A LONG-TERM ANALYSIS OF THE RELATIONSHIP BETWEEN FLUENCY AND THE TRAINING AND MAINTENANCE OF COMPLEX MATH SKILLS

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In 2 experiments, each involving different mathematical operations, we compared 2 training procedures for teaching component math skills in terms of their effects on the learning and long-term maintenance of composite skills. The dependent variables were learn units to composite task mastery and performance on the composite task 2 months later. The independent variables were instruction in math facts under (a) fluency and (b) mastery conditions. The experiments used a simultaneous treatment design in which the students were selected for participation according to prerequisite skills and instructional histories and randomly assigned to receive 1 of the 2 training procedures. Four adolescents with developmental disabilities participated in each experiment. Instructional presentations were controlled by yoked learn units during component skill instruction. Results showed that fluency instruction did not result in fewer learn units to criterion on the composite task. However, 2 months later, the fluent students performed between 83% and 100% correct on the composite task, while the mastery students performed between 17% and 83% correct. The data are discussed in terms of fluency theory and educational practice.

According to behavioral fluency theorists, responses that are mastered at fast rates will result in several outcomes or benefits (Binder, 1996; Johnson & Layng, 1994, 1996). Other theorists also have a theoretical and research literature concerned with fast and accurate performance of skills, and they refer to performance of skills without "conscious attention" as automaticity (Bloom, 1986; Dougherty & Johnston, 1996; Gagne, 1983; Hasher & Zacks, 1979; Samuels, 1987; Wachsmuth, 1983). Research in automaticity has resulted in outcomes similar to those touted by behavioral fluency theorists (Bloom, 1986; Gagne, 1967; Hasselbring, Goin, & Bransford, 1988; LaBerge & Samuels, 1974; Spring, Blunden, & Gatheral, 1981).

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Several demonstration studies in the literature are devoted to fluency effects; however, there are few experimental investigations (Lindsley, 1972, 1992; Potts, Eshleman, & Cooper, 1993; West & Young, 1993). The demonstration studies showed correlations between fast rate instruction and each of the benefits associated with the fluency theory. Those benefits that were reported included (a) greater maintenance of skills (Binder, 1996; Ivarie, 1986), (b) continuous or prolonged task performance without the need for prosthetic reinforcement (i.e., reinforcement operations employing consequences that are not natural outcomes of behavior) (Binder, 1996; Binder, Haughton, & Van Eyk, 1990; McDowell & Keenan, 2001), (c) accurate and fast rates of performance in the face of distraction (Binder, 1979, in 1996), (d) application and generalization of skills to novel stimuli (Binder & Bloom, 1989; Johnson & Layng, 1992), and (e) combinations of component skills that result in new, more complex skills (Haughton & Kovacs, 1977, in Binder, 1996; Van Houten, 1980).

Behavioral fluency theorists also claim that fluent component skills make learning problem-solving repertoires easier, or even possible, and that these new skills can be acquired with little or no instruction (Binder, 1996; Epstein, 1985; Johnson & Layng, 1992, 1994). They use the term *adduction* to refer to "the production of novel behavior when new combinations of stimulus properties that separately control different classes or properties of behavior engender new combinations of those classes" (Catania, 1998, p. 378). At least one experimental study has demonstrated contingency adduction in pigeons as a function of fluent component skills (Andronis, Layng, & Goldiamond, 1997).

A few true experiments have tested the comparative effects of fast rate, or fluency, instruction on longer maintenance. Young, West, Howard, and Whitney (1986) tested the effects of mastery and fluency criteria on the acquisition, generalization, and maintenance of dressing skills for students with developmental delays using a single case experimental design. Young et al. found a functional relationship between fluency and generalization of skills. Maintenance probes, conducted 1 month following fluency instruction, showed that the skills taught to fluency criteria were maintained; however, there was no comparison with instruction that led to mastery but not fluency.

A critical obstacle to isolating rate as a controlling variable for any of the outcomes of rate instruction concerns the problem of mastery versus fluency. That is, in the studies comparing percentage mastery versus fast rate mastery, inevitably the participants who received rate instruction also received more instructional presentations. Recently, investigators have isolated the instructional unit that predicts learning, the *learn unit* (Albers & Greer, 1991; Emurian, Hu, Wang, & Durham, 2000; Emurian, 2004; Greer & McDonough, 1999; Greer, McCorkle, & Williams, 1989; Ingham & Greer, 1992; Selinske, Greer, & Lodhi, 1991). A learn unit includes the teacher or automated teaching device ensuring the student's attention, the unambiguous delivery of an antecedent that is to be the discriminative stimulus when the student has mastered the discriminated operant, and
delivery of either a reinforcer or a correction. Corrections include repetition of the teacher's antecedent and are given in the presence of the stimulus. Research that has identified the learn unit as a predictor of instructional outcomes provided the means to isolate the number of instructional units from fast rate instruction.

