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An analysis of DI flashcards and reading racetracks with and without a lotto game to teach letter names: A failure to replicate reading racetracks with preschoolers

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Abstract
Learning to read is critical for academic success and can be enhanced by the kindergarten preparedness skill of letter naming. The purpose of this study was determine the effectiveness of DI flashcards and a reading racetrack procedure on the expressive letter identification of three children in a special education preschool program. A multiple baseline across letter groups and participants was employed. Social behaviors by the participants, toward the reading racetrack procedure, led to the decision to replace the reading racetrack with an alphabet lotto game. A combination of student behaviors appeared to be a factor, with one participant apparently knowing the letter names prior to the study and requiring praise to increase his performance. A second participant engaged in high rates of aggressive behaviors during the sessions. Learning varied among children, although all improved over their baseline performance. Suggestions for special education preschool classroom personnel were provided.

Keywords: preschool students with disabilities, letter names, flashcards, reading racetracks, lotto game, failure to replicate reading racetracks

Introduction
Learning to read is a critical skill for the academic success of children (1). By the end of third grade children are expected to learn academic content through reading (2). Thus, if children are unable to read fluently and comprehend what they are reading, they will miss out on academic content necessary for achievement in their other school subjects. A growing number of children are starting school with poor levels of language development necessary for academic success (3). And more than one-third of children have significant difficulties with learning to read (2, 4). Catching up with peers is a difficult task. Stanovich (5) has noted a "Matthew Effect" for such youth. This refers to the tendency for children with low reading skills to fall further behind their peers as their peers are able to build upon existing literacy skills. Research has shown that reading ability in the first, third, and fifth grades is a strong predictor of an individual's success in reading tasks presented in the eleventh grade (6).

The ability to label individual letter names has been shown to be a strong predictor of later achievement in reading (7, 8). Although knowing letter names is not required for reading (9), rather it is the sounds of the letters that are needed to decode words, a positive correlation between children's ability to accurately name letters and their later reading achievement has been a longstanding finding (10, 11, 12). It is the act of giving a label to the letters which familiarizes children with the letters and allows them to store the information in their long-term memory (13, 14). Many letter names provide a cue to the sound they make, such as the letter *m* whose name is the combination of the short *e* sound and the sound made by *m*. Other examples of this are the letter names *f*, *l*, *n*, and *x*, which are all pronounced in the same manner. Conversely, the letter names for *b*, *d*, *p*, *t*, *v*, and *z*, are pronounced by first saying the sound of the letter and then adding the long *e* sound (15).

Children with a language delay have been shown to have a greater impairment in phonological working memory and phonological fluency, as well as in semantic fluency, grammatical comprehension, and verbal IQ, compared to children without a language delay (16). Children with developmental delays can benefit from specialized instruction to assist with reading and language skills. The use of direct instruction flashcards has been found to

be a successful method for teaching academic skills to children with special needs (17, 18).

Another successful method, used to teach academic skills to children with and without special needs, is a reading racetrack drill procedure (19, 20). This procedure employs error correction, recorded timing, drill and practice procedures along with a fun practice sheet that resembles a car racetrack to improve accuracy and fluency of information printed in the cells of the racetrack. The student typically goes through a set of flashcards and after that, they are times when they say or write items on the racetrack. Racetracks have been employed alone as well as with flashcards.

DI flashcards and the reading racetrack procedure were employed to increase the accuracy and fluency with which three students, enrolled in a special needs preschool program, expressively identified the letters of the alphabet. Another purpose of this study was to replicate and extend upon previous research utilizing DI flashcards (17, 21, 22, 18) and the reading racetrack procedure (19, 20).

Method

Participants and Setting

There were three participants in this study. All three participants were selected for this study by their teacher because they were to transition to kindergarten at the end of school year. The teacher was concerned about the academic preparedness of these children, for kindergarten, as they did not know any letters of the alphabet which is a kindergarten readiness skill.

The first participant was a five-year-old male with developmental delays. He attended special education preschool with goals in the areas of academic, and speech and language. Participant 1 also attended a Head Start Program. His Head Start teacher maintained contact with the special education teacher and had discussed her frustration that this participant had not learned his alphabet during the course of typical group instruction at the Head Start program.

The second participant was a five-year-old male diagnosed with autism. He attended special education preschool to work on goals in the areas of academic, adaptive, social, and speech and language. He often vocalized the names of the numerals from 1 through 10, and said the words "more", "no", and "please." Other words had been reported to have been heard by the classroom teacher, parent, and speech therapists, but not with regularity. Participant 2 used a picture exchange communication system for mealtimes and to request specific preferred toys. He also frequently used American Sign Language (ASL) to sign "please".

The third participant was a six-year-old female diagnosed with developmental delays. She attended special education preschool to work on goals in the areas of academic, social, speech and language, and physical therapy. Participant 3 had some hearing loss and damage to the vocal muscles. The extent of both was unknown, but she was unable to speak. She had primarily been using a picture exchange communication system (PECs), when she and her mother attended sign language classes. Sign language was also regularly used in the classroom. Her mother had expressed a desire that ASL be the primary language of Participant 3.

