

The effects of using flashcards with reading racetrack to teach letter sounds, sight words, and math facts to elementary students with learning disabilities*

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Abstract

The purpose of this study was to measure the effects of reading racetrack and flashcards when teaching phonics, sight words, and addition facts. The participants for the sight word and phonics portion of this study were two seven-year-old boys in the second grade. Both participants were diagnosed with a learning disability. The third participant was diagnosed with attention deficit hyperactivity disorder by his pediatrician and with a learning disability and traumatic brain injury by his school's multi-disciplinary team. The dependent measures were corrects and errors when reading from a first grade level sight word list. Math facts were selected based on a 100 add fact test for the third participant. The study demonstrated that racetracks paired with the flashcard intervention improved the students' number of corrects for each subject-matter area (phonics, sight words, and math facts). However, the results show that some students had more success with it than others. These outcomes clearly warrant further research.

Keywords: reading racetracks, flashcards, learning disabilities, ADHD, sight words

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Introduction

The Effects of Using Flashcards with Reading Racetrack to Teach Letter Sounds, Sight Words, and Math Facts to Elementary Students with Learning Disabilities

In a world of ever changing technology and information, there is still basic knowledge one needs in order to be successful in life, and reading is one of these skills (Chambers, Dunn, & Rabren, 2004). Research has shown that students who struggle in the area of reading during the primary stages of their education career often have difficulties into their secondary education and adulthood (Boland, 1993; Ravitch, 2010). One of the key elements in learning to read and helping to boost low progress readers is an understanding of phonetic awareness (Pogorzelski, & Wheldall, 2005). Thus, it is important to teach reading skills to students, particularly those who have poor skills in sight word reading.

Another key area to success in life is basic math calculation skills. Once students have the concept of basic operations, the next goal is to teach the student fact memorization and the ability to respond quickly and correctly to various facts (Thornton, 1989). Without such skills, it becomes more and more difficult for students to build upon their basic skills and attain mastery of higher level of math concepts. Similar to basic reading skills, it is equally important to foster such skills in mat.

The National Reading Panel (2000) identified five different areas within reading instruction that help to foster successful readers: phonics, phonetic awareness, fluency, vocabulary, and text comprehension. A drill and practice procedure called reading racetracks (McLaughlin, Weber, Derby, Hyde, Violette, Barton, et al., 2009; Rinaldi & McLaughlin 1996; Rinaldi, Sells, & McLaughlin, 1997) meets four of those criteria Reading racetracks are a form of instruction using a track with twenty-eight cells to discrete information such as sight words. The track resembles a racecar track with a start and finish. There are two pictures of automobiles on the track. In the reading racetrack, words are placed in each cell. The students read around the track in one minute. Fluency and accuracy are increased with the reading racetrack. Reading racetracks allow for a large number of sight words or other discrete academic skills to be taught to the students in a systematic and fun way (McLaughlin et al., 2009).

Has been shown to be an effective instructional tool that works to increase the specific reading area of fluency. Reading racetracks have been shown to be effective across a wide range of students (Anthony et al., 1997; Falk et al., 2003; Rinaldi et al., 1997). These authors found that using the racetrack procedure improved fluency across participants with varying disability types. Additional research replications have been done using the racetracks in addition to the use of flashcards (Anthony et al., 1997; Falk et al., 2003). They used flashcards paired with a reading racetrack to improve sight word recognition of a child with learning disabilities. Beveridge, Weber,

Derby, and McLaughlin, (2005) examined the use of a math racetrack, which is almost identical math facts being presented on the track rather than sight words to the reading racetrack. Beveridge et al., successfully increased math skills of two students with learning disabilities. Finally, a recent case report indicated that employing a racetrack procedure increased spelling skills (Arkoosh, Weber, & McLaughlin, 2009). In that report, words to be spelled correctly were placed on the track and the student had to spell them orally as he moved around the track.