Three experiments comparing rate mastery versus percentage mastery have controlled for learn units and thereby isolated the rate variable. However, in these studies the results were not consistent. In a series of two experiments reported in a dissertation, Kelly (1995) found a functional relationship between fast rate instruction and maintenance of sight words for preschoolers with disabilities. Students in her experiments who received rate instruction maintained words at 90% to 100% accuracy up to 190 days without practice, while the words taught to mastery, without fluency, resulted in 35% to 60% mastery. In Kelly's experiments learn units were used to control for instructional presentations (i.e., overlearning, Chasey, 1971, 1977; Dougherty & Johnston, 1996; Van Houten, 1980), whereas prior research did not isolate instructional presentations from the rate variable. However, in two attempts to replicate these findings, Hanretty and Greer (2000) found that when learn units were controlled, students in both mastery and fluency conditions showed 80-100% long-term maintenance, suggesting that the controlling variable was learn units or numbers of instructional presentations, and not rate. In these experiments and in the experiment reported herein, we equated the instructional presentations by controlling for learn units and this allowed us to isolate the rate component.

No studies have compared the effects of rate versus mastery on the learning and maintenance of composite skills. Such a comparison, by necessity, involves a prolonged analysis and long-term tests of maintenance. The purpose of the research we report was to determine whether there were any benefits of fluency versus mastery instruction in component skills relative to instruction in and maintenance of more complex or composite skills. In order to do this we needed to control for instructional presentations in each condition to eliminate the potential confound of overlearning. In our experiments, all instructional presentations were learn units and numbers of learn units between the rate participants and the mastery participants were the same during the component skill conditions.

Experiment 1

Method

Design. We used a simultaneous matched treatment design (Kazdin & Hartmann, 1978) in order to compare the effects of two instructional tactics for teaching component skills (fluency instruction in math facts and mastery instruction in math facts) on learn units to criteria and maintenance of composite math skills. The composite task involved multiplication of 2-digit numbers by 2-digit numbers containing digits from
0 to 3 (e.g., 46 x 23). Each experiment had two phases, one in which component skills were taught to different criteria and one in which composite skills were taught to accuracy criterion.

The students were initially selected for participation in the studies based on skills they had in their repertoires. Further, we taught to 100% accuracy criteria any additional prerequisite skills that were required in order to complete the component and composite tasks in the experiments. Thus, either by selection or instruction, we ensured that students entered the experiments with the same prerequisite skills. The students’ learn units were yoked throughout the first part of the experiments, as they received component skill instruction. A full description of the yoking procedure is provided below.

**Participants and setting.** Four adolescent students with developmental disabilities and behavior disorders participated in this study. The students attended a private, publicly funded day school in a suburb of a large metropolitan area that implemented the Comprehensive Application of Behavior Analysis to Schooling (CABAS®) model of education (Greer, 2002). All students in this study emitted independent reader-writer (on at least a 2nd-grade level) and emerging self-editor behavior (Skinner, 1957). In order to control for instructional histories and prerequisite skills, we selected the students for participation because they had all necessary prerequisite skills in their repertoires. All 4 students had achieved accuracy criteria for all single-digit addition facts and single-digit multiplication facts through the 3s tables (0 x 0 to 3 x 9) to a 100% accuracy criterion.

**Preinstruction procedures.** Prior to the beginning of the study, probes were conducted with all 4 students to test for additional prerequisite skills required for instruction on the composite task. Those skills included identification of place value to the 100s place, reading sight words on word lists (e.g., column, equal, multiply), and comprehension of those sight words (e.g., differentiating between digit and number, above and below, over and under). The words on the word lists were taken from the written instructions that the students were later given to use in solving the composite problems. Students who did not demonstrate the 100% accuracy criterion received instruction until criterion was achieved. Participant selection and preinstruction procedures took a total of 2 months to complete.