This study took place in the individuals' self-contained special education preschool classroom. These participants attended the afternoon session of preschool and there were a total of eight students in the class at the start of the study and a total of 14 students in the class by the end of the study. Also present in the classroom was the classroom teacher and two instructional assistants. Therapists came in and out of the classroom throughout the afternoon. The first author worked with each participant individually, for ten minutes each, at an empty classroom table away from the other students.

Materials

Flashcards, in which a single lower-case letter was printed on each card, were used. A kitchen timer kept track of timings. A series of reading racetracks (23) were also created (see Figure 5). Two types of reading racetracks were used. Each of the first four racetracks contained the letters from a set. They were printed on the track four times each in a random order (20), to prevent participants from memorizing the order of the letters. The final racetrack was a review track which contained all of the letters of the alphabet, in a random order. The participants remained on each racetrack until they reached a mastery level of expressively identifying 90 letters per minute, or until they completed five timed sessions with a specific racetrack. A series of homemade alphabet lotto game cards were created. Each game card had one set of letters on it that corresponded to the letters in which the participant was receiving instruction. A deck of letter cards was used for calling letter names to be found on the game cards and markers were used to cover the letters as they were found on the game card.

Dependent Variables and Measurement

Two dependent variables were measured in this study. The first dependent variable measured was the number of letters correctly identified by each participant through either vocalization or sign language (ASL), per minute. A correct response was defined as the participant saying or signing the letter name within 5s. The participant who used sign language had difficulties in the area of fine motor movements; therefore the sign did not have to be exact to count as a correct response, but needed to be a close approximation so that it was understandable to adults who regularly worked with her. The second dependent variable was the number of errors made by each participant. An error was scored if a participant said an incorrect letter name or if nothing was said. An error was not counted, if a participant corrected themselves before moving on to the next letter.

Data Collection and Inter observer Agreement

Data were collected by the first author at the end of each ten-minute session recording frequency of the two targeted behaviors (see Appendix). The first author went through the flashcards with each participant; no assistance or feedback to the responses made by the participants was provided. The first author marked correct or incorrect on the data sheet, for each letter.

Inter observer agreement data were collected on 4 of the 13 (31%) sessions for Participant 1, on 3 of the 10 (30%) sessions for Participant 2, and on 4 of the 11 (36%) sessions for Participant 3. Inter observer agreement data were collected by the first author and the classroom teacher who scored data simultaneously but independent of one another. The number of correct and incorrect responses,

recorded by each observer on their individual data recording sheet, was compared for the two target behaviors for each participant. An event ratio was calculated to determine the inter-observer agreement score. Mean agreement was 100%.

Experimental Design and Conditions

A single subject, multiple baseline design (24, 25, 26) across participants and sets of letters was used to evaluate the effectiveness of employing racetrack procedures. Participant 1 received two days of baseline before intervention began, Participant 2 received three days of baseline and Participant 3 received 4 days of baseline. There were four sets of letters which were introduced to the participants in a staggered fashion. The introduction of a new set of letters was individual to each participant's success with the previous set of letters.

Baseline: During baseline typical classroom procedures were in place. The first author went through the deck of DI Flashcards with each participant, no instruction was provided and no comments were made regarding accuracy of the responses. The first author marked correct or incorrect on the data sheet, for each letter. Participants were encouraged to try their best and verbal praise was given for participation.

DI flashcards and reading racetracks: Four sets of letters were created. The order of letters was determined using the acceptable sequence for introducing letters given by Carnine et al. (15). This list was then divided into four sets by taking the first seven letters for Set 1, the next seven letters for Set 2, the next six letters for Set 3 and the remaining six lowercase letters of the alphabet comprised Set 4.

At the beginning of each session, the first author went through the flashcards of the current instructional set with the participant. The first author made a pile of correct responses and a pile of incorrect responses. A model, lead, test format was employed, using the flashcards to review the letters on the cards in the incorrect pile.

The reading racetracks were then used to practice fluency with each set of letters. The first author said "Ready, set, go!" and started the timer for 1 minute. The participants each identified the letters on the track, and were encouraged to go as quickly as they could without making mistakes. The first author kept track of the number of errors, as each participant read, and recorded the number of corrects and the number of errors daily, for each participant.

At the end of each session the first author went through all four sets of letters, using the flashcards. The first author recorded the number of correct responses and the number of incorrect responses, for each participant. This was done to record baseline data for sets on which participants had not received instruction and to record maintenance data on sets previously mastered.

DI flashcards and alphabet lotto game: The implementation of the DI flashcards remained the same as in the original intervention, but an alphabet lotto game was introduced. The first author and participant would play the game using the lotto game card that corresponded to the set of letters in which the participant was receiving instruction. The participant could choose to be the caller or the player first. The caller took the set of letter cards, mixed them up, and called out a letter name for the player to find on their lotto game card. When the player found the letter they covered it with a marker. When all the letters on the game card had been found and covered the player had won the game and the first author and participant switched roles.

Results

Baseline

During the initial baseline period, the results for expressively identifying letter names indicated a low level of performance that remained stable for all three participants, prior to the implementation of DI flashcards, reading racetracks, and alphabet lotto games. The baseline phase of letter identification began with two sessions for Participant 1 who identified one and two letters during this time. Participant 3 and Participant 4 had three and four sessions of baseline, respectively, during which zero letters were identified.