The present study focused on two seven-year-old males who had skill deficits in the areas of reading, writing, and math according to testing and teacher observation and a fifth grade male who had skill deficits in reading, writing, and math. The initial research question posed for the study was as follows: Will a reading and math racetracks paired with flashcards increase our participants' skills in phonics, reading sight words, and math computation? Another purpose was to replicate and extend the use of reading racetracks and flashcards (Anthony et al., 1997; Beveridge et al. 2005; Falk et al., 2003; Kaufman, McLaughlin, Derby, & Waco, 2011; Printz et al., 2006; Rinaldi & McLaughlin, 1996; Rinaldi et al., 1977) to a different group of students in a public school resource room setting. This will provide additional evidence as to the efficacy of racetrack like procedures in a different resource room with different group of students (Kazdin, 2010).

Method

Participants and Setting

There were three participants in this study. The first was a 7-year-old male, who had been diagnosed with specific learning disabilities in the areas of math, reading and writing by his school's multiple disciplinary team (MDT). This team consists of various school personnel charged with making a determination if the student meets the guidelines for placement in special education. This team is composed of a school psychologist, a general education classroom teacher, the special education teacher, support personnel such as a speech and language pathologist, The second participant was also a 7-year-old male was had been diagnosed with specific learning disabilities in the areas of math, reading, and writing. The third participant was an 11-year-old male who had been diagnosed with attention deficit hyperactivity disorder (ADHD), learning disabilities in the areas of math, reading, and writing, and traumatic brain injury (TBI) by his pediatrician and the school's MDT team. He often engaged in high rates of out of over activity and had poor attention to task as a due to his ADHD and TBI. When assessed using the *Woodcock-Johnson Test of Achievement III*, Participant 3 scored a minimum of three levels below grade level in reading, writing and math. All three participants attended the resource room at a public elementary school. Each also participated in their general education in the second and fifth grade. The participants were chosen due to their need to improve their skills in reading and to master basic math facts.

The first participant recognized several letters by name, but often only gave the letter name when asked specifically for the phonetic sound. The second participant was able to give the correct phonetic sounds with each letter, but had difficulty decoding words, from a kindergarten sight word list as developed by the school district. The third participant was chosen for his inconsistent ability to recall basic math facts quickly and correctly.

The classroom was located in a low-income school in a large school district in the Pacific Northwest. Sessions were held Monday through Friday, each lasted less than 15 min. They also took place during the scheduled time the students were assigned to the resource room. A total of 28 other students made up the case load of the resource room, most with varying disabilities within the learning disabled spectrum. The first author of this research project was completing her student teaching in that classroom. There were also one certified teacher, and one permanent instructional assistant, and one intermittent instructional assistant in the classroom.

Materials

A reading racetrack described by Rinaldi et al. (1997) was used. Reading racetracks consist of 28 empty cells placed in an oval shaped track. A picture of a racecar is located in the upper right hand corner, and space is provided for the teacher to indicate which racetrack is being employed. The sounds and words used for students one and two were chosen from a graded phonetic word list. A kindergarten sight word list was used as a probe to evaluate which words students knew at the end of data collection. The math facts chosen for participant 3 were based on his performance on a pretest that consisted of 100 addition facts which was administered once. Based on these data from all three students, the first author created three different lists, and put each of the words/sounds/math facts on 3x5 white index flashcards. These flashcards were used to present and practice sight words and math facts. Preprinted sheets of paper with all three sets of words/math facts were used to record data during the last session. A wall clock in the classroom with a second hand was used to time all child performances on the racetrack.

Dependent Variables and Measurement Procedures

The dependent variables for this study were the number of correct and incorrect sounds, words, or math facts. These sounds, words, or math facts were placed on each student's personalized racetrack, each containing 28 cells. Students were first shown the flashcards with a sound, word, or math fact and then given the racetrack to go over for a practice round where the student went through their word or math facts on the reading racetrack prior to the official timing and data collection. A "correct" was defined as the student correctly matching the phonetic sound with the letter shown, correct word reading for the word shown, or answering the addition fact correctly. An error was marked when a student pronounced the sound incorrectly, gave an incorrect word or numerical answer for the math fact or if the item was

skipped entirely. An error was not marked if the student self-corrected before going on to the next item.

Experimental Design and Conditions

A multiple baseline reversal design across sets (Barlow, Nock, & Hersen, 2008; Kazdin, 2010) with follow up probes was employed to evaluate the efficacy of the interventions. However, baseline, reversal, and the final probes were measures that differed somewhat from that employed during the reading racetrack conditions.