In order to ensure that students did not have the composite skill in their repertoires, we conducted preinstruction probe trials after the students had met prerequisite criteria for participation in the study. These trials were different from learn units because the students did not receive any consequences or feedback following their responses. A preinstruction probe trial for the composite task consisted of one worksheet containing 12 multidigit multiplication problems, arranged in columns of six and rows of two. In order to control for practice effects, two versions of the composite task were devised, consisting of different problems. Three trials were conducted prior to component skill training. Students were provided with written instructions to perform the composite task during all preinstruction trial sessions.
Component skill instruction. In the first part of the experiment, students were randomly assigned to one of two instructional conditions, where they received instruction on (a) fluent responding or (b) mastery responding (overlearning) to component math skills. The component skills consisted of single-digit multiplication facts through the 3s tables, single-digit addition facts with sums 10 or less, single-digit addition facts with sums greater than 10, and reading word lists. The component skills taught in the first part of the study were chosen from the composite task. Component skill instruction took 9 months to complete.

Fluency instruction. Students A and B were randomly assigned to receive fast rate instruction until their responses to component skills became fluent, or, until they met the rate criterion. In this experiment, the normed rate criterion for each component arithmetic skill was determined by assessing the mean rate of 10 adults. For both addition facts and multiplication facts, the rate criterion for performance on component skills was set at 100 written digits per minute, with no errors. The criterion for reading from the word lists was set so that the reader was reading at a "normal" pace, without hesitation (so that others could listen and follow along), and was established at 150 words correct per minute with no errors. Students A and B were prompted and coached to increase their rates of correct responding, while keeping errors low. Faster rates of correct responding were reinforced and corrections for incorrect responses were delivered at the end of each session (page), as per learn unit instruction.

Mastery instruction. Students C and D were randomly assigned to receive postmastery instruction on component math skills. Students C and D responded to math facts without using observable verbally governed strategies or operations to solve arithmetic problems. Once these students made contact with the textual antecedent (looked at the problem) they began to write the response without hesitating or averting their eyes from the problem. The students continually responded to all the problems on the page, without pause or distraction. Although their responses were timed for measurement purposes, correct responses alone (not rate) were reinforced and corrections were delivered at the end of each session, as per learn unit instruction.

Yoking procedures. Students assigned to the fluency instruction condition received learn units that were designed to increase their rates of performance. Students not receiving rate instruction continued to engage in postmastery practice. In order to rule out the effects of learn unit presentations from the rate component (often characterized as overlearning), we needed to control for the numbers of instructional presentations each student received in the component skill phase. To do this, we randomly assigned the students to each instructional condition. Then we randomly paired one student from the fluency condition with one student from the mastery condition. The learn units for each pair were then yoked for each component skill. The numbers of learn units required for the student in the fluency condition to achieve rate criteria determined
the number of postmastery learn units the student in the mastery condition received. Student C’s learn units were yoked to Student A’s and Student D’s learn units were yoked to Student B’s.

Because their learn units were yoked, Students A and C completed 41 learn units for multiplication facts 0-3, 96 learn units for addition facts summing 10 or less, 117 learn units for addition facts summing more than 10, and 21 learn units for reading word lists. Students B and D completed 13 learn units for multiplication facts 0-3, 23 learn units for addition facts summing 10 or less, 101 learn units for addition facts summing more than 10, and 2 learn units for reading word lists from the composite task. Students B and D completed fewer learn units across all component skills because Student B required fewer learn units to achieve rate criteria.

Composite task instruction. Once students completed component skill instruction, they entered the second phase of the experiment. The second part of the experiment was conducted in order to test for the effects of component skill instruction for different conditions of responding by measuring the ease of acquisition and maintenance of a composite, problem-solving task comprised of those components. One dependent variable in this experiment was the numbers of learn units required to reach criterion on the verbally governed task of solving multidigit multiplication problems.

Composite instruction began once all component skill instruction was completed and all criteria were met. Students entered composite task instruction at different times, coinciding with the completion of all component skill criteria. We gave the students written rules for completing the problems and we provided learn unit instruction according to a previously written script. We instructed the students to read each written instruction aloud and then to perform the operation described in the instruction. If a student did not perform the operation correctly we delivered successive prompts until the student responded correctly (in lieu of a full correction). We only gave full corrections if the response could not be prompted any further. We reinforced correct responses and instructed the students to read the next written instruction and perform the next operation. Composite task learn unit instruction continued until the students performed two consecutive sets of 12 problems correctly without any assistance. Criterion for the composite task was 100% accuracy for two consecutive sessions. Composite task instruction took 4 months to complete.

