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## Effects of auditory response feedback on matching-to-sample performance

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**Effects of Auditory Response Feedback on Matching-to-Sample Performance**

**A Thesis Presented**

**by**

**Margaret M. Dickson**

The Department of Counseling and Applied Educational Psychology

In partial fulfillment of the requirements

for the degree of

**Master of Science**

**in the field of**

**Applied Behavior Analysis**

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Performance

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Effects of Auditory Response Feedback on Matching-to-Sample Performance

by

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Submitted in partial fulfillment of the requirements for the degree of  
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A Comparison of Methods for Marking Correct Responses in the Skill Acquisition of an  
Arbitrary Matching Task

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## Abstract

Auditory feedback has been used to shape behavior. Using TAG (teaching with acoustical guidance) has some advantages: the auditory stimulus can be delivered immediately following the behavior, produces one sound which is uniform across trainers or experimenters and it is easy to implement. In a matching-to-sample task using arbitrary stimuli, there were three conditions that compared the effects of auditory feedback: TAG paired with edible, verbal praise paired with edible and edible alone. The participants were 3 males ranging in age 14-15. All were diagnosed with an autism spectrum disorder and attended a school for children with autism. Each participant was trained on a matching-to-sample task with 2 sets of arbitrary stimuli. This study was conducted with a multi-element design. Conditions were counterbalanced across participants and stimuli. Based on the results for all the participants the average rate of acquisition was more efficient in the verbal praise paired with an edible condition. TAG paired with an edible was the next most efficient treatment followed by the edible only condition. The results of the study indicate that using verbal praise paired with an edible and TAG paired with an edible are more efficient when training an acquisition task than using edible only.

Reinforcement is an important component of educational programs for children with autism spectrum disorders (Cooper, Heron, & Heward, 2007). As noted in Catania (2007) “a stimulus is a positive reinforcer if its presentation increases responding that produces it.” There are two types of reinforcers that are used, primary reinforcers and conditioned reinforcers. Primary reinforcers are events or stimuli that are of biological significance to the individual; for example, food and water. Conditioned reinforcers are defined as initially neutral events or stimuli that are paired with a primary reinforcer, and through this pairing acquire reinforcing properties (Catania, 2007).

There are two variables that should be considered when studying the effects of reinforcement: establishing operations and amount of time between the behavior and the delivery of the reinforcer. An establishing operation may increase or decrease the effectiveness of a reinforcer (Cooper et al., 2007). For example, satiation of a specific reinforcer may temporarily decrease the effectiveness of that reinforcer, and behavior that previously lead to contacting that reinforcer will decrease in frequency. Delay between the occurrence of the target behavior and the onset of the consequence can have an impact on the effectiveness of reinforcement (Sassenrath, Yonge, & Shrable, 1968). The immediacy of reinforcement is particularly important because other behaviors or responses may occur during the delay between the behavior and reinforcer. Delayed reinforcement may result in adventitious reinforcement of behavior other than the target behavior. Although they are important, these factors related to the effective use of reinforcement are not always possible to include in a behavioral educational program. It is not always possible to deliver reinforcement immediately after a response, and the use of primary reinforcers such as edibles can lead to temporary decreases in motivation.

Conditioned reinforcement has been used to address both of these issues. Auditory stimuli can serve as conditioned reinforcement and can be used for the purpose of avoiding delays to reinforcement (Breland & Breland, 1961). Additionally, a conditioned reinforcer can be paired with many different primary reinforcers so that satiation is less likely (e.g., Moher, Gould, Hegg & Mahoney, 2008).

Effective applications of conditioned reinforcement in the form of an auditory “click” has been demonstrated repeatedly and popularized by Karen Pryor (1999). She developed a procedure called clicker training, and used this procedure to establish and shape desired behavior in humans and animals. Clickers are devices that produce auditory stimuli that can be used to provide feedback for or “mark” the occurrence of the correct response and signal the availability of reinforcement. Shaping is defined as “gradually modifying some property of responding by differentially reinforcing successive approximations to a target operant class” (Catania, 2007). The auditory stimulus is not necessary for shaping to be successful, but may be helpful. Because of the association with dog training, Pryor refers to the use of clickers in teaching situations with humans as TAG (Teaching with Acoustical Guidance). TAG teaching has been used to train athletes including gymnasts, divers, and dancers.

There are a few advantages to using the clicker to shape behavior. First, the auditory stimulus can be delivered immediately following the behavior, eliminating some of the effects of reinforcement delay. Second, the clicker produces one sound which is uniform across trainers or experimenters, increasing the procedural integrity with which the reinforcer is delivered. Third, the use of the clicker is easy to implement. Last, the

sound of the click can be paired with multiple reinforcers, and could decrease the effects of satiation.

The delivery of an auditory stimulus immediately following target behavior is a component of animal training procedures dating back to the 1960s. Breland and Breland (1961) used a whistle to reinforce the jumping behavior of dolphins. They described the whistle as a “bridging stimulus.” The whistle was sounded when the dolphin jumped in the air, indicating that reinforcement was available. Upon hearing the whistle, the dolphin would swim to the side to receive reinforcement.

Breland and Breland’s (1961) article, *The Misbehavior of Organisms*, discussed the conditioning of thirty-eight species with over 6,000 individual animals, including reindeer, cockatoos, raccoons, porpoises and whales. They found many different examples of unexpected patterns occurring when conditioning behavior. One of the examples was a story about a dancing chicken. The goal was for the chicken to come out of its compartment, pull a ring on a rope and stand on a platform for 12-15 seconds. When the interval ended, the door to the compartment would open with food present and the chicken would return to the compartment. Over the course of training, the chicken began to scratch or peck at the platform, looking as though it was dancing. Breland and Breland (1961) described many other instances in which behavior drifted from the original target. Using a conditioned reinforcer such as an auditory stimulus would have eliminated the delay to reinforcement and may have prevented the drift in behavior from the original target.