The letters of the alphabet were divided into four sets which were presented to each participant in a multiple baseline design across sets. Participant 1 consistently identified low numbers of letters during baseline for each set. Zero letters were identified during baseline for Set 1 and Set 2. For Set 3 and Set 4, Participant 1 remained stable (M = 0.11, and M = 1.4 respectively). During the initial baseline Participant 2 consistently identified zero letters across all 4 sets. Following the start of intervention on Set 1, Participant 2 had fluctuating levels of letters identified during baseline across Set 2 (M = 2.33; range: 0-7), Set 3 (M = 2.89; range: 0-6), and Set 4 (M = 1.9; range: 0-4).

DI Flashcards and Reading Racetracks

The results of the DI flashcards and reading racetracks procedure, across all three participants, are also shown in Figure 1. During baseline the students showed low levels of expressive identification of letter names. When the DI flashcards and reading racetracks procedure was implemented, the students began increasing their performance.

The results for Participant 1 are shown in Figure 2. Following the implementation of DI flashcards and reading racetracks, Participant 1 was able to expressively identify an average of 3.0 letter names (range: 2 to 4), when shown the letter printed on a flashcard.

The results for Participant 2 are shown in Figure 3. Following the implementation of DI flashcards and reading racetracks, Participant 2 was able to expressively identify an average of 5.33 letter names (range: 3 to 7), when shown the letter printed on a flashcard.

The results for Participant 3 are shown in Figure 4. Following the implementation of DI flashcards and reading racetracks, Participant 3 was able to expressively identify two letter names, when shown the letter printed on a flashcard.

DI flashcards and Alphabet Lotto Game

The results of the DI flashcards and alphabet lotto game procedure, across all three participants, are also shown in Figure 1. Participant 1 increased his performance with the implementation of DI flashcards and the alphabet lotto game, from his prior performance during the intervention

of DI flashcards and reading racetracks. Both Participant 2 and Participant 3 remained stable across both interventions.

The results for Participant 1 can be seen in Figure 2. With the intervention of DI flashcards and alphabet lotto game, Participant 1 increased his letter identification across all four sets, and reached 100% accuracy by the end of the study. For Set 1, Participant 1 identified an average of 5.71 letters (range: 3 to 7). For Set 2, Participant 1 identified an average of 5 letters (range: 2 to 7). For Set 3, Participant 1 identified an average of 3.25 letters (range: 2 to 6), and for Set 4, Participant 1 identified an average of 4 letters (range: 3 to 6).

The results for Participant 2 can be seen in Figure 3. Following the implementation of DI flashcards and reading racetracks, Participant 2 was able to expressively identify an average of 5.5 letter names (range: 3 to 7), in Set 1 and 4.5 letter names (range: 2 to 6) in Set 2. Only one day of intervention was implemented for Set 3, in which Participant 2 identified 5.0 letter names. Intervention was unable to occur for Set 4, with Participant 2.

The results for Participant 3 can be seen in Figure 4. Following the implementation of DI flashcards and reading racetracks, Participant 3 was able to expressively identify an average of 1 letter name (range: 0 to 2) for Set 1. Participant 3 did not learn to identify any letter names in Set 2 and intervention was unable to occur for Set 3 and Set 4.