Pre-assessment. Before taking any baseline data or starting intervention, a pre-assessment of phonetic sounds, sight words was completed for the two second grade males. After consulting the classroom teacher, the first author administered the graded San Diego word list with *The Basic Phonics Skills Test* (Shefelbine, 2008). to assess which letters the students were able to correctly name and give the appropriate phonetic sound. The pre-assessment data indicated that both boys were behind grade level skills for reading. Also, a kindergarten sight word list was used identify known sight words. The first author then put all 26 capitol and 26 lower case letters on 3x5 index cards to present to the students and record what the students could identify. The same was used for the sight words from the kindergarten list, and presented in the same fashion. Participant knew almost all of his letter names and their correlating sounds, for both capital and lower case letters. However, he could only identify a few of the sight words. Therefore, we decided to focus primarily on sight words for this participant.

Participant 2 was able to correctly name the letters, but often gave the incorrect corresponding sound or said “I don’t know” in response to many of them. Also, when given the sight word list there were very few words he was able to correctly read or pronounce. Because this individual did not have a strong foundation of phonics and applying the correct sound to the letter, it became obvious that the focus of intervention for him should be on phonetic awareness and being able to correctly pronounce the right sound with the right letter.

For Participant 3, the first author gave him a 100 addition problem fact sheet. He was provided 10-minutes to complete this task. The student only completed 30 of the 100 problems, and calculated most of them incorrectly. Based on the results of his pre-assessment, we determined he needed review of his basic addition math facts. Math facts consisting of 2’s, 3’s and 4’s were chosen.

After assessing the students, sets and correlated racetracks were created. The word lists and phonic lists were constructed so that sounds or words that were visibly or auditorally similar were not introduced together. Each list contained seven words. Each list contained 3 known words or sounds, or math facts and 4 unknown sounds, words, or math facts. The

words or sounds were written with a black marker on a 3x5 index card for instruction. The racetracks were then constructed so that each word, sound, or fact appeared four times.

For the third participant, each set contained nine math facts, from the number and the addend starting at one and going up to nine. With each of the math facts the participant was able to solve with manipulatives, but once those were removed, the participant would make errors. Each set was to focus on learning one set of math facts, (e.g. all of the 2's math facts, then 3's and then 4's). Each racetrack was designated with one specific fact set, and was written in the cells. The addition equations were also written on 3x5 index cards, and had the answer written on the back.

Baseline (B). For baseline, the first author presented each flashcard individually and the participant was allowed to orally respond by saying the sound, word, or answering the math problem within 5 s. If the participant did not know the word, sound or problem presented they said either "I don't know" or "pass." There was no feedback given regarding the accuracy of the participant's responses. The first author made notes on a pre-printed sheet of paper that contained all of the letters, words, or math facts. An X was placed next to the letter, word, or math fact that resulted in an error and a tally mark was written next to a correct response. After collecting data the marks were counted and results were totaled for each participant. For participants 1 and 2 the number of sight words were counted per set, which with our third participant, math.

Reading or math racetrack (RR or MR). After baseline, data were taken, and instruction on words began using both flashcards and racetracks. The first author presented each flashcard individually to the participants. The participants were asked to provide the correct answer if known. If unknown, the first author provided instruction. This consisted of the first author modeling the correct way to pronounce the word or sound or math fact. Next, the participant was asked, "What word, sound or fact is this?" The participant would say the word, sound or math fact.

After going through the flashcards three or four times, the racetracks procedure was introduced. A practice session was completed to allow the participant to go around the entire racetrack saying each sound, or word, or math fact. If the participant missed any of the cells in the racetrack during the practice round, immediate error correction was provided using the same model, lead, and test format used during flash card instruction. Once the practice round was completed, the official one-minute timing and recording was taken. The first author prompted the participant by saying, "all right get ready, on your mark, get set, go." The first author would point to each cell as the participant read the word or provided the answer. As the participants were going around the track, the first author would keep tally marks on the pre-printed sheets of paper to keep track of corrects and errors. At the end of the one-minute timing, an X was placed at the cell that they ended on so that

the participant could keep track of their own progress to see how far they had gotten. No feedback or praise was given during the timings, except for saying “good job” at the end of the timing. After completing the session, the first author counted the total number of corrects and errors and recorded these data.