Several studies have investigated the use of stimuli as conditioned reinforcers with animals. In Lieberman, McIntosh & Thomas (1979) rats were trained to perform a

spatial discrimination in a two choice T-maze; with one arm painted white and the other arm painted black. There were two groups of rats: the control group and the experimental group. In all experiments and with both groups, after making a correct choice, there was a 1-min delay before a food reward was presented at the start of the maze. After making an incorrect choice no food was presented, and the trial was repeated. In Experiment 1, after the choice selection, the control rats were picked up by the experimenter and then immediately replaced at the start of the maze. The experimental rats were transferred to their home cages during the delay interval, and then replaced at the start of the maze after 1 min. Both groups learned to make the correct choice. In Experiments 2 and 3 the rats were not handled immediately after the choice response and no learning occurred. In Experiment 4 the choice response was followed by an intense light or noise, and the rats learned to make the correct choice. In summary, rats learned to discriminate the correct choice when handled immediately after the choice response or when the choice response was followed by an intense light or noise.

Thomas, Lieberman, McIntosh and Ronaldson (1983) replicated Lieberman et al.'s (1979) study. Thomas et al. (1983) trained rats to perform a spatial discrimination in a maze similar to the one in the previous study. In this maze the rats would start in a start box and then enter a choice box where the rat could make a choice selection. The rat then entered one of the two side arms and walked down the side arm to a delay box. The rat entered the delay box and stayed there for 2 min until the door to the goal box opened. If the rat made a correct choice the food reward was placed in the goal box, and if it made an incorrect choice the goal box would be empty. An auditory stimulus was used: a 2-s burst of noise from a loud speaker built into the top of the maze. In Experiment 1 there

were two groups; for the first group the auditory stimulus was presented twice: immediately following choice making, and after the 2-min delay, before the rat entered the goal box. This auditory stimulus was presented in this way for both correct and incorrect choices. For the second group, the auditory stimulus was presented once: immediately after choice making. Thomas et al. (1983) found that that the second auditory stimulus after the choice response and the delay is unnecessary for learning to occur. Experiment 2 compared the effects of presenting auditory stimuli before and after the choice response. For one group the auditory stimulus was presented prior to the choice response, and for the other group the auditory stimulus was presented following the response. The auditory stimulus was presented on both correct and incorrect trials. The authors found that an auditory stimulus presented before a response is as effective as one presented after. In these two studies, the authors concluded that these stimuli aided in learning not because they were conditioned reinforcers, but because they served to “mark” the choice response.

Ferguson & Rosales-Ruiz (2001) expanded upon previous research by using an auditory stimulus to shape behavior in animals. They developed a non-aversive way to load a horse into a trailer using a shaping procedure involving a target and an auditory stimulus paired with food. The horses were trained to touch the target with their nose and the auditory stimulus and the food was used to reinforce successive approximations. Once the horse reliably touched the target, the experimenters moved the target closer to the trailer, and eventually all the way into the trailer. Each time the horse met the criteria for reinforcement, the auditory stimulus was sounded, indicating that food reinforcement was available. This procedure continued until the horse was reliably walking into the

trailer and allowing the trainer to fasten the horse into the trailer. This performance was generalized to novel conditions (a different trainer and a different trailer). This study allowed the horse to be trailer loaded using positive reinforcement and no physical guidance, and reduced the risk of injury to the trainer and the horse.

Although few studies have used clicker training in applied settings the use of conditioned reinforcement in these settings is common. Kazdin (1982) discusses advances in research on token economies and reviews progress on training staff, overcoming client resistance, promoting long term maintenance and transfer of training. In token economy, tokens are delivered for appropriate behavior or task completion, and these tokens serve as conditioned reinforcers. The clients can use the tokens at a later time to trade in for a preferred item.

Moher et al. (2008) focused on establishing and validating non-generalized and generalized conditioned reinforcers with children with an autism spectrum disorders. They paired novel tokens with an edible reinforcer and then completed a preference and reinforcer assessment to verify that the tokens functioned as conditioned reinforcer. Preference and reinforcer assessments demonstrated that the tokens served as conditioned reinforcers. The tokens matched the reinforcing value of the primary reinforcer with which it had been paired. The effectiveness of the conditioned reinforcer decreased during satiation conditions. Moher et al. (2008) found that increasing the variety of backup reinforcers that the tokens were paired with maintained the tokens' reinforcing effects, even during satiation conditions.

Few studies have been conducted using an auditory stimulus as a conditioned reinforcer with humans. Zamansky (2001) taught independent living skills to three

children with developmental disabilities using an auditory stimulus as a conditioned reinforcer. A multiple probe design across participants was used. A combination of clicker training and backward chaining was used to increase the percentage of correct and independent steps completed. For all three of the participants, independent living skills improved.

In a study that compared conditioned reinforcement and response marking functions of stimuli, Grindle and Remington (2002) taught children with an autism spectrum disorder to identify pictures of objects. There were two conditions, cue-value and response-marking. In the cue-value condition a 1-s compound red light/tone stimulus was presented twice following each correct response: once immediately after the correct response and once after the 5-s delay (i.e., immediately prior to food reinforcement). In the response-marking condition, the 1-s compound green light/buzzer stimulus was presented immediately after both correct and incorrect responses but not after the 5-s delay (i. e., not contiguously with food reinforcement on correct trials). The number of training trials to learn each receptive label was compared across conditions. Students learned receptive communication skills in both cue-value and response-marking conditions, but acquisition was faster in the cue-value condition.

