Teaching Analytical Thinking Skills to a Learner with Autism

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Learners with an autism spectrum disorder often require explicit instruction in many areas important for their success in school and life, including requiring such instruction in analytical thinking. Talk Aloud Problem Solving (TAPS) is an approach to analytical thinking that involves teaching students to make their thinking behavior explicit so that their behavior can be shaped and strengthened (Whimbey & Lochhead, 1999). TAPS allows what are typically private events to become public so that the student's teachers can influence those events in ways that support effective analytical thinking. This article illustrates how we applied analyses of verbal behavior (Michael, 1982; Skinner, 1957; Vargas 1986) to help identify measures that would allow us to shape the analytical thinking skills of Leila, an 11-year-old girl with high-functioning autism.

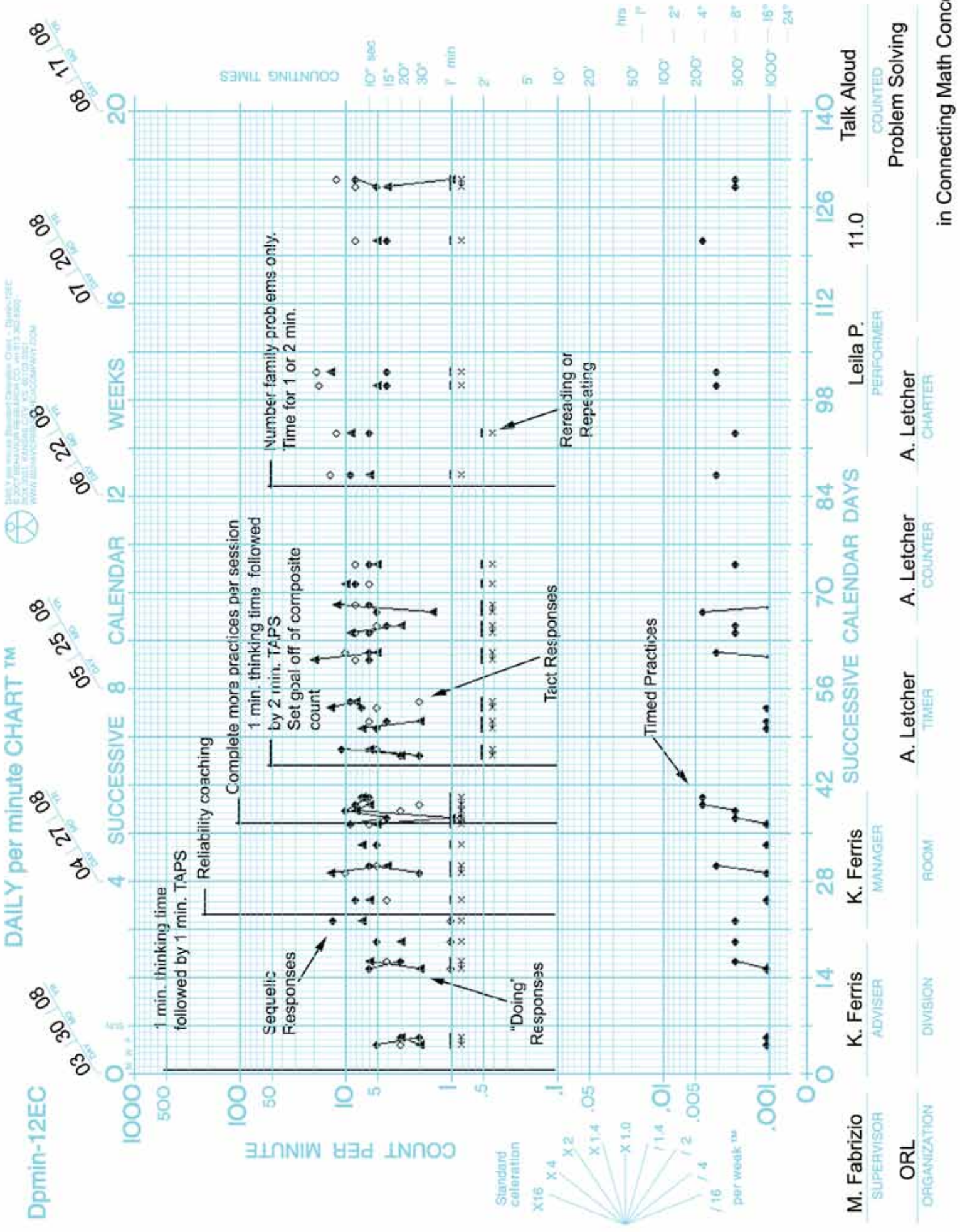
Although Leila was fully integrated into general education, it was essential to improve her analytical thinking skills as she prepared to transition from elementary school to middle school. Teaching Leila TAPS presented us with an important opportunity to analyze where her interpretation of text broke down, and where she became confused while studying texts from various academic subjects. Leila's language and thinking skills impairments hindered her synthesis and understanding of material she encountered in the classroom and negatively affected her academic performance.

