JOURNAL OF APPLIED BEHAVIOR ANALYSIS 2004, **37,** 223–227 NUMBER 2 (SUMMER 2004)

EFFECTS OF DELAYED CONSTRUCTED-RESPONSE IDENTITY MATCHING ON SPELLING OF DICTATED WORDS

ELENICE S. HANNA

UNIVERSIDADE DE BRASÍLIA

AND

DEISY G. DE SOUZA, JULIO C. DE ROSE, AND MÔNICA FONSECA

UNIVERSIDADE FEDERAL DE SÃO CARLOS

We studied the effects of delayed constructed-response identity matching on spelling with 6 first graders with histories of school failure. After training, the children learned to spell words to dictation and their cursive writing improved. These results replicate studies showing that delayed constructed-response matching establishes spelling. For 2 children, spelling of generalization words—words formed by recombining the syllables of training words—also improved. These results extend studies that have shown recombinative generalization in reading and spelling.

DESCRIPTORS: children, delayed constructed-response matching to sample, generalization, spelling, writing

After Sidman (1971) taught a boy with mental retardation to match printed words to dictated words, the boy showed the emergence of matching between printed words and pictures (he already matched pictures to dictation) as well as oral reading of the printed words. Sidman argued that such procedures may establish classes of equivalent stimuli that enable reading with comprehension. In related studies, children who learned to read a set of words were also able to read new words formed by recombining textual units of the training words (de Rose, de Souza, & Hanna, 1996; Mueller, Olmi, & Saunders, 2000; Saunders, O'Donnell, Vaidya, & Williams, 2003). To teach spelling, Stromer and Mackay (1992, 1993) used matching tasks with complex samples that included a printed word and its corresponding picture on a computer screen. On some trials, the sample disappeared after the student touched it and a pool of letters appeared. The student learned to touch letters to construct a word identical to that in the sample. On other trials, choice pictures appeared and the student learned to touch the picture identical to that in the sample. This constructed-response matching-to-sample (CRMTS) task taught spelling to students with mental retardation (Stromer & Mackay, 1993) and specific learning disabilities (Stromer & Mackay, 1992).

The present study attempted to replicate

This research was supported by Research Fellowships from Conselho Nacional de Desenvolvimento Científico e Tecnológico (Brazilian Research Council) to E. S. Hanna, J. C. de Rose, and D. G. de Souza and Grant 90/3435-4 from Fundação de Amparo à Pesquisa do Estado de São Paulo. Preparation of this article was supported by a PRONEX grant from Conselho Nacional do Desenvolvimento Científico e Tecnológico. We thank Drausio Capobianco for the software to analyze bigrams. We also thank Abelardo Vinagre da Silva, Andrea Osanai, Andréia Siqueira, Carlos Cameschi, Daniele Horowitz, Danielle de Holanda, Eduardo Schwartz, Fernanda da Silva, Gustavo Carvalho, Heila Veiga, Laura Santos, Léa Guimarães, Lídia Balduíno, Lúcia Sallorenzo, and Mariza Borges for their assistance with data collection. We also thank Robert Stromer, William Dube, and William McIlvane for their input on previous versions of this manuscript.

Address correspondence to Elenice S. Hanna, Departamento de Processos Psicológicos Básicos, Instituto de Psicologia, Universidade de Brasília, 70.910-900, Brasília DF, Brazil (e-mail: hanna@unb.br).

the results of Stromer and Mackay (1992, 1993) by expanding the set of words that students learned to spell and by increasing the choice pool so that it included all letters of the alphabet. Our procedure also differed because the sample stimuli were only printed words. After teaching students to construct (copy) the words to printed-word samples, we tested dictated spelling in the absence of the printed samples. We also wanted to expand the generality of the results of de Rose et al. (1996) by assessing recombinative generalization of constructed-response spelling and cursive writing. Positive results would also extend a recent demonstration of recombinative generalization in written spelling (Kinney, Vedora, & Stromer, 2003).