In a follow-up study, Grindle and Remington (2004) taught children with autism spectrum disorders to match printed words to objects. They used a within-subject alternating treatments design to compare rate of acquisition across three teaching conditions. The conditions were marked-before, marked-after and delay. In each condition correct responses were followed by a 5-s delay to reinforcement. In the marked-before condition, an instruction was given (for example, turn over the cards) to

visually orient the participant to the cards before they made their response. A verbal statement of approval such as “good” was delivered only after a correct response and again after the 5-s delay and was contiguous with food reinforcement. In the marked-after condition, an attention-getting verbal cue (e.g., “look!”) was delivered immediately after both correct and incorrect responses. In the delay condition, these cues were omitted. Performance in the delay condition was inferior to both the marked-before and marked-after conditions, but there was little difference in rate of acquisition between the marked-before and marked-after conditions.

As previously stated there is a lack of research on the use of auditory stimuli to aid in the acquisition of new skills. Although the use of auditory stimuli may not be needed for skill acquisition to occur, it may be helpful. The purpose of this study is to compare the effects of providing auditory feedback for correct responding in the acquisition of an arbitrary matching task.

## **Method**

### **Participants and Setting**

The participants were 3 males ranging in age from 14-15 years. All were diagnosed with an Autism Spectrum Disorder and attended programs for children with these disorders.

Brian was a 15-year-old male who communicated vocally in full sentences and could talk about a wide range of topics. He lived at home with his parents and attended a day school for children with an Autism Spectrum Disorder.

Issah was a 14-year-old male who also communicated vocally in full sentences and could talk about a wide range of topics. He lived at a residential school for children with an Autism Spectrum Disorder and attended classes there 6 days a week.

Dan was a 14-year-old male who communicated vocally for purposes of requesting specific items, He also labeled objects, and answered familiar questions; however, his speech was sometimes unintelligible. Dan lived at the same residential school as Issah and also attended classes there 6 days a week.

All sessions were conducted in either a quiet classroom at the school or in a room at the at the students' residence. The classroom contained several desks and chairs, and shelves with leisure materials and work materials. Session occurred in a number of rooms at the students' residence each of which contained different furniture and materials. All rooms, however, were quiet, had a place for the student to sit, and contained a table or platform on which the stimuli could be presented. At times, other teachers and students were present in the room during the sessions. During sessions, the participant sat across a table or platform from the experimenter who presented the stimuli and provided the programmed consequences.

### **Materials**

Materials included 54 arbitrary stimuli (see Appendix A and B), and an auditory stimulus that produced a sound (TAG). The stimuli, which were black and white symbols, were printed and laminated onto a 2x2 inch card and were arbitrarily grouped into one of 3 sets. Each set was then divided into 3 subsets. In each subset, 9 stimuli served as samples and 9 stimuli served as the array stimuli. Each sample was arbitrarily selected as the match for one of the array items. Each subset with in each Set was

assigned to one of the three experimental conditions. During a trial, the sample stimulus was placed in front of the student on a table or platform and a rectangular board with Velcro, which was used to display the choice stimuli, which were placed above where the sample stimulus was. The participants' highly preferred food items (see preference assessment below) were present as was a video camera, which was used to tape all sessions.

### **Measurement**

The experimenter used paper and pencil to record correct and incorrect responses. A correct response was defined as touching the sample stimulus and then touching the designating matching stimulus in the 3-member array. An incorrect response was defined as touching the sample stimulus and then touching anything but the matching stimulus in the 3-member choice array or no response. Every session included 9 trials. The total number of correct responses were divided by the total number of trials in a session and then multiplied by 100% to calculate the proportion of the session in which correct responding occurred.

### **Interobserver Agreement**

Using the videotapes recorded during the session, an independent observer scored responding for a minimum of 33% of sessions for each participant. Interobserver agreement (IOA) was calculated by dividing the number of intervals with agreements by the total number of intervals with agreements plus disagreements and multiplying by 100%. IOA scores for both Sets for all participants were an average of 99% (range, 89% to 100%). IOA for the sessions run with Brian and Dan averaged 99% (range, 89% to 100%). IOA was at 100% for the sessions run with Issah.

## Procedure

**Preference Assessment.** Prior to sessions, a paired stimulus preference assessment was completed for each participant (Fisher et al., 1992). The assessment consisted of 2 sessions during which 112 trials were presented (each session 2 food items were presented). The items were counterbalanced and each item was presented 14 times. On each trial, two small edible items were placed in front of the participant and he was told to pick one. Once the participant chose an item, the other item was removed. The participant then was given time to consume the selected item before the next trial was presented. During training, the food item identified as the most highly preferred item based on the preference assessment was used as a consequence for correct responses.

**Experimental Phase.** Following a baseline assessment, the effects of three different conditions, TAG Paired with Edible, Verbal Praise with Edible, and Edible Only, was compared in a multi-element design. Specific subsets of stimuli were associated with each condition and the conditions were counterbalanced across participants and stimuli. Table 1 presents the stimuli Sets, subsets, and conditions for each participant. Note that Stimulus Set 1 was used with Brian while Set 1a was used with Issah and Dan.

All conditions and the baseline assessment used the same trial format. At the beginning of each trial, a sample stimulus and 3 covered choice items were presented. Once the participant touched the sample, the choice items were revealed. A 3-step prompting hierarchy that included an immediate point prompt, a 2 second delay point prompt for step 2 and no prompt was used to train the responses. No correction procedure followed incorrect responses. A match between two stimuli (sample and its designated

choice) was considered to be mastered when independent correct responding occurred at 89% for 1 session.