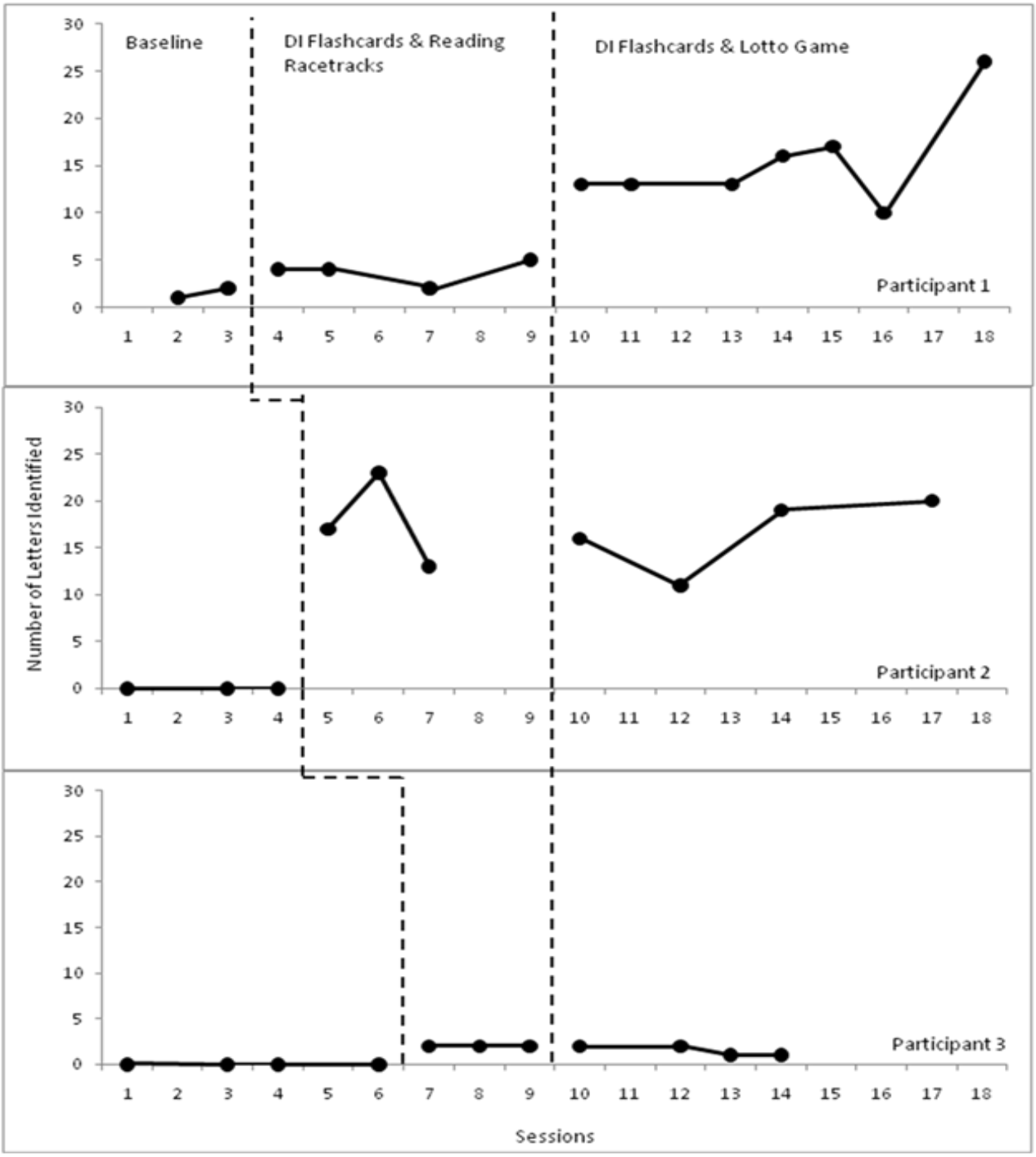

Fig 1: The total number of letters identified by each participant is shown across participants.