The acceleration targets presented in this chart share included sequelic and tact responses that Leila emitted while solving problems. Sequelic behavior is a subtype of intraverbal responding where the form of the responses matches neither the form nor the order of its preceding verbal stimulus (Vargas, 1986). Examples of sequelic responses related to Leila's analytical thinking included: after reading a math word problem that asked Leila to determine the total distance a train traveled, and that also described the time at which the train left, Leila stated, "I know that starting at 10 AM isn't important because the question asks how far she went, so what time she started won't help me." Another example included Leila emitting the statement, "It's asking me how many shoes were made all together. 'All together' means that I will have to add."

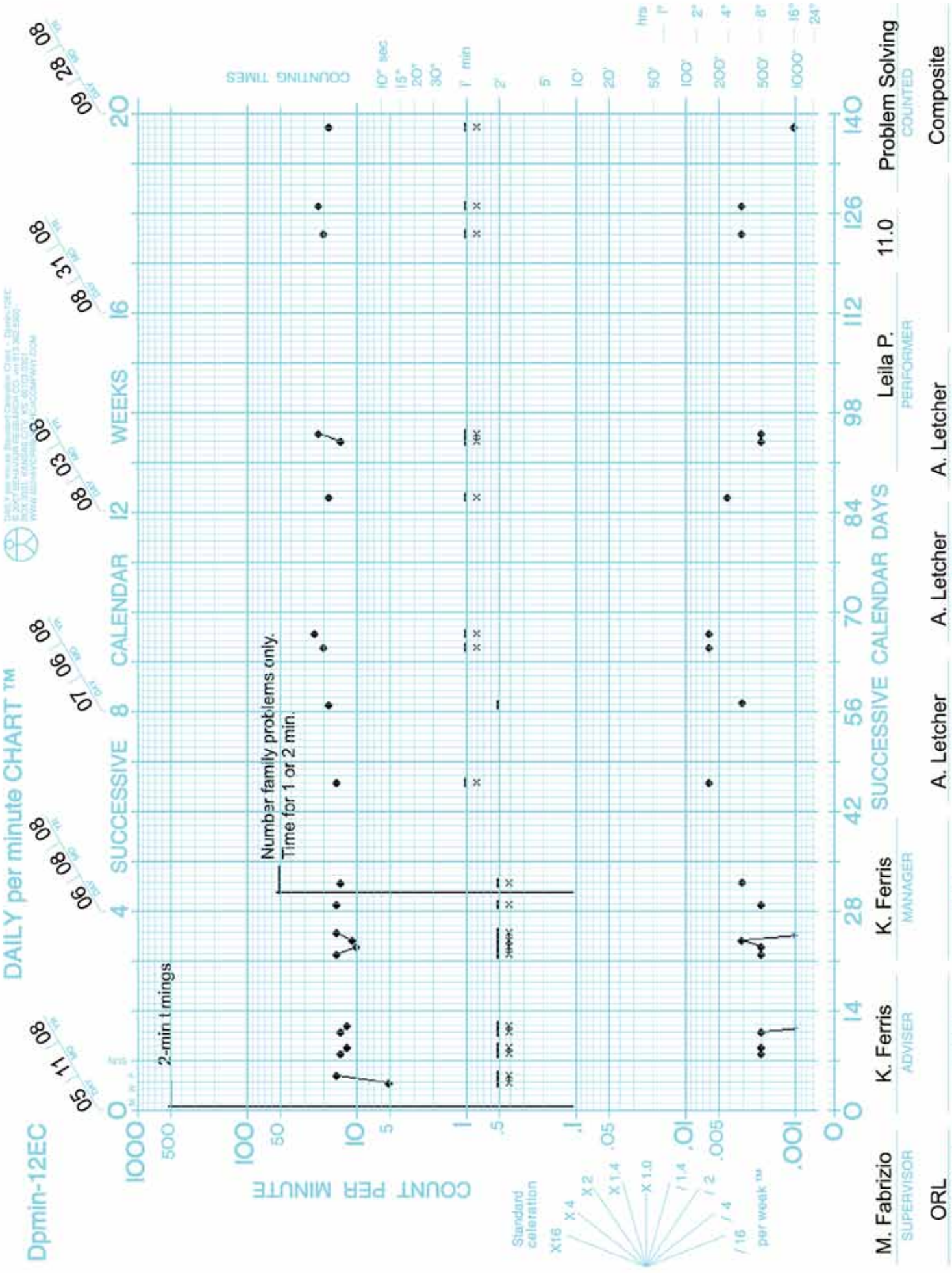
Tacts are a class of verbal responses occasioned by some feature of the physical environment and maintained by generalized conditioned reinforcement (Skinner, 1957). In terms of Leila's problem solving, tact responses often related to the completion of tables or diagrams and occurred frequently during her written work. For example, when referring to a table, Leila emitted a tact response that included, "This box shows what one factory did." When starting to complete a vocabulary exercise, Leila said, "I need to complete these blanks with a power word." When working on fractions, Leila commented, "This numerator tells how many parts."