The baseline assessment was taken to ensure that the participant could not match the stimuli prior to training. The trial format described above was used, however, neither prompts nor programmed consequences following responses were provided. In the TAG with Edible condition, the auditory stimulus, a click, was paired with an edible. Immediately following the correct response (prompted or unprompted), a TAG was sounded and a preferred edible delivered. In the Edible Only condition, the experimenter gave the participant his highly preferred edible following each correct response (prompted or unprompted). No other consequence was provided. In the third condition, Verbal Praise with Edible the experimenter said “nice job” when a prompted or unprompted correct response was made and gave the participant his highly preferred edible.

## **Results**

Figure 1 depicts the number of sessions each individual participant required to reach the mastery criterion for Set 1/1a. In the TAG Paired with Edible condition, Brain, Issah, and Dan took 7, 3, and 4 sessions, respectively. In comparison, they took 5, 3, and 4 sessions, respectively, in the Verbal Praise Paired with Edible condition, and 9, 8, and 6 sessions, respectively, in the Edible Only condition.

Figure 2 depicts the number of sessions the individual participants required to reach mastery criterion for Set 2. In the TAG Paired with Edible condition Brian, Issah, and Dan required 6, 8, and 15 sessions, respectively. However, in Verbal Praise Paired with Edible condition, the participants took 3, 11, and 10 sessions, respectively; to reach

criterion, while in the Edible Only condition they required 3, 7, and 14 sessions, respectively.

Table 2 shows the number of sessions each participant needed to meet mastery criterion by condition. In the TAG Paired with Edible condition, Brian met criterion with Set 1 stimuli in 7 sessions and in 6 sessions with Set 2 stimuli. For the combined Sets, Brian took an average of 6.5 sessions to reach mastery criterion. In the same condition, Issah took 3 sessions to reach criterion for Set 1a and 8 sessions for Set 2. His average number of sessions to meet criterion for both Sets was 5.5. The remaining participant, Dan, took 4 sessions to each criterion for Set 1a and 15 sessions for Set 2. For the combined Sets, he required an average of 9.5 sessions.

In the Verbal Praise Paired with Edible condition, Brian-reached mastery criterion in 5 and 3 sessions for Sets 1 and 2, respectively. His combined average for all Sets was 4 sessions. Issah took 3 and 8 sessions to master Sets 1a and 2, respectively. His average number of sessions for the combined Sets was 7. The remaining participant, Dan, required 4 and 10 sessions to reach criterion for Set 1a and 2, respectively. His combined average for both Sets was 7.

In the Edible Only condition, Brian, took 9 and 3 sessions to master Sets 1 and 2, respectively. He averaged 6 sessions to meet mastery criterion. Issah required 8 and 7 sessions to reach criterion for Sets 1a and 2, respectively. He averaged 7 sessions to reach master criteria for the combined Sets. Dan reached criterion in 6 and 14 Sets 1a and 2, respectively. His combined average was 10 sessions.

Figure 3 presents session-by-session data for Brian for Set 1. Brian achieved mastery criteria in the TAG Paired with Edible condition in 7 sessions. He acquired the

discrimination in the Verbal Praise Paired with Edible condition in 5 sessions and in the Edible Only condition in 9 sessions. Figure 4 depicts session-by-session data for Set 2. Brian acquired the discriminations in the TAG condition in 6 sessions. Brian acquired the stimuli and in 6 sessions in the Verbal Praise Paired with Edible condition. In the Edible Only condition, Brian acquired the discriminations in only 3 sessions.

Figure 5 depicts session-by-session data for Set 1a. In the TAG condition, Issah acquired the discriminations to mastery criteria in 8 sessions. In the Verbal Praise with Edible condition, Issah acquired the discriminations in 11 sessions. Issah took 7 sessions to achieve the master criterion in the Edible Only condition. Figure 6 displays the session-by-session data for Set 2. In the TAG Paired with Edible condition, Issah acquired the discrimination to mastery criteria in 3 sessions. He learned the discriminations in the Verbal Praise Paired with Edible condition in 3 sessions. Lastly, Issah acquired the discriminations in the Edible Only condition in 8 sessions.

Figure 7 presents Dan's Set 1a session-by-session data. Dan acquired the discriminations to mastery criteria in 15 sessions during the TAG Paired with Edible condition and in 10 sessions in the Verbal Praise Paired with Edible. In the Edible Only condition, Dan learned the discriminations in 14 sessions. Figure 8 depicts Dan's session-by-session data for Set 2. Dan acquired the discrimination to mastery criteria in the TAG with Edible condition in 4 sessions. In the Verbal Praise with Edible condition, he achieved mastery criterion in 4 conditions while in the Edible Only condition he required 6 sessions.

## **Discussion**

The combined results for all the participants indicated that their average rate of acquisition was fastest in Verbal Praise with Edible; in that condition they, averaged 6 sessions to meet mastery criteria. TAG with Edible was the next most efficient treatment, with an average of 7.17 sessions to meet mastery criteria. Least effective was the Edible Only condition, with an average of 7.83 sessions to meet mastery criteria. The outcomes, however, were participant specific.

For both Brian and Dan, acquisition was fastest in the Verbal Praise with Edible condition. On average, Brian met mastery criteria in the Verbal Praise with Edible condition in 4 sessions. Dan met mastery criteria in the Verbal Praise with Edible condition in an average of 7 sessions. Issah, however, acquired the discriminations fastest in the TAG with Edible condition. His average sessions to mastery criteria in that condition was 5.5 sessions. These results indicate that both the Verbal praise with Edible and the TAG with Edible were equally efficient methods of teaching arbitrary match to sample and more effective than Edible Only.