The second dependent variable in this experiment was maintenance of the composite task following periods of time with no practice. Single session maintenance probe trials were conducted at 1 and 2 months for all students, except for Student B, for whom a 1-month trial could not be conducted, to test for maintenance effects across treatment conditions. The students had access to the written instructions during all maintenance trial sessions.

Interobserver agreement. For the component skill instruction, independent observers scored 62% of the component skill worksheets.
Percentage of agreement ranged from 86% to 100%, with a mean of 98.8% agreement for the math component skill worksheets. Interobserver agreement was obtained for 38% of all reading sessions. Percentage of agreement ranged from 98% to 100%, with a mean agreement of 99% for the reading component skill.

Two independent observers also measured timings during component skill instruction independently. All timings were rounded to the nearest second. Agreement on timings was especially important for Students A and B as they neared rate criteria, to ensure accurate identification of rate criteria achievement.

Interobserver agreement for the learn unit instruction on the composite task was obtained via videotape or when another observer was present, for 29% of all composite task instructional sessions. Percentage of agreement ranged from 87% to 100%, with a mean of 95% agreement for the composite math task.

Interscorer agreement was also obtained for students responding to the composite task. Independent observers scored completed worksheets and made checkmarks for correct responses and/or circled any errors for 42% of all composite task sessions. The mean of interscorer agreement was 99%, with a range from 97% to 100% for all written responses to the composite task.

**Results**

Figure 1 represents the number of learn units to criterion for the

![Figure 1. Numbers of learn units to criterion on the composite task for Students A-D in Experiment 1.](image-url)
composite task for all 4 participants. Students A and B, who received fluency instruction for component skills, required 613 learn units and 530 learn units respectively to meet criterion for performing the composite math task. Students C and D, who received mastery instruction for components, required 489 learn units and 377 learn units respectively to meet criterion on the composite task.

Figure 2 shows the percentages of correct responding to 1- and 2-month maintenance probe trials for all 4 students. Data for the maintenance trials are reported as percent correct, as opposed to

![Figure 2](image-url)

**Figure 2.** Percentages of correct responding to 1- and 2-month maintenance probe trials for the composite task for Students A-D in Experiment 1.

number per minute correct and incorrect, to better illustrate the results. Rate of response did not clearly indicate the accuracy of responses over time. Student A (fluency condition for components) maintained the composite task with 100% accuracy for both the 1- and 2-month maintenance trials. Student B (fluency condition) maintained the composite task with 83% correct responding for the 2-month maintenance trial (a 1-month trial could not be conducted for Student B). Student C (mastery condition for components) maintained the composite task with 100% accuracy after 1 month and 17% accuracy after 2 months. Student D (mastery condition) maintained the composite task with 100% correct responding after 1 month and 50% correct responding after 2 months with no practice.
Discussion

The results of the first experiment showed that the students who received mastery instruction (overlearning) required fewer learn units to meet criterion on the composite task than either of the students who responded to components at a normed rate criterion. These results indicate that fluency instruction in components did not lead to easier or faster acquisition of composite tasks involving those components. However, the results from the maintenance trials showed that the student for whom there were complete maintenance data who had achieved rate criteria for responding to components maintained correct responding to composite task problems longer than students who had received mastery instruction.

These results were different than those proposed by behavioral fluency theorists (Binder, 1996; Johnson & Layng, 1994), although there was a maintenance benefit for the composite task. However, a 1-month probe could not be conducted for Student B, so the maintenance effects of fluently responding to components could not be fully determined.

Because of the process of ensuring that we controlled for prerequisites and component skill instruction, the first experiment required 15 months to complete. Though it would take much more time, we decided to conduct a second experiment. We conducted the second experiment for three reasons: (a) to determine whether we could replicate the results from the first experiment, specifically the number of learn units to criterion on the composite task and the maintenance effects, (b) to further examine maintenance results, since we did not have 1-month maintenance data for Student B, and (c) to increase control over the instructional presentations or learn units to ensure that overlearning effects were isolated from rate effects. In the first experiment, there was a large discrepancy between the number of rate and overlearning learn units that the two pairs of students received. In order to account for possible differences between students assigned to the two component skill conditions, we changed the yoking procedures in the second experiment.