Sequelic and tact responses were counted separately. Leila's frequencies of sequelic responses are shown as dots on the first SCC. Her frequencies of emitting tacts are shown as open circles on the first SCC. Additionally, any "doing" response (not vocal) related to solving the task was counted and

Keywords: Autism, Precision Teaching, Problem Solving, Analytical Thinking, Verbal Behavior



in Connecting Math Concepts


DAILY per minute CHART ™
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COUNT PER MINUTE
COUNTING TIMES
SUCCESSIVE CALENDAR DAYS
SUCCESSIVE CALENDAR WEEKS
2-min timings
Number family problems only.
Time for 1 or 2 min.
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shown as triangles on the first SCC. A "doing" response included pointing, circling, underlining, or writing.

The deceleration movement cycles were Leila's rereading of the problem or restating verbatim what the problem told her. These responses were coded as deceleration movement cycles because repeatedly rereading instructions or restating the question after reading it were common patterns in Leila's early responses, and such behaviors rarely helped her solve the problem at hand. Instead, repeated rereading and restating often led Leila to engage in cyclical reasoning and kept her from identifying the important and unimportant pieces of information contained in the problem.

The curricula that served as sources of practice problems included Mastering Reading Through Reasoning (Whimbey, 1995), Connecting Math Concepts—Level D (Engelmann, Engelmann, & Carnine, 2003), and Reasoning and Writing—Level D (Engelmann & Silbert, 2001). While we charted Leila's problem-solving performance on a separate SCC for each of the curricula previously listed, we present here data only from Leila's problem solving within the Connecting Math Concepts Level D curriculum because these data nicely illustrate her performance across the other curricula employed.

In the first phase of intervention, Leila's tutors allowed her 1 minute to think about what she would do after she read a problem, and 1 minute of measured problem-solving time. Leila's tutors set daily improvement goals for her based on her exceeding the frequency of sequelic responses she had previously emitted. Tacts served as an auxiliary measure, meaning that they were not considered in calculating Leila's daily improvement goal. During this phase of intervention, Leila's frequency of sequelic, tact, and "doing" responses all increased, with her sequelic responding showing the most bounce from one day to the next.

The second phase of intervention involved improvements in procedural and measurement reliability. Leila's team consisted of two tutors, both new to Precision Teaching. Neither tutor had any formal education in either behavior analysis or the analysis of verbal behavior. It was important to compare measures regularly between each of the tutors and between the tutors and the supervising behavior analyst to ensure that the appropriate responses were not only being counted but also (and more importantly) reinforced. Reliability sessions involved one tutor implementing TAPS with Leila while the second tutor and the first author counted Leila's responses separately. These separate counts were then compared. If the counts differed from one another, the behavior analyst recalled aloud statements Leila had made and specified how they should be counted. Following this, Leila completed a second TAPS timing. Both counts matched each other after the second timing. Sometimes the behavior analyst had to tact the verbal operants Leila emitted while she was solving problems to more closely establish a connection between her responses and how the tutors should categorize her responses.