One limitation of this study was that the stimuli in Set 1 were different for Brian than those that were used for Issah and Dan. Because the difficulty of the stimuli used in the original Set 1 appeared to be unmatched when used with Brian. These stimuli were changed to match a Set that had an equal amount of difficulty. Additionally, Set 1 for Brian was trained first while Set 2 was trained second. Set 2 for Issah and Dan was trained first and Set 1a was trained second. Brian acquired the discriminations in Set 2 faster than Set 1. Issah and Dan acquired discriminations in Set 1a faster than Set 2. The order of the Sets may have affected the outcome of the rate of acquisition.

In the future studies should be extended using more participants, in order to determine whether one teaching method is definitively better than the others. In the future studies could also be extended to other acquisition tasks such as task analysis and self-help skills rather than just arbitrary matching-to-sample.

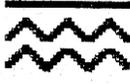
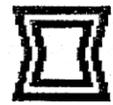
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Set number		A	B	C
1 Set 1	Array		$\neq$	
	Sample			
2 Set 1	Array			
	Sample			
3 Set 1	Array			
	Sample			
4 Set 2	Array			
	Sample			
5 Set 2	Array	$\pm$	$\infty$	
	Sample			$\Sigma$
6 Set 2	Array			$\Phi$
	Sample			

Appendix A. These are the arbitrary stimuli used in set 1 and set 2.

Set number		A	B	C
1 Set 1a	Array			
	Sample			
2 Set 1a	Array			
	Sample			
3 Set 1a	Array			
	Sample			

Appendix B. These are the arbitrary stimuli used in set 1 a.

	Set 1.1/1a.1	Set 1.2/1a.2	Set 1.3/1a.3	Set 2.1	Set 2.2	Set 2.3
Brian	TAG Paired with Edible	Verbal Praise Paired with Edible	Edible Only	TAG Paired with Edible	Verbal Praise Paired with Edible	Edible Only
Issah	Edible Only	TAG Paired with Edible	Verbal Praise Paired with Edible	Verbal Praise Paired with Edible	Edible Only	TAG Paired with Edible
Dan	Verbal Praise Paired with Edible	Edible Only	TAG Paired with Edible	Edible Only	TAG Paired with Edible	Verbal Praise Paired with Edible

*Table 1.* The stimulus set and condition for each participant.

<u>Participant + Stimuli</u>	<u>Condition</u>		
	<u>TAG + Edible</u>	<u>Verbal Praise + Edible</u>	<u>Edible Alone</u>
Brian set 1	7	<b>5</b>	9
Brian set 2	6	<b>3</b>	<b>3</b>
Brian average:	6.5	<b>4</b>	6
Issah set 1a	<b>3</b>	<b>3</b>	8
Issah set 2	8	11	<b>7</b>
Issah average:	5.5	7	7.5
Dan set 1a	<b>4</b>	<b>4</b>	6
Dan set 2	15	<b>10</b>	14
Dan average:	9.5	<b>7</b>	10
All participants average:	7.17	6	7.83

*Table 2.* Number of sessions to meet mastery criteria for each participant and each condition. The condition that required the fewest sessions to meet mastery criterion are in bold.