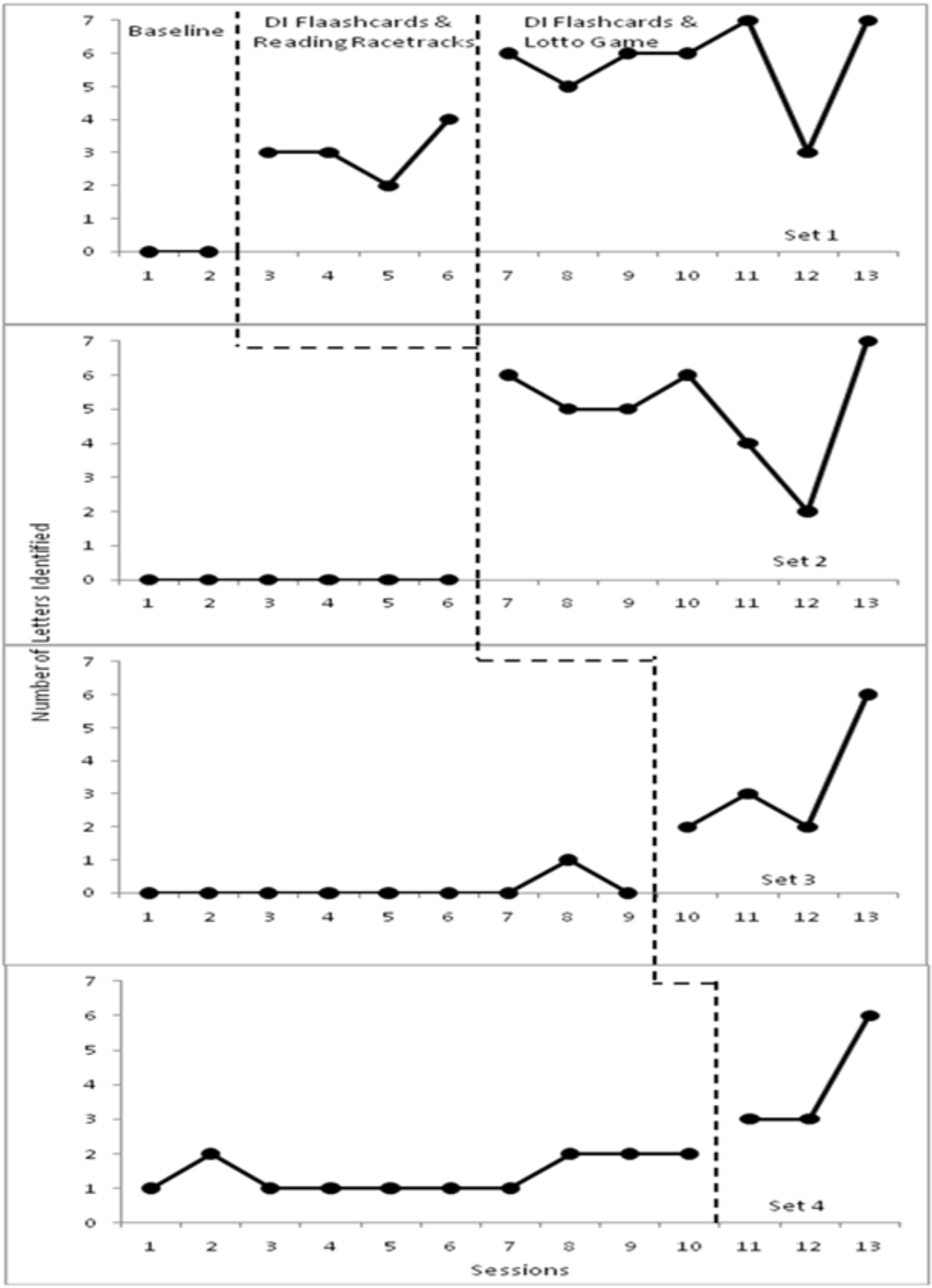

Fig 2: The number of letters identified by Participant 1 is shown across four sets. Sets 1 and 2 had a possible total of seven letters each and Sets 3 and 4 had a possible total of six letters each.

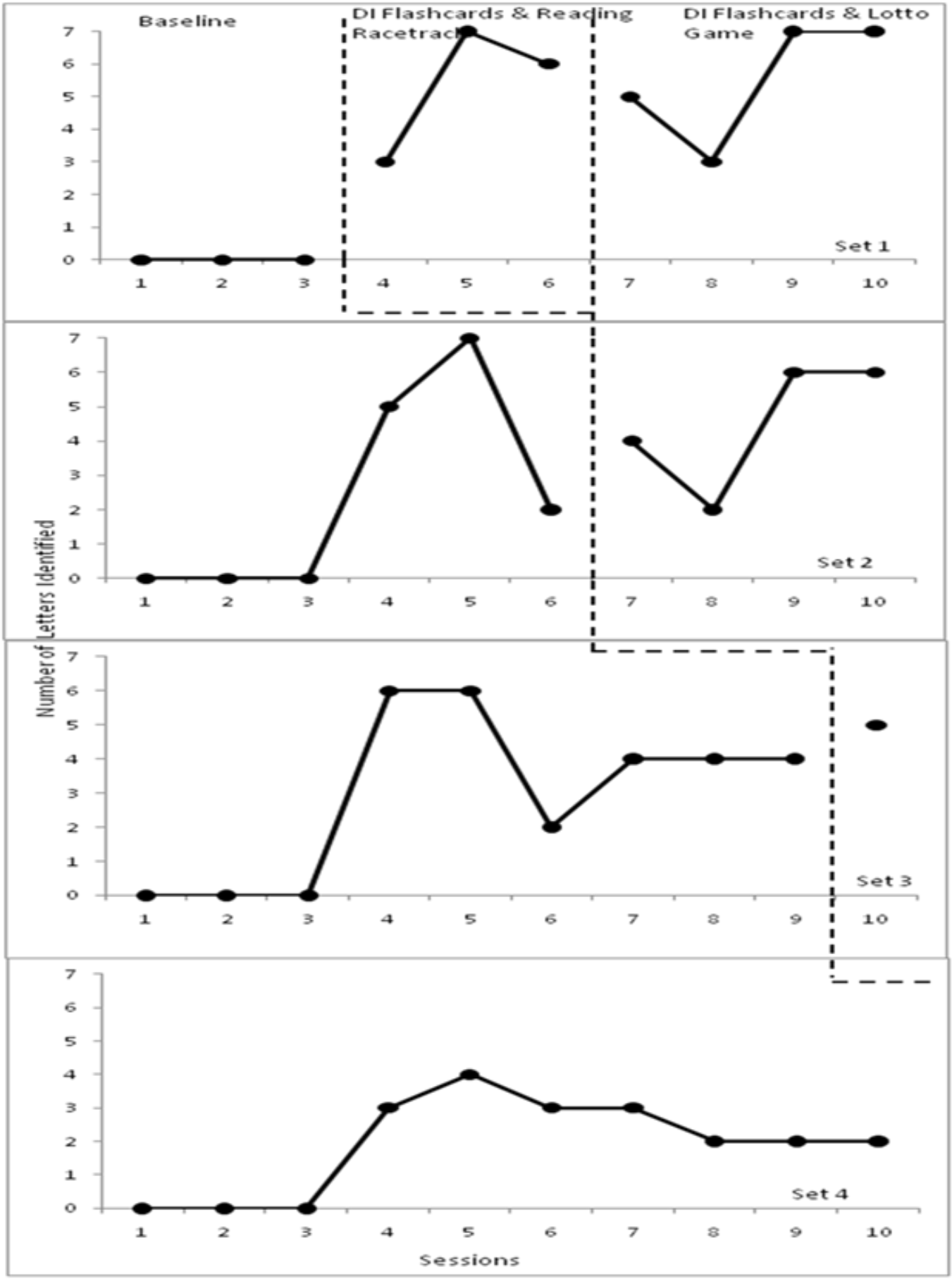

Fig 3: The number of letters identified by Participant 2 is shown across four sets. Sets 1 and 2 had a possible total of seven letters each and Sets 3 and 4 had a possible total of six letters each.

