggests that using words rather than jumbles may reduce overall training time by as much as 35%. Because trainees are paid $10.00 per hour, 18.2 fewer hours of training time also translates to approximately $180.00 less per trainee in keyboarding training costs. On average, fluent performance was achieved in nearly half the time when words rather than jumbles were used as stimuli. Using words rather than jumbles during fluency training had a substantial effect on adult trainees' progress through the program.

This study has several limitations. First, because no assessment of reading skill was conducted, we cannot evaluate the relation between reading skill and typing performance. The effect of words as training stimuli must be mediated by reading skill, because to a nonreader, the order of characters in a string is functionally irrelevant. It is likely that the participants differed substantially with respect to reading skill, because many did not have a high school diploma or equivalent qualification. Thus, much of the variability in the present results could be a function of differences in reading skill. A second limitation is that we did not independently assess typing skill as a function of the type of training received. It is therefore possible that jumble steps ultimately produce improvements in typing skill that would cancel the benefits of using word steps. Thus, a future study that includes assessment of reading skill and independent typing skills before and after training is warranted.

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