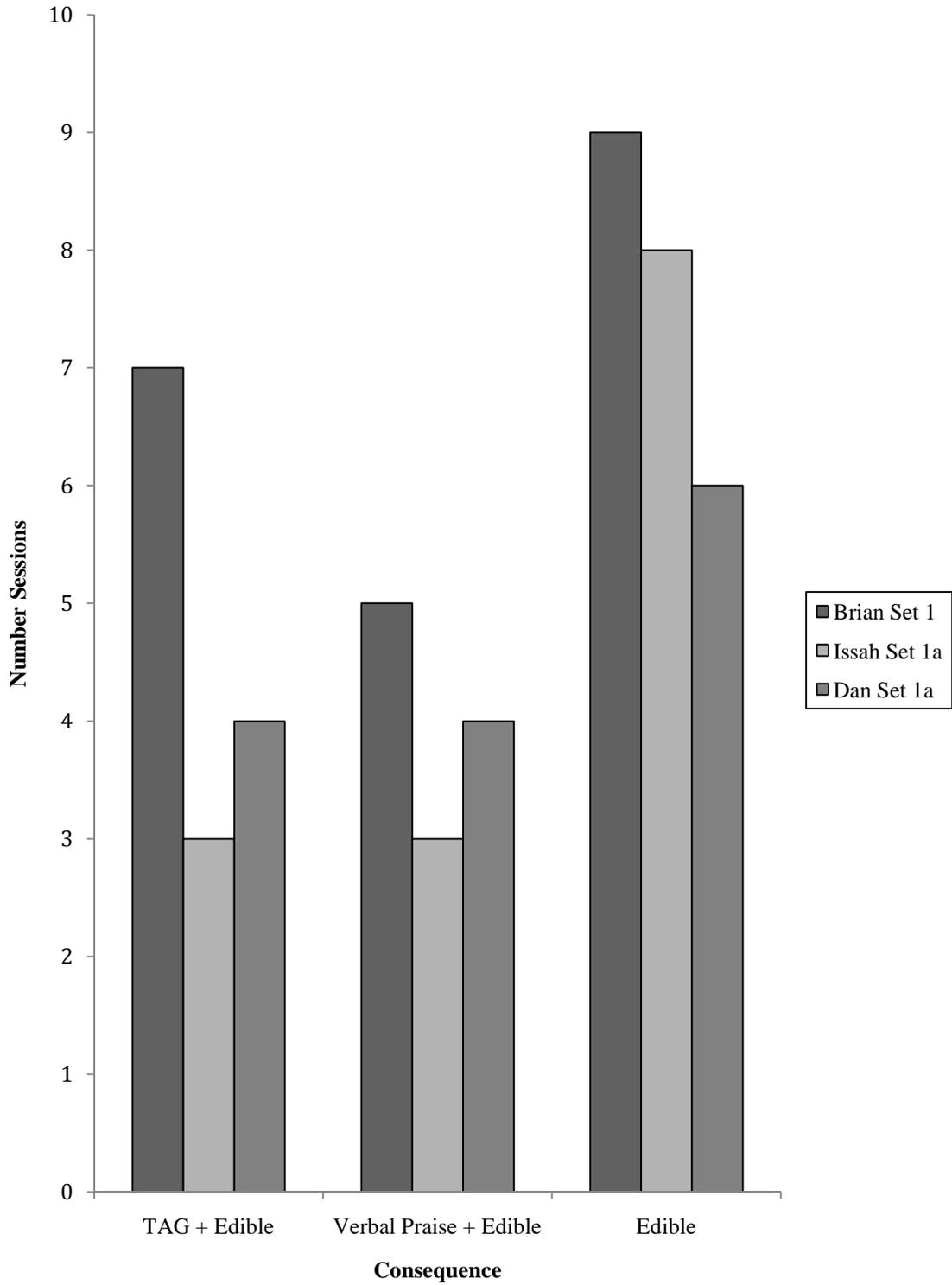


Figure 1. Total number of sessions to reach mastery criteria for each participant in set 1 for Brian and set 1a for Issah and Dan.

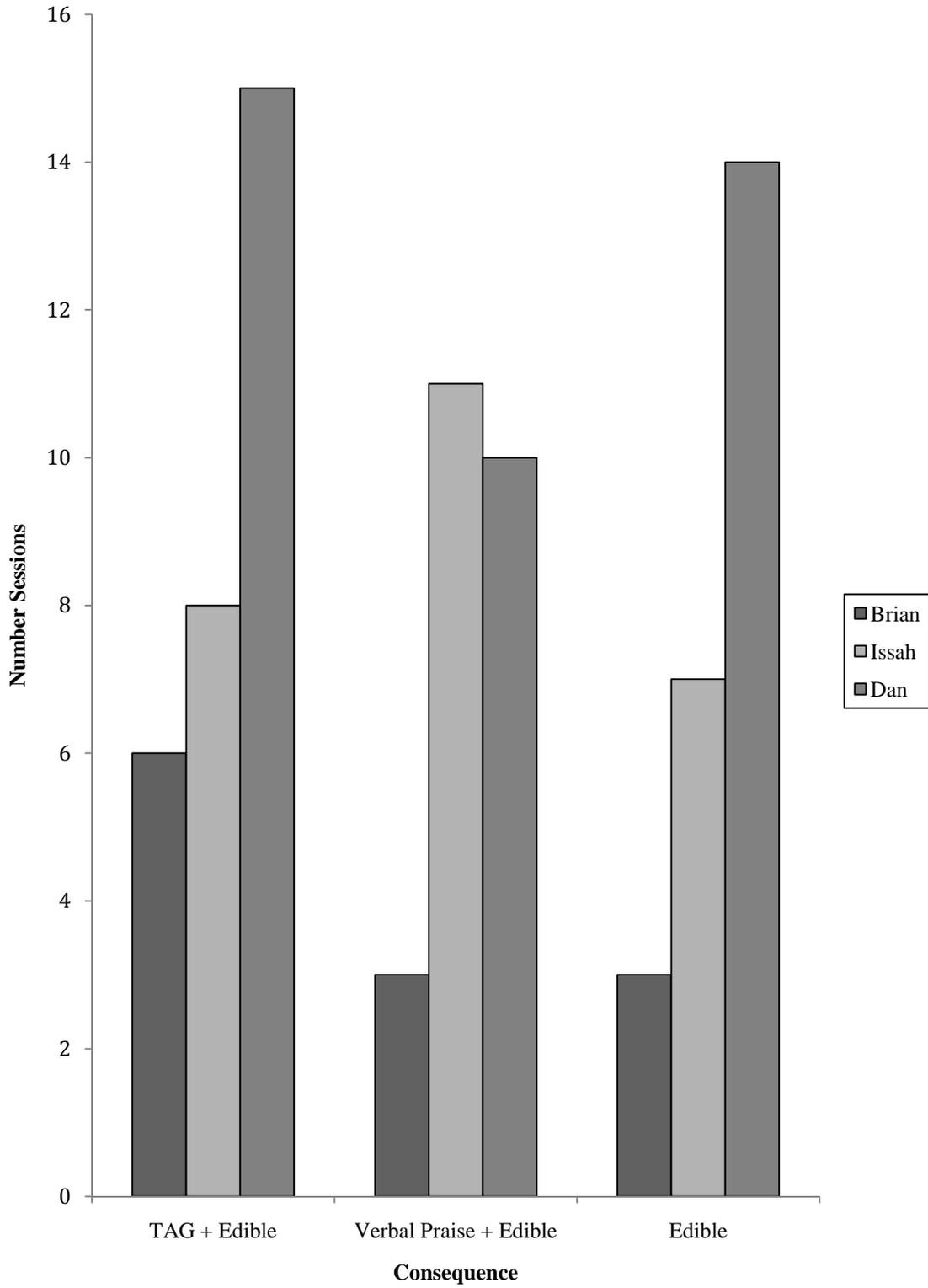


Figure 2. Total number of sessions to reach mastery criteria for each participant in set 2.