Reversal (RV). A reversal was carried out, once the participants were showing measured progress within their sets. The reversal was conducted by presenting the word, sound or math fact on the flashcard. This was done to determine if the participant could recall the item without the use of the racetrack. A reversal lasted for one data point for Participant 1 and two data points for Participant 2 before the racetrack and flashcards were reinstated.

Probe. A final probe was given at the end of the study to determine which sounds, words, or addition facts were retained. These items were presented in the same format as they were for baseline and reversal.

Interobserver Agreement

The first author used preprinted sheets with each of the items to record the data. Each set was listed, with room left to the right to make marks for corrects or errors. There was also room above to indicate session and date and if it was baseline data, intervention, probe, etc. After collecting the data the errors and corrects were counted and recorded. During data collection the certified teacher in the classroom would sit next to the first author with her own data sheet on which to score the participants’ answers. These data were collected simultaneously and independently with the first author and the certified classroom teacher. The formula used for calculating interobserver agreement was the number of agreements divided by the number of agreements plus disagreements, multiplied by 100. Interobserver agreement was measured at 100% for each of the participants. Reliability as to the appropriate implementation of flashcards and racetracks was gathered three times by the second and third author. Each used a checklist and observed the first author employing these two procedures. For each observation, the first author implemented the procedures correctly.

Results

Participant 1

The number of corrects and errors for letter sounds for Participant 1 in Set 1 can be seen in Figure 1 (top panel). During baseline, the number of words correct ranged from 2 to 3 with an overall mean of 2.67. His errors were high ($M = 4.3$; range 4 to 5). When flashcards and reading racetracks were employed with Participant 1, his performance increased greatly ($M = 26.8$ for corrects and 4.8 for errors). For the reversal, his corrects decreased $M = 2.0$ corrects with 5.0 errors. When reading racetracks and flashcards were again employed, his corrects increased to an average of 38.0 with 0.0 errors. During final probe for Set 1, this participant scored 7.0 correct and 0.0 errors out of a possible 7.

For Set 2, (middle panel) in baseline, the average number of corrects was 1.6 with a mean of 5.3 for errors. During intervention his corrects increased to an average of 10.3 and 2.6 for errors. For the reversal out of a possible of 7, he had 2.0 corrects and 5.0 for errors. When the racetrack was reinstated after the reversal, he scored an average of 20.0 for corrects (range 18 to 20), and 1.0 for errors (range 0 to 2). During the final probe, out of a total of 7, he had 7.0 correct with 0 errors.

During baseline for Set 3 (bottom panel), the participant made 7 errors with 0 corrects for session. For reading racetracks and flashcards, his performance increased to 6.0 corrects with only 3.0 errors. When the racetrack and flashcards were reinstated, Participant 1 had an average of 12.5 for corrects and just 2.0 for errors. For the final probe the participant read 6 correct with 1 error.

Participant 2

For baseline Set 1 for Participant 2 (See Figure 2, lower panel) he averaged 2 correct with 5 errors. During intervention his average for corrects increased to 5.8 words and his errors averaged just 1.1 words. For the reversal the participant read 5 correct with 2 errors. When the flashcards were reinstated he read all 7 correct with 0 errors. For the final probe the participant read 7 correct, with 0 errors.

For Set 2 (Figure 2, middle panel), the participant averaged 1.5 corrects with 5.5 errors. During the reading racetrack and flashcard intervention, his performance improved. He averaged 5.25 for corrects and 1.75 for errors. For the reversal, he decreased his errors to 3.0 correct and increased his errors to 4.0. When the reading racetracks and flashcards were reintroduced, his performance improved. He scored 5.0 corrects with just 1.0 error. For the probe on Set 2, he had 5 corrects with 2.0 errors.