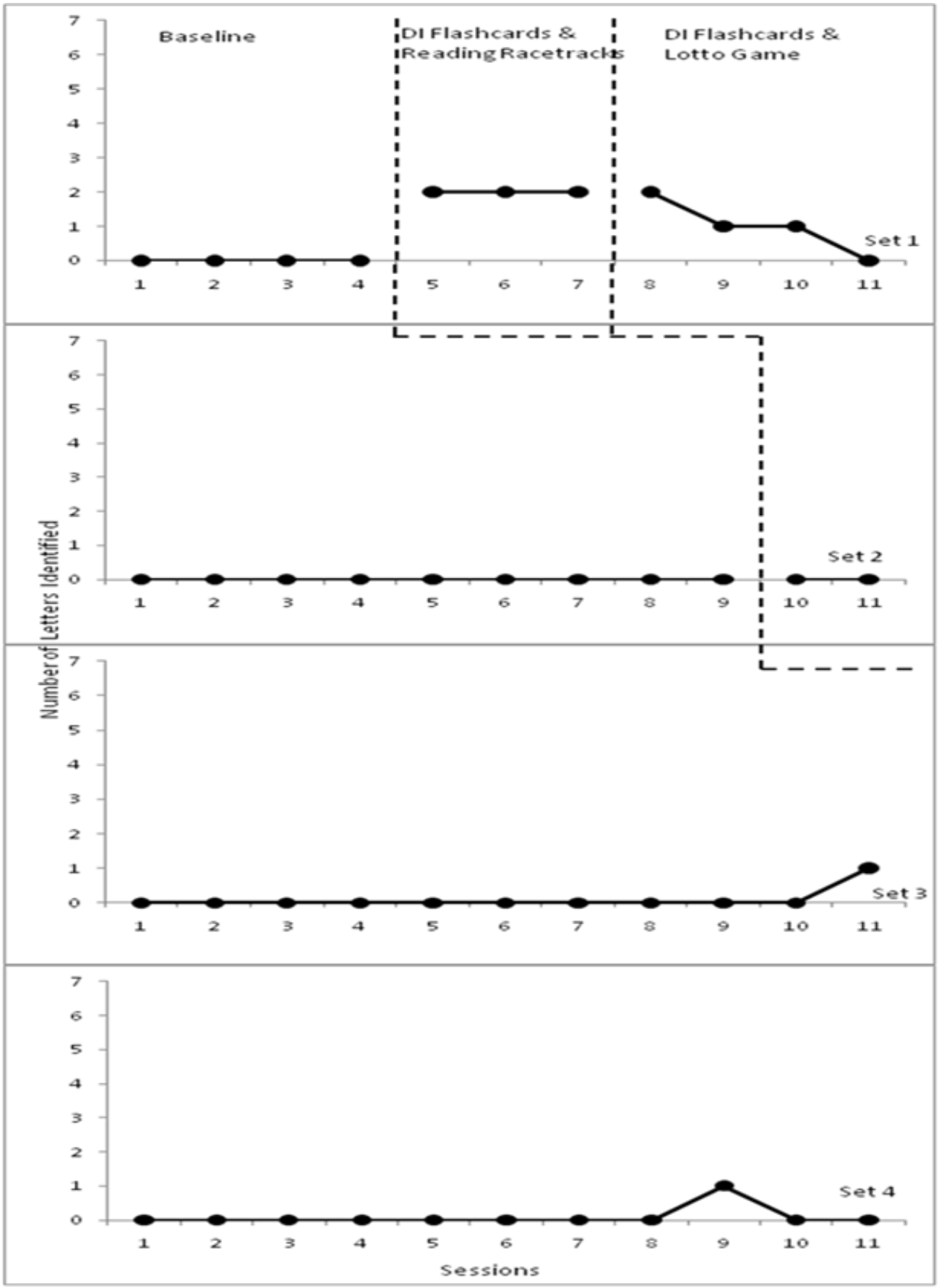

Fig 4: The number of letters identified by Participant 3 is shown across four sets. Sets 1 and 2 had a possible total of seven letters each and Sets 3 and 4 had a possible total of six letters each.