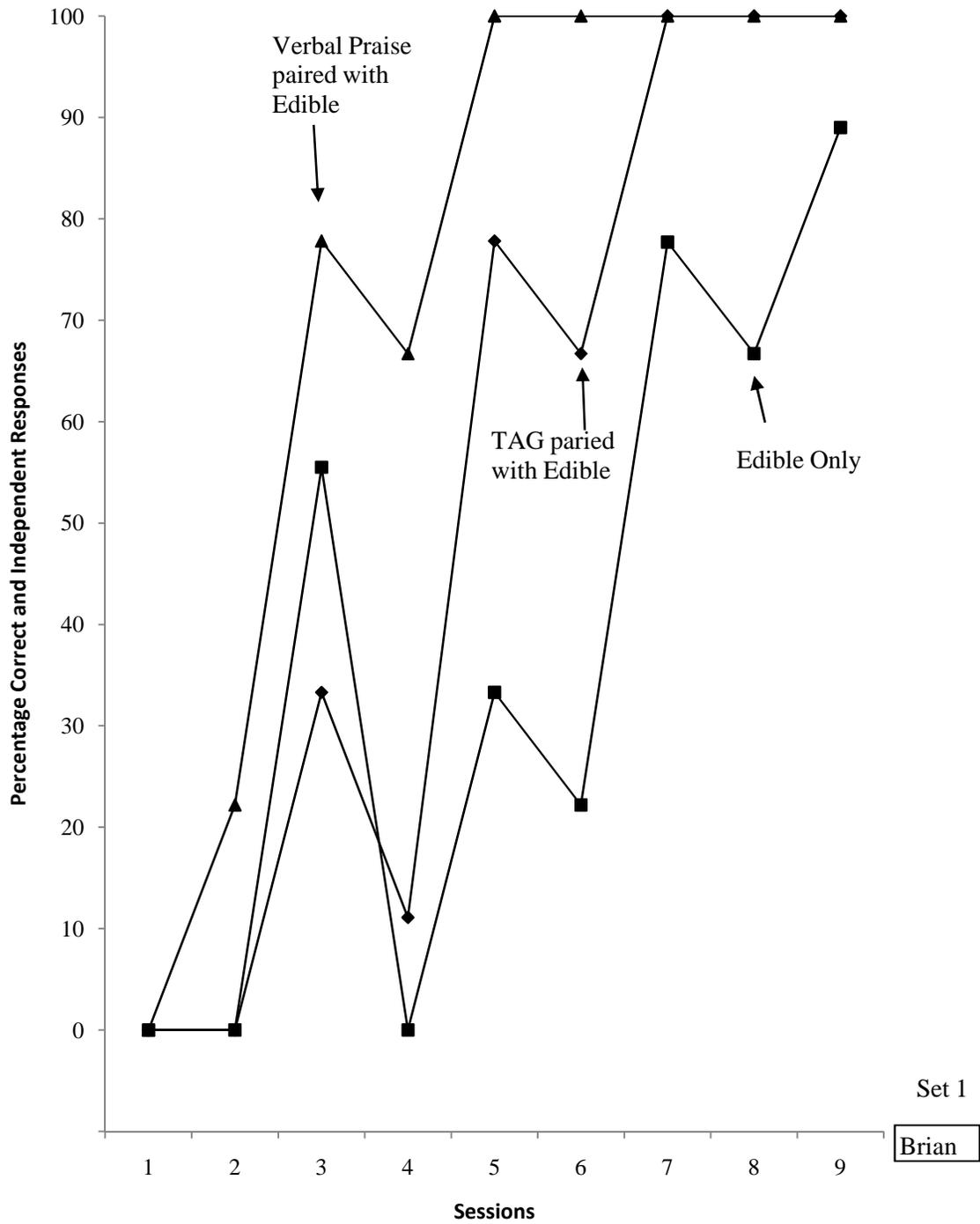


Figure 3. Graph of session-by-session data for Brian for set 1.