METHOD

Participants and Materials

Six first-grade students (2 girls and 4 boys, ages 8 to 10 years) participated. They had participated in the study of de Rose et al. (1996) and learned to read orally 51 trained words. In that study, Elena, Elia, and Ari had CRMTS training (copying the words with movable letters). This may have helped Elena and Elia, who showed recombinative generalization of reading and spelling in that study. Ari was less proficient in spelling and showed no generalization in reading, as did the 3 children who did not have CRMTS training (see de Rose et al. for details). In the present study, cards presented printed words (lowercase Arial 30 font) and a wooden platform displayed an assortment of movable letters including all 23 letters of the Portuguese alphabet.

Procedure

Three successive spelling-to-dictated-word tests were conducted during 10 sessions, with five training words and five generalization words formed by recombination of letters of training words per session. Training and generalization words (50 each) had two or three syllables and three to seven letters (e.g., training words: *bolo* [*cake*], *faca* [*knife*], and *janela* [*window*]; generalization words: *boca* [*mouth*], *loja* [*store*], and *boneca* [*doll*]). The same words were used by de Rose et al. (1996). Except for Elena and Elia, the children did not read generalization words before this study. Pretests 1 and 3 required cursive writing with pencil and Pretest 2 required word construction. After the experimenter dictated a word, the children were allowed to erase and rewrite words or parts of words during writing tests. They constructed words by picking up movable letters and placing them side by side. They could change the order of letters and return letters to the pool and pick up new ones. Tokens, which were later exchanged for trinkets and edible items, followed all constructed responses and attempts to write, correct or incorrect. No tokens were delivered if the child responded with "I don't know."

During delayed CRMTS training, the experimenter presented a card with a printed-word sample for 10 s or until the child said "pronto" (ready), whichever came first. The experimenter then removed the sample and asked the child to construct the word with movable letters. Afterwards, the card was placed beside the constructed word and the child was required to say whether the construction was correct. Correct constructions were followed by praise and tokens, and the child named the word aloud. After incorrect constructions, the card remained beside the constructed word while the child corrected its spelling. If an error still occurred, the child was prompted (a) to examine each letter of the printed word in the card from left to right, (b) to compare letters in identical positions of sample and constructed word, and (c) to select a letter and place it in the correct position. Children were allowed to construct the word after each step of the correction procedure, and the next prompt level

was employed only if the child did not make a correct response. Correct constructions on such trials were followed by praise. Words were trained in 10 blocks of five words each, and training was repeated until all words were constructed without errors.

Reading scores for training and generalization words had been obtained at the end of the study by de Rose et al. (1996) (about a week before beginning this study). Reading of training words was checked again before training started, and if children failed to read orally any word, there was retraining with the exclusion procedure described by de Rose et al.

Tests after each training block assessed the constructed response to dictated words and writing with paper and pencil. These posttests involved the five training words of each block and five generalization words. Contingencies in the posttests were identical to those in the pretest.

Interobserver reliability of two independent recordings of word construction was obtained using a point-by-point formula (Kazdin, 1982) for 78% of the data, with a mean agreement score of 98% (range, 80% to 100%).

RESULTS AND DISCUSSION

In this study, children learned constructed-response spelling after the printed words were presented and removed. During training, the number of trial blocks necessary to achieve criterion ranged from one to eight. During testing, the children were required to spell words (constructed or cursive writing) that were dictated. Figure 1 shows that accuracy of CRMTS of trained words increased for all students in the posttests. Five students correctly spelled 80% or more of the words in the constructed-response posttests, and the other one, Toni, correctly spelled 60% of the words. Scores for 4 of these children (Ari, Ilto, Toni, and Gil) were close to 0% in the pretests. Correct spelling generalized to the cursive mode: Scores were lower than for constructed-response spelling but were well above pretest scores.