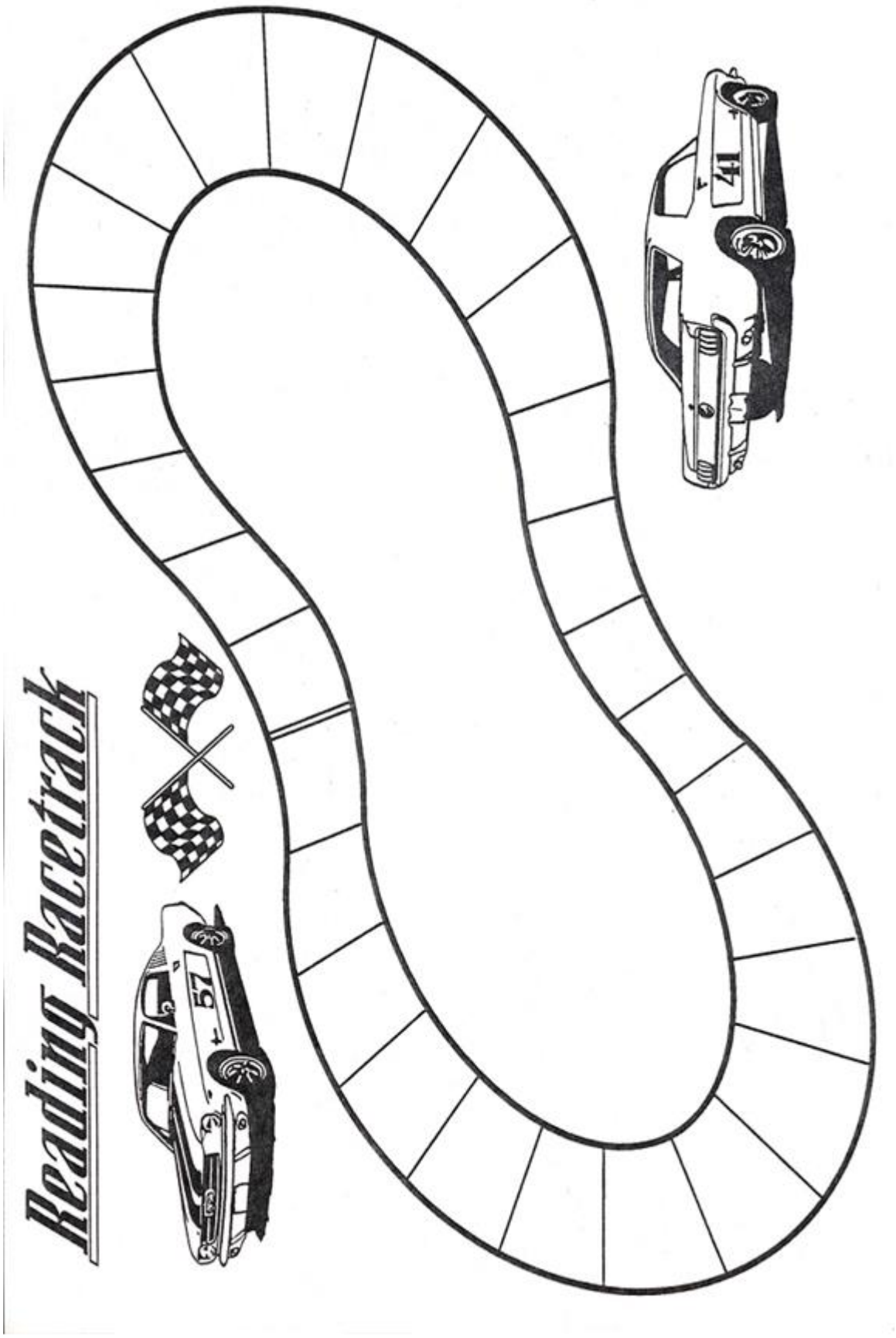

Fig 5: A blank copy of the reading racetrack which was copied and customized with the letters of each set in the racetrack cells.

Discussion

The results showed that all three participants began making progress using the intervention of DI flashcards and reading racetracks, supporting previous research showing the effectiveness of this intervention when working with children with learning disabilities. However, all three participants expressed dislike for the reading racetracks, which is why this intervention was stopped.

Participant 1 was very self-conscious about his difficulty learning new skills and was known to become extremely

upset when he did not know an answer. Participant 1 enjoyed the individual attention provided by working with the first author and willingly came to sessions. He worked hard during the flashcard instruction and remained positive with the use of flashcards. However, he banged his head with his fists, hid his eyes, and said "No, I'm not doing that!" when the reading racetrack was presented, which was intended as a game to improve fluency as well as to be a fun break from the flashcard work. Participant 1 provided small amounts of verbal explanation for his behavior over the course of several sessions to explain his frustration with the reading racetracks. With the flashcards, if he did not know the letter name, the card was removed after 5 seconds and he did not have to look at it anymore; he could forget about it. With the racetrack, when he came to a letter he did not know, the letter stayed in front of him and he felt stupid for not knowing the letter name.

Participant 2 had a diagnosis of autism, and displayed common characteristics of a preoccupation with certain objects, a need for routine, and distress with novelty (27). Participant 2 was familiar with the use of flashcards, but he had not previously seen a reading racetrack. On the first occasion that the reading racetrack was presented to Participant 2, he turned his head and pushed the racetrack away. On repeated presentations of the racetrack, Participant 2 cried or attempted to leave the table where he and the first author worked. On one occasion, Participant 2 did read the first three letters printed on the racetrack presented to him before becoming agitated which he demonstrated by yelling and engaging in self-stimulatory behavior.

The third participant enjoyed placing the flashcards into a toy purse after finishing with each one. When the reading racetrack was presented to her she would try to place the racetrack into her purse. The time required to attend to the racetrack before getting to place it into her purse was too long for the participant to focus her attention on the learning activity and she often engaged to inappropriate behaviors of saying "No, no!" and pinching the first author.