During baseline for Set 3 (See Figure 2, lower panel), the participant averaged 1.19 corrects with a mean of 5.6 errors. For the reading racetrack phase, his corrects increased to an average of 4.2. His mean was 2.8 for errors. During the two-session reversal, his corrects decreased ($M = 3.5$ for corrects, and his errors increased ($M = 3.5$). For the replication of flashcards and reading racetracks, his corrects increased (5.0 corrects with 2.0 errors). His performance on the probe condition was the same as during the final reading racetrack and flashcard phase.

Participant 3

The number of math facts answered correctly or in error during the various experimental conditions for Participant 3 can be seen in Figure 3. During baseline for Set 1 (upper panel) for Participant 3, the average number of correct math facts was low ($M = 2.3$; range 2 to 3), while his errors were high ($M = 6.7$; range 6 to 7). Throughout the math racetrack intervention, his accuracy increased ($M = 7.12$; range 1 to 12), and errors declined over time ($M = 5.7$; range 2 to 13). A return to baseline (Rev) resulted in a decrease in

corrects ($M = 3.0$; range 2 to 4), and an increase for errors ($M = 6.0$; range 5 to 7). For probe measure, there were 9 corrects and 1 errors.

For Set 2 (middle panel) during baseline, this participant averaged just 2.1 corrects and 6.5 for errors. For the math racetrack and flashcard condition (RR), the participant averaged 10.0 for corrects (range 6 to 11 for corrects) and averaged 5.9 for errors (range 3 to 10) for Set 2. During the reversal, his corrects decreased ($M = 6.0$) and errors increased ($M = 3.0$). A replication of the math racetrack and flashcards, resulted in an increase in his accuracy ($M = 12.0$; range 10 to 14). Likewise his errors declined ($M = 4.0$; range 3 to 5). On the final probe, his corrects were 6.0 with only 2.0 errors.

For Set 3 (lower panel) in baseline, Participant 3 averaged 3.2 correct (range 1 to 6), and his errors were high ($M = 5.8$ range 3 to 8). During the math racetrack and flashcard phase, he averaged 6.0 for corrects and 3.5 for errors. A replication of the intervention for two sessions (RR), resulted in an increase in corrects ($M = 10.5$; range 9 to 12) and a decline in errors ($M = 5.0$; range 2 to 8). On the probe he scored 8.0 correct with just 1.0 error.

Discussion

The outcomes of this research suggest that the reading/math racetrack procedure paired with flashcards was helpful in improving reading or math skills. These procedures increased the accuracy of sounds, sight words and addition facts for the participants.

The first participant was very compliant and eager to work. He showed great progress in the number of sight words he was able to recognize. The second participant also increased his performance. The third participant was very interested in his performance when he took his medication. If he forgot to take his medicine, he was noncompliant and extremely inattentive. His performance became quite variable on such days. Also as a manifestation of his TBI, his results were quite variable from day to day. For example, on some days he appeared to be making adequate progress. On the next school day, it was like he had retained little or nothing from the previous session.

The present outcomes replicate much of our previous work with students with learning disabilities (Armstrong et al., 1996; Falk et al., 2003; Rinaldi & McLaughlin, 1996; Rinaldi et al., 1997). In addition, we could also improve both reading and math skills in the same resource setting.

The study was practical. The racetrack was effective, and was easy to use in an elementary resource classroom. The flashcards and racetracks were simple to create, and were easy to use in two subject-matter areas. Reading/math racetracks were easy to implement and could be incorporated into the general and special education classroom routine.

There were limitations in the present research. Unfortunately, no follow up data were taken to see how well the students generalized their skills taught into daily work. Also, very little time was spent on Set 3 for each of the participants due the ending of the first author's student teaching. Finally

to better evaluate the effectiveness of reading/math racetracks, future research could be carried out with a larger number of students and across a wider range of skill etc. This research also revealed that certain students (Participants 1 and 2) benefitted more from these procedures than others (Participant 3). Determining the type of student that could benefit the most will have to be examined in future research. The outcomes for the first two participants also replicate much of our prior research (Anthony et al., 1997; Falk et al., 2003; Printz et al., 2006; etc.) with elementary students while the outcomes for the third participant were not as pronounced. This differential outcome warrants further analysis and research.