Experiment 2

Method

Experiment 2 was conducted as a systematic replication of Experiment 1. There were, however, three differences between the first and second experiments. Other than these differences, all of the procedures in the second experiment were the same as the first. The differences were the participants, the composite task and component skills, and the yoking procedures. The composite task for the second experiment consisted of division of three-digit numbers that could be evenly divided by either 2 or 3, resulting in single-digit quotients for each operation (e.g., 396 divided by 3 or 212 divided by 2). Two versions of the composite task were devised, each consisting of 12 problems arranged in columns of six and rows of two. The component skills for the second experiment included single digit quotient facts for divisors 2 and 3 and reading word lists comprised of words from the
written instructions. The design of the second experiment was the same as the first, with the exception of the yoking procedures. Experiment 2 took 10 months to complete.

Table 1
Comparison of Sequence of Procedures Occurring Before and During Component Skill Instruction for Experiments 1 and 2

<table>
<thead>
<tr>
<th>Experiment 1</th>
<th>Experiment 2</th>
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<tbody>
<tr>
<td>1. Students met all prerequisite requirements and were selected for participation in the study.</td>
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<tr>
<td>2. Students were taught to 100% accuracy criterion all additional repertoires necessary to begin the study.</td>
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<tr>
<td>3. Students were randomly assigned to instructional conditions.</td>
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<td>4. Students were randomly assigned to pairs. Learn units of each pair were yoked throughout component skill instruction.</td>
<td>4. All students' learn units were yoked to the learn units of the fluency student who required the most learn units to meet rate criteria for component skills.</td>
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<tr>
<td>5. Students received learn unit instruction on all component skills simultaneously, according to their assigned instructional condition. Learn units for students in the mastery condition were yoked to those of their matched peers in the fluency condition.</td>
<td>5. Students received learn unit instruction on all component skills simultaneously, according to their assigned instructional condition. All students received the same number of learn units.</td>
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Participants. Four adolescents with developmental delays and behavior disorders participated in the second experiment. As in the first experiment, we selected the students for participation in this experiment because they had prerequisite skills in their repertoires. All 4 participants attended the same school and were in the same classes as the students in the first experiment. All 4 students in the second experiment read on at least a 2nd-grade level and all students had met preselection criteria, including single-digit quotient division facts for divisors 2 and 3 (e.g., 12 divided by 3) to 100% accuracy criterion. In addition, all 4 students had met prerequisite criteria for reading word lists comprised of words from the written instructions needed to complete the composite task and comprehension of those words (e.g., identification of the divisor and the number to be divided).

Yoking procedures. We randomly assigned Students 1-4 to receive either rate instruction for division facts and word lists or fact mastery overlearning instruction for component skills. In the second experiment, however, we did not yoke the learn units of students in the mastery instruction condition to students in the fluency instruction condition. Instead, we yoked the learn units of all of the students to those of the
student in the fluency condition who required the most learn units to meet criterion on each component skill. This was done to further account for possible differences in the numbers of learn units each student received on each component skill.

In the first part of Experiment 2, all participants' learn units were yoked to Student 1’s, because he required the most learn units to meet fluency criteria for both component skills. All participants completed 72 learn units to criterion for the division facts and 59 learn units to criterion for the reading word lists.

**Interobserver agreement.** For the component skill instruction, independent observers scored 53% of the component skill worksheets. Percentage of agreement was 100% for division facts. Interobserver agreement was obtained for 42% of all reading sessions. Percentage of agreement ranged from 98% to 100%, with a mean agreement of 99% for the reading component skill.

Interobserver agreement for the learn unit instruction on the composite task was obtained when another observer was present for 34% of all composite task instructional sessions. Percentage of agreement ranged from 89% to 100%, with a mean of 96% agreement for the composite math task.

Interscorer agreement was obtained for 51% of all composite task sessions. The mean of interscorer agreement was 99%, with a range from 98% to 100% for all written responses to the composite task.

![Figure 3](image-url)

*Figure 3.* Numbers of learn units to criterion on the composite task for Students 1-4 in Experiment 2.
Results

Figure 3 represents the number of learn units to criterion for the composite task for all 4 participants. Students 1 and 2, who received fluency instruction for component skills, required 250 learn units and 83 learn units respectively to meet criterion for performing the composite math task. Students 3 and 4, who received mastery instruction for component skills, required 226 learn units and 135 learn units respectively to meet the percentage mastery criterion on the complex task.

![Figure 4](image-url)

Figure 4. Percentages of correct responding to 1- and 2-month maintenance probe trials for the composite task for Students 1-4 in Experiment 2.