The third phase of intervention consisted of asking Leila and her teacher to complete more timed practices per day. Comparing Leila's data on skills with her progress on this SCC, we noted that Leila rarely achieved her daily improvement goal in only one timing. Instead, Leila's performance often improved significantly from the first timed practice to the final timed practice. We sought to replicate the facilitating effects of multiple timed practices by asking Leila to complete more timed practices per day on this SCC. This change increased the practices from an average of 1 per day to 3 per day.

The fourth phase of intervention increased the timing interval to 2 minutes of measured problem solving. While during the 1-minute timings, Leila often spoke about her plan for solving the problem and identified what was important within the problem, these 1-minute timings only allowed her to actually start to solve the problem for the final 15 seconds of the minute. Measuring her performance for 2 minutes allowed Leila's tutors to provide her feedback both on her problem-solving planning and her execution of the plan. During the fourth phase, a second change was made to the daily improvement goal-setting procedure used; in this fourth phase of intervention, Leila's tact and sequelic responses were combined to create a problem-solving composite measure, and this composite measure served as the basis for Leila's daily improvement goal. This change happened because it became clear that different types of problems required different tact and sequelic response frequencies.

Complicated tables and diagrams seemed to demand higher frequencies of tact responses along with frequencies of "doing" responses. Other problems required lower frequencies of tacts to describe and execute skilled problem solving. The combined measure reduced the bounce in the data and allowed both the tact and the sequelic responses to contribute equally and flexibly to the daily improvement goal frequency. Once Leila's tact and sequelic counts were combined into a problem-solving composite measure, a second Daily per Minute SCC was started to track this combined frequency of responding.

The fifth and final phase of intervention specifically targeted number family math problems and gave Leila's tutors the flexibility to measure for either 1 or 2 minutes. Number families presented the greatest instructional challenge for Leila, and she lacked a consistent algorithm for solving these problems. Targeting number family problems through TAPS allowed us to mediate her plan effectively to avoid practicing the same errors.

The composite measure showed an initial acceleration in the frequency of problem-solving responses. Upon changing to number family problems, Leila gradually increased her frequency of problem-solving statements to a high of 26 per minute. As Leila's frequency of responding increased, she was more efficient when she stated the details of her plans, and so timings were shortened to 1 minute. The summer months imposed many breaks in the implementation of the programs. However, with only 11 implementation days across 15 weeks, Leila's frequency of problem solving remained steady while her effort, or number of practices required to achieve that frequency of responding, decreased from 6 practices to 1 practice.

The problem-solving composite measure proved an appropriate measure for shaping the critical aspects of problem solving for Leila. The composite measure allowed the unique requirements of different math problems to vary freely without producing undue bounce in the data. The composite measure allowed us to begin to identify a potential predicted frequency aim for analytical thinking skills. We plan to collect further data in the future and test various problem-solving frequencies for their ability to predict the outcomes of fluent performance.

Leila now approaches instructional tasks by first stating what she knows, what she thinks is being asked of her, and her plan for solving the problem. Her tutors and parents can more effectively intervene at critical times to correct or praise as appropriate. When recently tested on a standardized test of academic achievement, Leila commonly emitted problem-solving responses and reviewed her responses carefully before moving on. This performance differed greatly from previous testing sessions when she answered quickly, never reflected on what she was doing, and always appeared confident regardless of her accuracy. Leila, for the first time, notices when she gets confused, pauses, and asks for more information at appropriate times. She seems to have a much better sense of what she knows and what she does not know.

REFERENCES

Engelmann, S., Engelmann, O., & Carnine, D. (2003). *Connecting math concepts*—Level D. Columbus, OH: McGraw-Hill Publishers.

Engelmann, S., & Silbert, J. (2001). *Reasoning and writing*—Level D. Columbus, OH: McGraw-Hill Publishers.

Michael, J. (1982). Skinner's elementary verbal relations: Some new categories. *Analysis of Verbal Behavior, 1*, 1-3.

Skinner, B. F. (1957). *Verbal behavior*. New York: Appleton-Century-Crofts.

Vargas, E. A. (1986). Intraverbal behavior. In P. N. Chase & L. J. Parrott (Eds.), *Psychological aspects of language* (pp. 128-151). Springfield, IL: Charles Thomas.

Whimbey, A. (1995). *Mastering reading through reasoning*. Cary: NC. Innovative Science.

Whimbey, A., & Lochhead, J. (1999). *Problem solving and comprehension*. Lawrence Erlbaum.