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Figure 1. Number of corrects (closed square) and errors (closed triangles) for baseline, reading racetracks, reversal (Rev), reading racetracks (RR), and final probe for Participant 1.

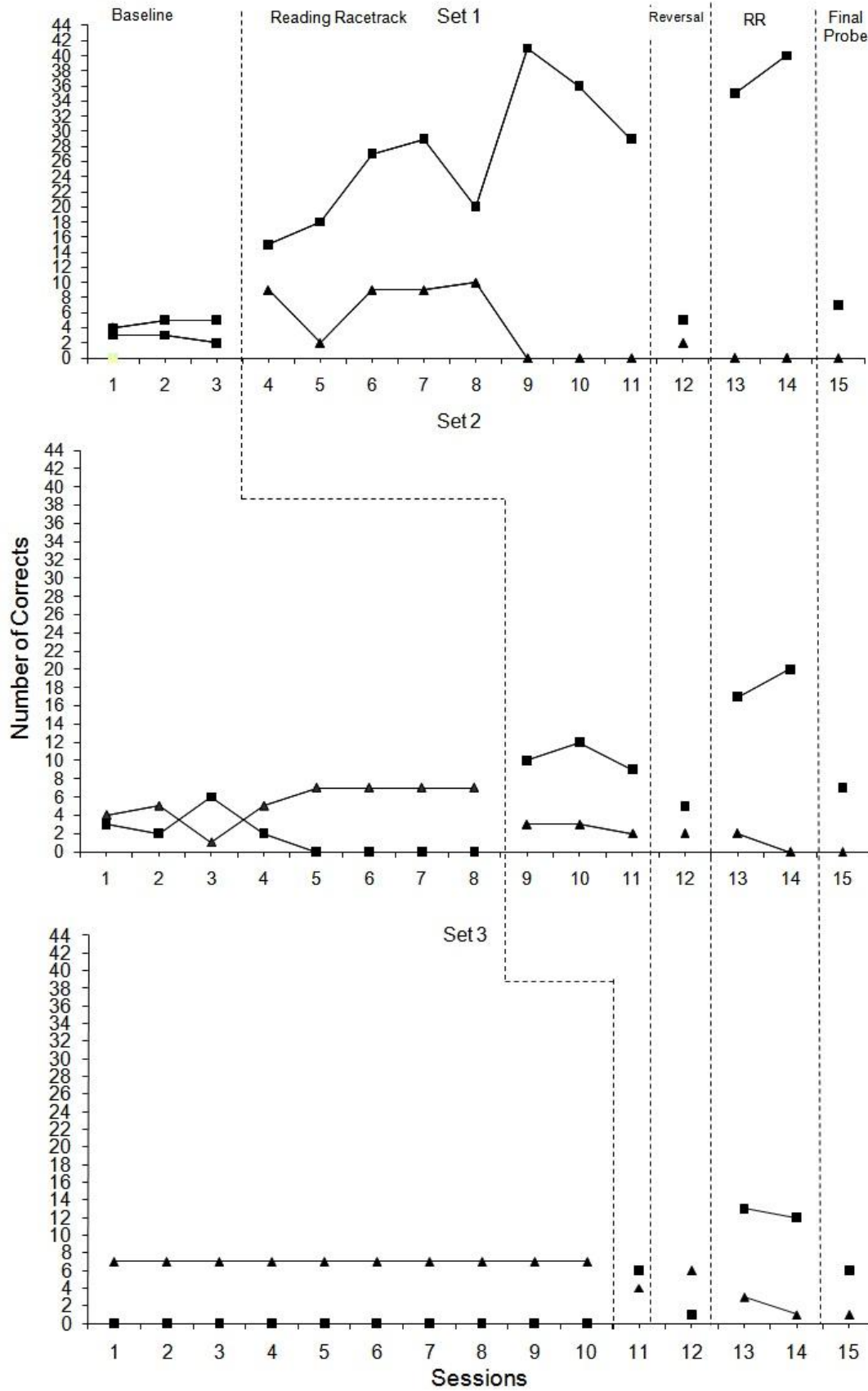


Figure 2. Number of corrects (closed square) and errors (closed triangles) for baseline, reading racetracks, reversal (Rev.), reading racetracks (RR), and the probe for Participant 2.