Elena and Elia showed low to intermediate reading scores with generalization words before the study, but showed an increase in generalization words spelled correctly after the CRMTS training. Other children showed virtually no generalization before training and showed small increases in words spelled correctly. Thus, on the basis of words spelled correctly, children who failed to show recombinative generalization of reading in de Rose et al. (1996) showed virtually no recombinative generalization of spelling in the present study. However, inspection of their protocols indicates approximations to standard spelling. As Lee and Sanderson (1987) suggested, the process of spelling acquisition may be reflected in a score based on the percentage of correct bigrams (sequences of two letters) in each spelled word. For example, *caneta* (*pen*) has seven bigrams (*-c, ca, an, ne, et, ta, a-*, where "-" indicates spaces before and after the word). Gil spelled *lea* in the pretest (one correct bigram: *a-*) and *caleta* in the posttest (five correct bigrams). Although Gil spelled few words correctly in the posttests, he often missed or substituted only one letter, resulting in a high bigram score (about 50%). Posttest bigram scores also increased for Ari, Ilto, and Tony, although not as much as they did for Gil (Figure 1).

The present results replicate previous findings that have shown the effectiveness of delayed constructed-response matching to establish spelling (e.g., Stromer & Mackay, 1992, 1993). They also extended those findings to a tabletop procedure, using a larger set of Portuguese words and choice pool of letters. These results also extend the generality of de Rose et al. (1996) by showing that the intervention package may yield recombinative generalization in spelling (cf. Kin-

