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Effects of Letter-Identification Training on Letter Naming in Pre-Reading Children

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Abstract

Three pre-reading children who named 0 to 3 of 20 targeted letters were taught to select the 20 printed letters upon hearing spoken letter names. For all participants, the letter-identification training resulted in naming for the majority of letters.

Keywords

letter identification; letter naming; matching-to-sample; pre-reading children; reading

Prereaders' ability to name letters at school entry is the strongest single predictor of their first-grade reading achievement (Adams, 1990). Converging evidence suggests that letter naming provides a critical foundation for subsequent reading instruction (see Foulin, 2005, for review). Share (2004), for example, demonstrated that learning to name letters helped children to learn letter-sound relations—a key element of phonics instruction.

We conducted this study to inform the development of computerized instructional programming for early reading skills. An effective instructional program arranges a sequence of teaching steps, each of which prepares the student for the next, more difficult, step. Given this goal, there are at least two reasons for preceding letter-naming instruction with a letter-identification task, in which the child hears the spoken letter name, and selects the corresponding printed letter from an array of several letters (i.e., a matching-to-sample [MTS] task). First, letter naming requires the discrimination of letters presented one at a time (a successive discrimination). Selecting letters from an array, however, requires discriminating printed letters that can be seen together (a simultaneous discrimination). Other factors being equal, simultaneous discriminations are acquired more rapidly than successive discriminations, particularly with unfamiliar, abstract two-dimensional forms such as letters (Carter & Eckerman, 1975; Brady & Saunders, 1991). Second, learning to select visual comparison stimuli given spoken-word sample stimuli can produce emergent naming of the visual stimuli *without any additional teaching* (see O'Donnell & Saunders, 2003, for a review). This effect has been shown with printed words, letters, and letter-like abstract forms.

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The present study asked whether letter naming emerged following letter-identification training, in which pre-reading children learned to select printed letters upon hearing the spoken letter names. The study advances this area of research in that relatively few studies of emergent naming have included both typically developing children and real-world stimuli.

Method

Participants

One 4-year-old (Haley) and two 3-year-old (Abby and Art) children participated. They were selected based on the criterion of correctly naming no more than three (out of 26) lower-case letters. To continue in the study, we required participants to demonstrate at least 90% accuracy on two computerized tasks: selecting pictures that corresponded to spoken words and selecting printed letters that were identical to a "sample." Abby and Art were typically developing and Haley was diagnosed with Down Syndrome. Art was learning English as a second language. The mental-age equivalents on the Peabody Picture Vocabulary Test-Revised for Art and Haley were 2.5 and 2.0, respectively. We verified with preschool staff that letter identification and letter naming were not directly targeted for our participants.

Apparatus and Setting

We conducted sessions in a private room within a daycare center using a Macintosh® computer with a touch-sensitive monitor. The experimenter sat behind the child. Visual stimuli, either pictures or lowercase, black printed letters in Geneva font, were approximately 3.0 cm by 3.0 cm. The computer's speaker presented spoken words (recorded female voice). A custom-written program (Dube & Hiris, 1999) presented all stimuli and recorded data on the letter-identification task. The program also presented the letters for the letter-naming task, but observers scored responses.

Procedure

We conducted one or two sessions per day, 2 to 5 days per week excluding academic breaks, depending on the participants' availability. The number of days that elapsed between the first and last probes was 137, 184, and 87 for Abby, Art, and Haley, respectively. To encourage participation, we gave participants 5 to 10 min of access to preferred toys for completing a session, regardless of accuracy.

Letter sets—Twenty letters were included; excluding x, y, and four potentially difficult-to-discriminate letters (b, d, r, and n for Abby; b, d, p, and q for Art and Haley). For each child, we quasi-randomly divided the 20 letters into five sets of four letters, with the restriction that the final sets for Art and Haley included physically similar letters (e.g., n/h/t/f). Figure 1 shows the composition of sets and the order of training for each child.

Design—We used a multiple-probe-across-letters design (Horner & Baer, 1978) to demonstrate differences in letter-naming accuracy as a function of whether a given letter had been trained in the letter-identification procedure. We conducted a letter-naming probe before any letter-identification training, and again after training was completed with each set of four letters. We chose this strategy to avoid consecutive sessions under extinction conditions. Although the children were not receiving letter-naming instruction outside of this study, we assumed that small increases might occur before teaching, but that increases in taught letters would be greater than increases in untaught letters.

Letter-naming probe—Within a session, each of the 20 letters was presented once, appearing in the computer screen's center, in random order. Following a response, or no response for 5 s, the letter was removed, and the next letter was presented. There were no programmed consequences. If participants said more than one letter name on a trial (e.g., self-correction), we scored the first response only. A second observer independently scored 47% of the naming probe sessions. The two observers agreed on the occurrence or nonoccurrence of a correct response on at least 95% of trials.