The results for Participant 1 support previous research showing that DI flashcards are a successful learning tool for teaching children with learning dfficulties (21, 22, 20). Following the decision to end the intervention of the reading racetrack procedure, a set of homemade lotto game cards was created. Participant 1 enjoyed playing the lotto game with the first author, and especially liked getting to be the caller who held the deck of cards and called out letters for the first author to find on the game card and cover with markers (made from corresponding letter cards). Playing the part of the caller gave the participant practice in expressive identification of the letters. Then the participant and first author switched roles giving the participant extra practice with the letters through receptive identification of finding and marking the letters called on the game card. Participant 2 and Participant 3 both enjoyed the flashcards as well as the individual attention they received working with the first author. They did not have the skills to play the lotto game according to the traditional rules, however both enjoyed going through the letter cards in the same manner as the DI flashcards and playing matching games using the Lotto pieces for extra letter practice.

The results for Participant 2 show that he was able to identify letter names across all sets once intervention began for Set 1. Although no praise was given during the "quiz" at the end of each session, during instruction both verbal and physical praise was used to reward the participants for correct responses. On the first occasion of receiving praise, Participant 2 took the entire deck of flashcards from the first author and began going through the shuffled deck naming 17 of the letters printed on the cards. This demonstrates the reinforcing potential of verbal and physical praise for this child. These results also demonstrate that the child was familiar with letter names and needed practice with tacting. The term tact, as defined by Skinner (28), refers to the relationship of a stimulus causing an individual to say the word which represents that stimulus. Tacting is an important skill from which children can build off of to establish more effective verbal behaviors (29). Research has shown that specific training in tacts may lead to skills in mands and specific training in mands may lead to tacting skills (30). Future research with this individual should look at increasing his tacts and mands so he can share his knowledge with teachers and assessors which will allow for appropriate classroom placement and instruction in the future.

Participant 3 had less success learning the letters than the other two participants. She had been described by the classroom teacher as being a child with her own agenda and her IEP goals included learning to follow adult led activities. Participant 3 enjoyed coming with the first author and getting individual attention and praise for participating. After a few seconds, praise was no longer enough to reinforce her participation and she would begin saying "No, no" and pinching the first author. The child was not allowed to escape the activity however decreased demands were placed on the child, with which she had to comply with before the session was over. Future research with this individual should focus on finding a strong reinforcer that will motivate her to comply with and follow adult led activities, as this will be essential to her future success in learning new skills. Sets 3 and 4 were not introduced to Participant 3 because she was absent due to medical reasons for the last couple weeks of the study.

Multiple sets of the lotto game cards and marker pieces were made so that the children could play in a group. However, the children preferred the individual attention they received by working individually with the first author and the inappropriate behaviors of each of the children when they became overwhelmed or frustrated required the first author's full attention. Therefore the first author worked with each child individually for ten-minute sessions. The first author was completing a student teaching placement in the children's classroom, and therefore was responsible for the other children in the classroom as well, during the sessions, which led to this intervention as impractical for daily use. As a result, on days when data collection did not occur, the lotto game was out during free play for any of the children in the classroom to come to the table and play. Several of the children in the classroom knew the names of the letters and were good peer models during free play of the lotto game. Participant 1 came every day to this table during free play and enjoyed playing the game with the peer models. Participant 2 and Participant 3 came sporadically and often only stayed for a minute or so, when they were not receiving the adult attention of the first author.

Skinner (28) stated that verbal behavior is characterized by the functionality of the behavior and that language taught

under one circumstance may not occur under another circumstance. Thus, an important goal in language training is to promote generalization (31). In the present study, the participants received instruction in the letters of the current set using DI flashcards, and then practiced receptive and expressive letter identification using the alphabet lotto game. This promoted generalization across two letter activities. For success in elementary school, students must also generalize between lower-case and upper-case letters of the alphabet and between print and cursive written forms of the letters. Future research should focus on increasing generalization across a greater variety of alphabet activities ensuring students can recognize the letters in a variety of formats.

Our differential outcomes found in the present research we have also found with students in a resource room (32) and in preschool settings (33, 34). Also, we have found differential effects using DI flashcards with young children with autism (33, 34). Clearly, the differential outcomes with DI flashcards as well as reading racetracks warrants further examination. This is especially true when we have reported such effects in various classroom configurations. Also, these effects have been observed in preschool and elementary aged children. We have had two reports (33, 34) with young children with autism appear to respond less well to these procedures

Appendix A

Participant _____ Observer_____

Date _____

When shown each letter individually on a flashcard does the child say/sign the letter?

a	Y/N	n	Y/N
b	Y/N	o	Y/N
c	Y/N	p	Y/N
d	Y/N	q	Y/N
e	Y/N	r	Y/N
f	Y/N	s	Y/N
g	Y/N	t	Y/N
h	Y/N	u	Y/N
i	Y/N	v	Y/N
j	Y/N	w	Y/N
k	Y/N	x	Y/N
l	Y/N	y	Y/N
m	Y/N	z	Y/N

Racetrack:

Time:_____

Correct:_____

of Errors: _____

Correct = expressive – say/sign letter

Error = incorrect response or no response

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