Figure 4 shows the results of the 1- and 2-month maintenance probe trials for all 4 students for the composite problem-solving task. Student 1 (fluency condition for component skill instruction) maintained the composite task with 92% accuracy for the 1-month trial and 83% accuracy for the 2-month trial. Student 2 (fluency condition) maintained the composite task with 100% accuracy for both the 1- and 2-month trials. Student 3 (mastery condition for component skill instruction) maintained the composite task with 75% accuracy after 1 month and 58% accuracy after 2 months with no practice. Student 4 (mastery condition) maintained the composite task with 42% accuracy for both the 1- and 2-month trials.

Discussion

The results of the second experiment showed that performance of
component skills to normed rate criteria did not lead to faster learning of the composite task for 1 student (Student 1) than for students who received mastery (overlearning) instruction. These findings were consistent with the findings from the first experiment. However, fluent performance of components did lead to faster learning of the composite task for the other student in the fluency condition (Student 2), compared to students who received mastery instruction alone.

Results from maintenance probe trials showed that the 2 students who had achieved the fast rate criterion for components maintained correct responding to the composite task significantly better than the 2 students who received mastery instruction, as was the case in Experiment 1.

General Discussion

Taken together, the results from the two experiments showed that fluency instruction for component skills did not definitively reduce the numbers of learn units required to learn a composite task, even though 1 student who received fluency instruction met criterion on the composite task in the fewest number of learn units. The benefits touted by behavioral fluency theorists regarding fluent responding and easier learning were not observed for 3 of 4 students who received fluency instruction for component skills (Binder, 1996; Johnson & Layng, 1992, 1994).

However, with respect to the maintenance of the composite skills, only the students taught under the fast rate or fluency instructional condition maintained the composite skills after a 2-month period. Thus, while the fluency training did not show benefits in the learning of composite skills, the training of component skills to fluency led to important differences in the maintenance of composite skills over time. This latter finding is a new one, in that a history of fluent fact learning led to the maintenance of a composite skill even when the composite skill was not taught to a fluency criterion.

We do not propose that fluency training will prove beneficial for all students. However for those students like those who were in our experiments, it is a good choice. The matched simultaneous treatment design that we employed is similar to experimental control group designs. That is, participants were matched on relevant performance variables (a procedure in group designs that is preferable to random assignment. For group designs devoted to instructional variables, see Stanley and Campbell, 1963). The scientific logic of method of differences (Mill, 1950) is identical. However, while the use of the group design would have allowed interpretations about the distribution of behavior across groups, it would not have improved the internal validity of the procedure for comparing individuals. Thus, while simultaneous treatment designs in single case experiments are rare (Kazdin, 1982) they are true experimental designs. With the generality of findings restricted to individuals like those in our studies, the group design would be restricted to generality of groups with similar characteristics.
The use of such a design was dictated by the extremely long-term nature of providing control over the instructional histories necessary to test the variable of interest. First, our studies involved the careful provision of long instructional histories. We taught these students all of the component skills under continual direct instructional measurement and this required over 2 years to do. Such a fine-grained analysis would be financially and experimentally prohibitive for a large number of participants and would provide no greater generality to individuals. In fact, group designs would mask individual differences, and it may prove that individual differences will lead to the identification of students who require, or benefit from, fast rate instruction. Our research is suggestive rather than definitive. We did replicate the effects across two sets of students, suggesting that the findings do have validity. Given the current evidence, the additional instruction that leads to fluency is probably worth the effort in that the numbers of learn units required to achieve fluency or rate mastery are not that dissimilar to those for the percentage mastery alone.

The contingency adduction theory proposes that untaught, complex skills may emerge with little or no direct instruction, because of the "sudden recombination" of the components that comprise them (Binder, 1996; Epstein, 1985; Johnson & Layng, 1992, 1994). Contingency adduction refers to the production of generative behavior, whereby untaught relations emerge as a function of prior instruction in fluent component skills. We did not observe the emergence of untaught composite skills as a function of the teaching of fluent component skills. However, our study did not necessarily provide fluency instruction in a large set of composite skills that might be recombined in some adductive or generative response. Perhaps the combination of fluency and multiple exemplar instruction or experiential histories characterized in relational frame theory may lead to the phenomenon observed as contingency adduction (Hayes, Barnes-Holmes, & Roche, 2001). Future research needs to test for that possibility.

References