Letter-identification training—Each trial began with the presentation of a spoken letter name along with a black square in the screen's center. Touching the square removed it, and produced two-to-four printed letters, depending on the training stage, in the corners of the screen. The name repeated every 2 s until the child touched a printed letter. Correct selections produced 1-s flashing stars, chimes, and praise from the experimenter. Incorrect selections produced a 1-s black screen and a 0.5-s buzz sound. A 1.5-s white screen separated trials. We introduced letters one at a time during teaching conditions for four-letter sets. The new letter was correct on all trials until the participant made four consecutive correct responses. This ensured the simultaneous discrimination of letters within sets. Next, the second spoken name was presented on all trials. After four consecutive correct trials with the second name, the program branched to a mixture of both names. The third and fourth letters were added in the same way.

Comparison-stimulus locations varied quasi-randomly, except that each corner contained the correct letter equally often, and on no more than three consecutive trials. In conditions with more than one sample stimulus, samples were presented quasi-randomly, except that the same sample was presented on no more than three consecutive trials. Once four letters were intermixed within sessions (six trials per letter), the criterion was met when accuracy exceeded 90% with no more than one error per letter.

After mastering the second and each subsequent four-letter set, participants received review sessions that included all taught letters. We required overall accuracy of at least 90% to proceed to the letter-naming probe. If accuracy on particular letters was low, we suspended review sessions while retraining those letters. Retraining was conducted during the review after the fifth and second letter sets were taught for Abby and Haley, respectively.

Results and Discussion

All participants learned to select printed letters that corresponded to spoken letter names during the letter-identification training. The mean numbers (and ranges) of 24-trial sessions required to train each set of four letters were 5.6 (4 to 7), 16.5 (7 to 26), and 23.5 (22 to 25) for Abby, Art, and Haley, respectively. The mean number of sessions required to complete the cumulative reviews that occurred after each set was taught, including retraining, were 6.3 (1 to 20), 3.0 (1 to 5), and 3.0 (3).

Figure 1 shows the letters named correctly in letter-naming probes. The bars to the left of the vertical lines show that the participants named few letters correctly before letter-identification training. Moreover, there was little-to-no increase before training, and changes were consistent and limited to a few letters, despite some letters being probed four and five times. After training, however, letters named correctly increased in 10 of 11 cases. Art's naming of Set-1 letters (s/v/g/k) was an exception: None were named correctly during the second and third probes. Thus, we implemented a procedure only with this letter set. Before the fourth naming probe, naming trials for Art's Set-1 letters were intermixed within letter-identification sessions. For these trials, if Art did not name or named incorrectly, we provided the correct name and Art repeated it. Naming improved, although we cannot unequivocally credit the special training.

In the final probe session, the overall percentage of trained letters named correctly was 65%, 75%, and 75% for Abby, Art, and Haley, respectively. The finding that letter-identification training improved letter naming are consistent with studies in the stimulus-equivalence literature showing emergent naming of visual stimuli including letters, abstract letter-like shapes, and printed words (O'Donnell & Saunders, 2003). It is important to point out several features of this study that should be considered in replication and/or application.

A limitation in the experimental design warrants discussion. Six of the 11 teaching conditions occurred after fewer than three baseline sessions (i.e., the first and second sets), thus not demonstrating failure to learn these letters in the absence of instruction. Had all participants completed all five letter sets, this would have been less problematic. Haley, however, completed training on only two sets. Her data would be more convincing had she completed more sets. Producing uniformly large effects also would have rendered the baseline issues less problematic.

Some aspects of our procedures may have reduced the likelihood of correct naming. Because we taught letters in sets, and we used the same comparison arrays in review sessions as in teaching, some letters never appeared together in comparison arrays. This may account for some of Abby's letter-naming errors. For example, in the three naming-probe sessions after both t and f had been taught, Abby named both of these letters "t" in two sessions, and named both "f" in the third. She also said "p" for the letter q. To increase opportunities to discriminate all letters from one another, we recommend rearranging the composition of comparison arrays across trials such that all letters appear together during training. This is especially important for difficult-to-discriminate letter pairs.

Another caveat is that the letter-identification procedures alone would not be expected to promote naming unless two component skills of naming were also in the repertoire. First, the ability to produce the spoken letter names is essential. We did not test production of spoken letter names before the study (e.g., by asking participants to imitate letter names), because the participants had understandable speech. Such testing would be advisable, however, if replicating these procedures with individuals who have less-developed speech.

Second, letter naming requires the successive discrimination of all letters (i.e., the letters are presented *one at a time*). As in many studies of emergent relations, our procedures did not include a teaching component that explicitly ensured the successive discrimination. This limitation may account for some errors in the letter-naming probe. Mastering the simultaneous discrimination is likely to be beneficial, but may not be sufficient for producing the successive (see Sidman, Rauzin, Lazar, Cunningham, Tailby, & Carrigan, 1982). Although the majority of letters were named after letter-identification training alone in the current study, it is worth noting that some difficult-to-discriminate letters were not included in the study.