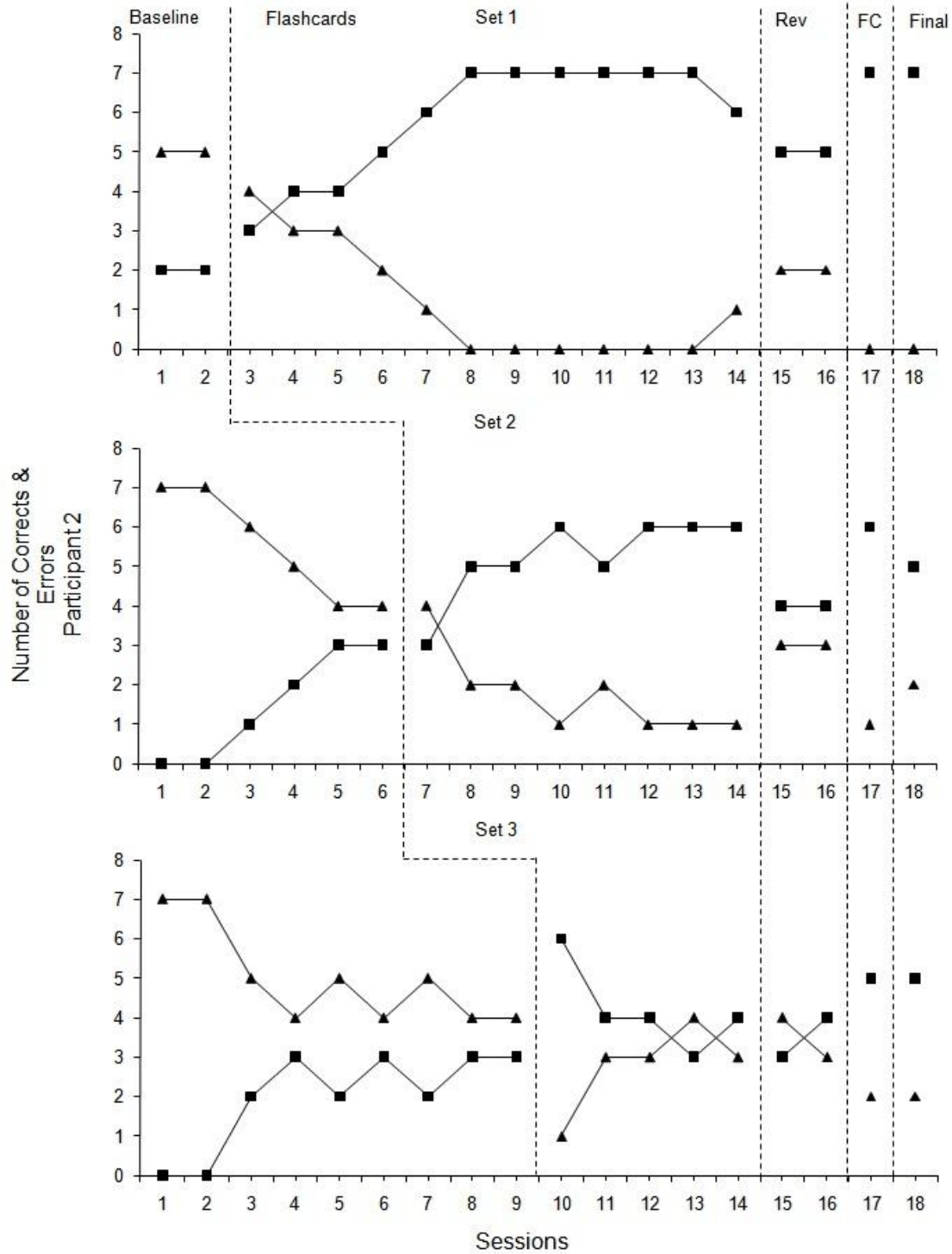


Figure 3. Number of corrects (closed square) and errors (closed triangles) for baseline, math racetracks, reversal (Rev.), math racetracks (MR), and probe for Participant 3. Baseline Reading Racetracks Set 1 Rev RR Probe