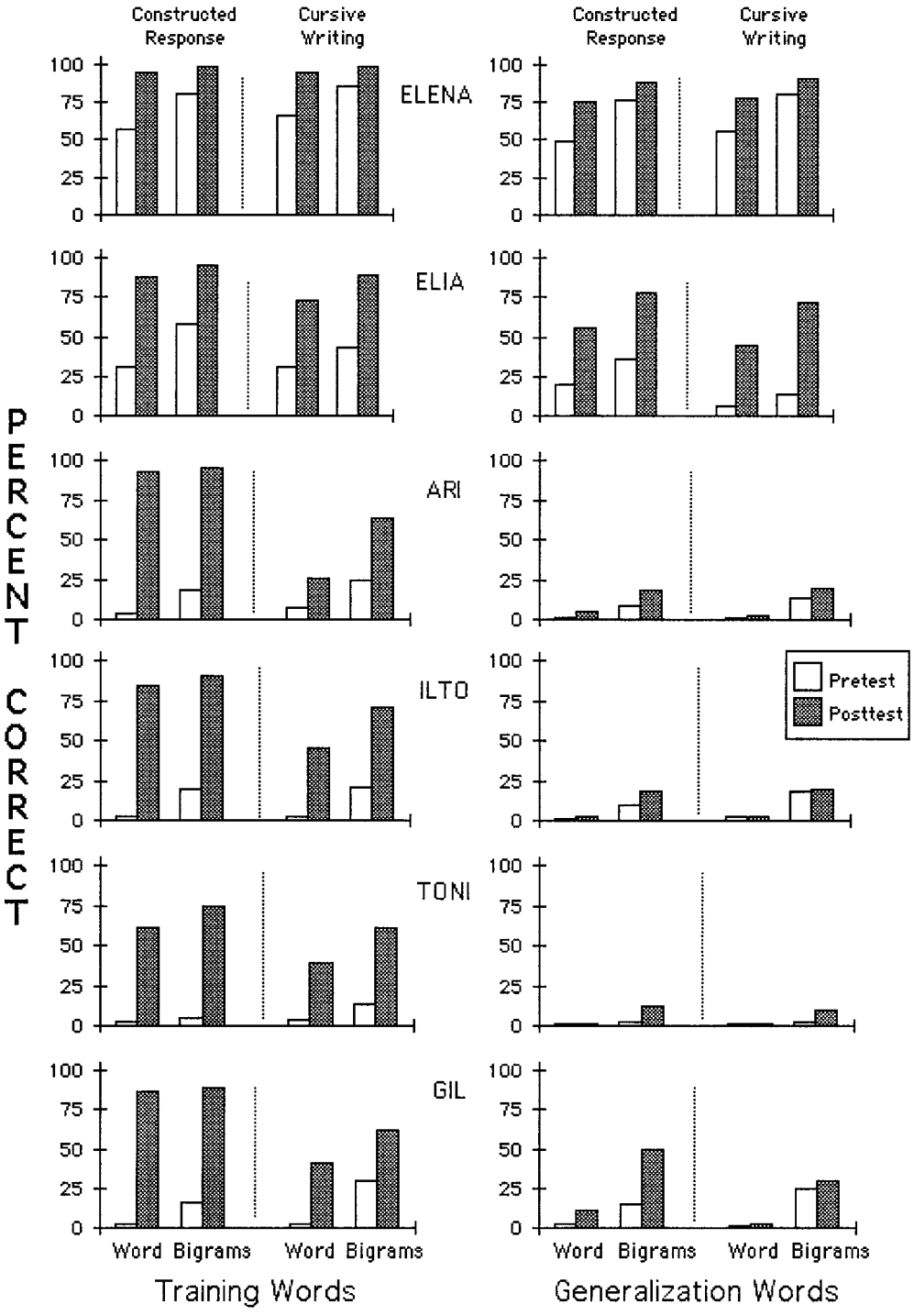

Figure 1. Percentage of correctly spelled words and correct bigrams for pretests (white bars) and posttests (gray bars) with constructed responses and cursive writing. The left panel presents scores for training words, and the right panel presents scores for generalization words.

ney et al., 2003). Even the children with low scores on spelling generalization at the start of training showed improved spelling, as reflected in the percentage of correct bigrams.

We speculate that, in the current study, learning to construct words with letter tiles improved written spelling through the following mechanisms. Delayed CRMTS training established control of constructing words by printed words. Because the printed words shared equivalence class membership with dictated words (established in de Rose et al., 1996), the dictated words came to control constructed responding; and, because printed words controlled both constructing and writing words, dictated words also controlled written spelling. Thus, in studies using the equivalence paradigm, participants may learn to produce responses to new stimuli (e.g., printed and dictated words) when the responses involved are already controlled by other stimuli (e.g., de Rose et al., 1996; Sidman, 1971; Stromer & Mackay, 1992). However, this explanation remains speculative, and future research should examine the extent to which stimulus equivalence, acquired by selection responses, can promote production-based responses (e.g., speaking and writing).

REFERENCES

de Rose, J. C., de Souza, D. G., & Hanna, E. S. (1996). Teaching reading and spelling: Exclusion and stimulus equivalence. *Journal of Applied Behavior Analysis, 29,* 451–469.

Kazdin, A. E. (1982). *Single-case research designs.* New York: Oxford University Press.

Kinney, E. M., Vedora, J., & Stromer, R. (2003). Computer-presented video models to teach generative spelling to a child with an autism spectrum disorder. *Journal of Positive Behavior Interventions, 5,* 22–29.

Lee, V. L., & Sanderson, G. M. (1987). Some contingencies on spelling. *The Analysis of Verbal Behavior, 5,* 1–13.

Mueller, M. M., Olmi, D. J., & Saunders, K. J. (2000). Recombinative generalization of within-syllable units in prereading children. *Journal of Applied Behavior Analysis, 33,* 515–531.

Saunders, K. J., O'Donnell, J., Vaidya, M., & Williams, D. C. (2003). Recombinative generalization of within-syllable units in nonreading adults with mental retardation. *Journal of Applied Behavior Analysis, 36,* 95–99.

Sidman, M. (1971). Reading and auditory-visual equivalences. *Journal of Speech and Hearing Research, 14,* 5–13.

Stromer, R., & Mackay, H. A. (1992). Spelling and emergent picture-printed word relations established with delayed identity matching to complex samples. *Journal of Applied Behavior Analysis, 25,* 893–904.

Stromer, R., & Mackay, H. A. (1993). Delayed identity matching to complex samples: Teaching students with mental retardation spelling and the prerequisites for equivalence classes. *Research in Developmental Disabilities, 14,* 19–38.

Received April 24, 2003
Final acceptance February 17, 2004
Action Editor, Robert Stromer