Training was too lengthy, especially for Art and Haley. Although we introduced new letters individually and required high accuracy prior to intermixing samples, we used only differential reinforcement once samples were intermixed. Systematic prompting procedures could increase the speed of acquisition (e.g., Carp, Peterson, Arkel, Petursdottir, & Ingvarsson, 2012). Also, the number of letters in a set may have affected performance. Adding the fourth letter, on average, approximately doubled the number of sessions required beyond the mastery of a three-letter mix. Note that, with 4 letters, sessions contained only 6 trials per letter. On the other hand, it is important to provide experience with discriminations among many letters. Teaching letters to mastery in pairs (e.g., k/o; o/c; k/c, etc.) before presenting larger screen arrays (e.g., k/o/c/a) is another potential solution.

Finally, future research could evaluate adaptations to instruction for individuals whose speech is unclear (e.g., children with cerebral palsy). Matching-to-sample procedures with spoken samples are gaining acceptance for teaching and/or assessing early reading skills in this population (see Barker, Saunders, & Brady, 2012). Such procedures allow individuals with speech impairments to begin learning associations between letters and their names before they are able to produce the spoken letter names. Thus, these procedures are deserving of further study, even if emergent naming is not an immediately expected outcome.

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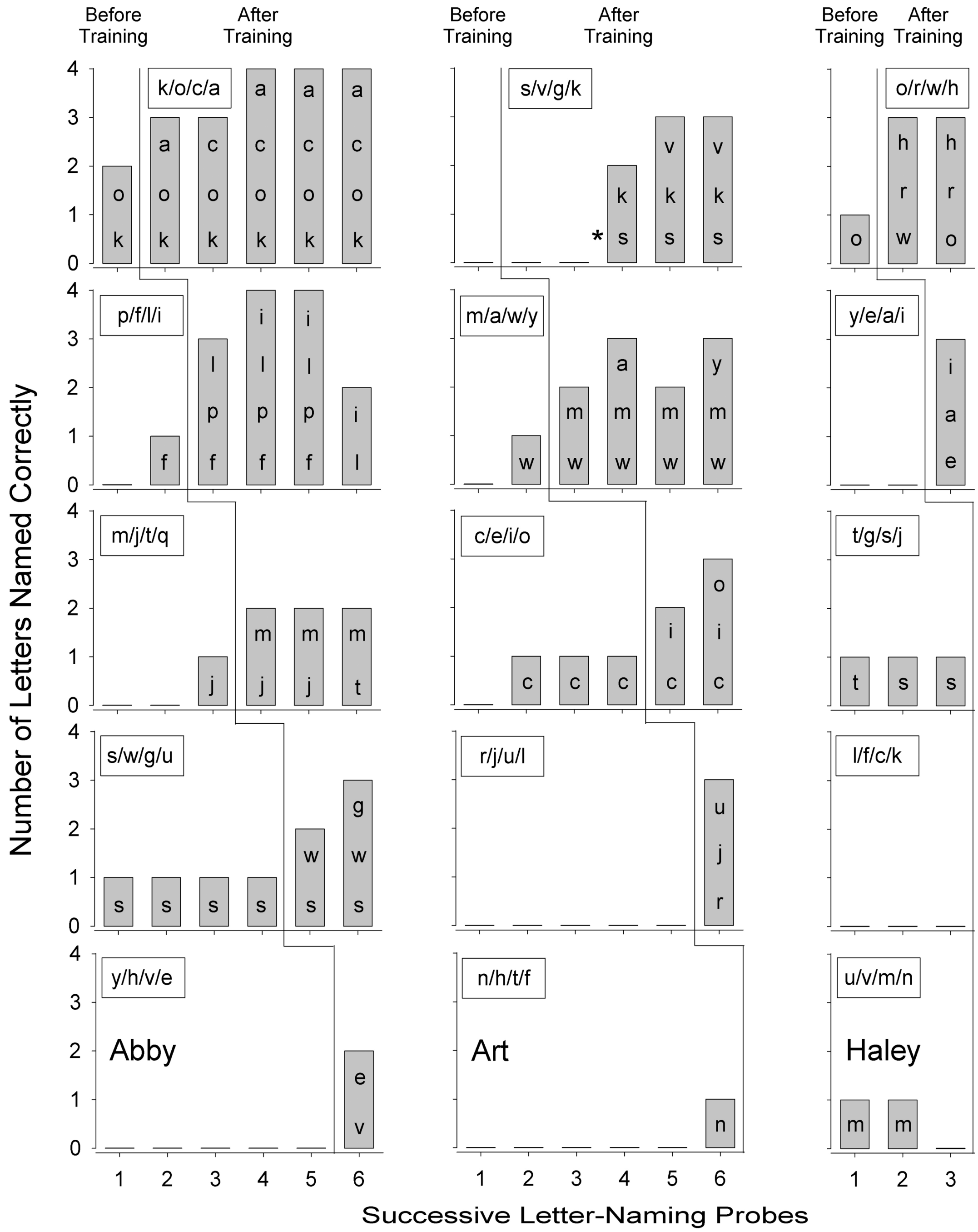

Figure 1.

The number of letters named correctly during letter-naming probes. The letters named correctly are displayed in the bars. The asterisk indicates the point where we implemented a letter-naming training procedure.