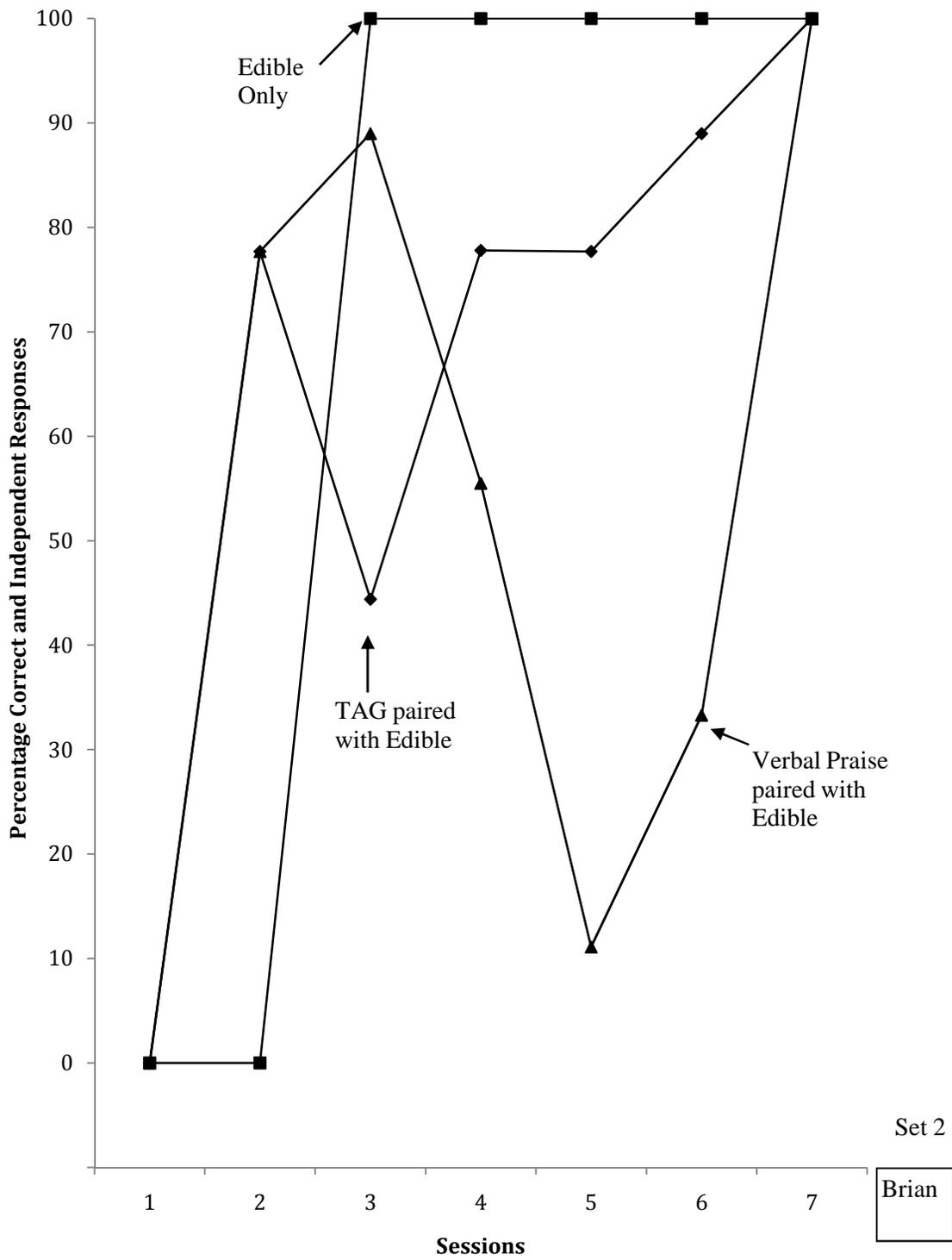


Figure 4. Graph of session-by-session data for Brian for set 2.

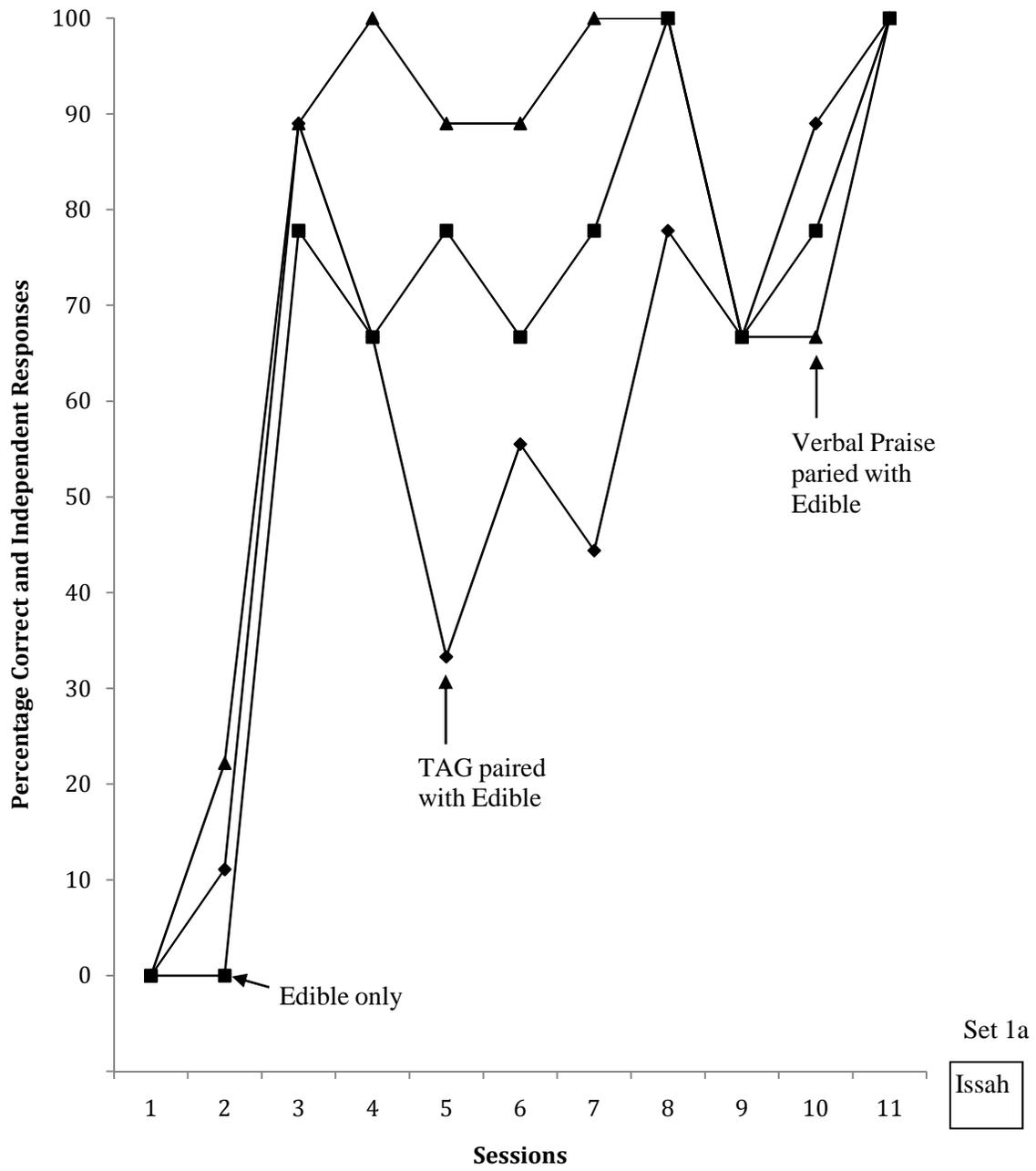


Figure 5. Graph of session-by-session data for Issah for set 1a.

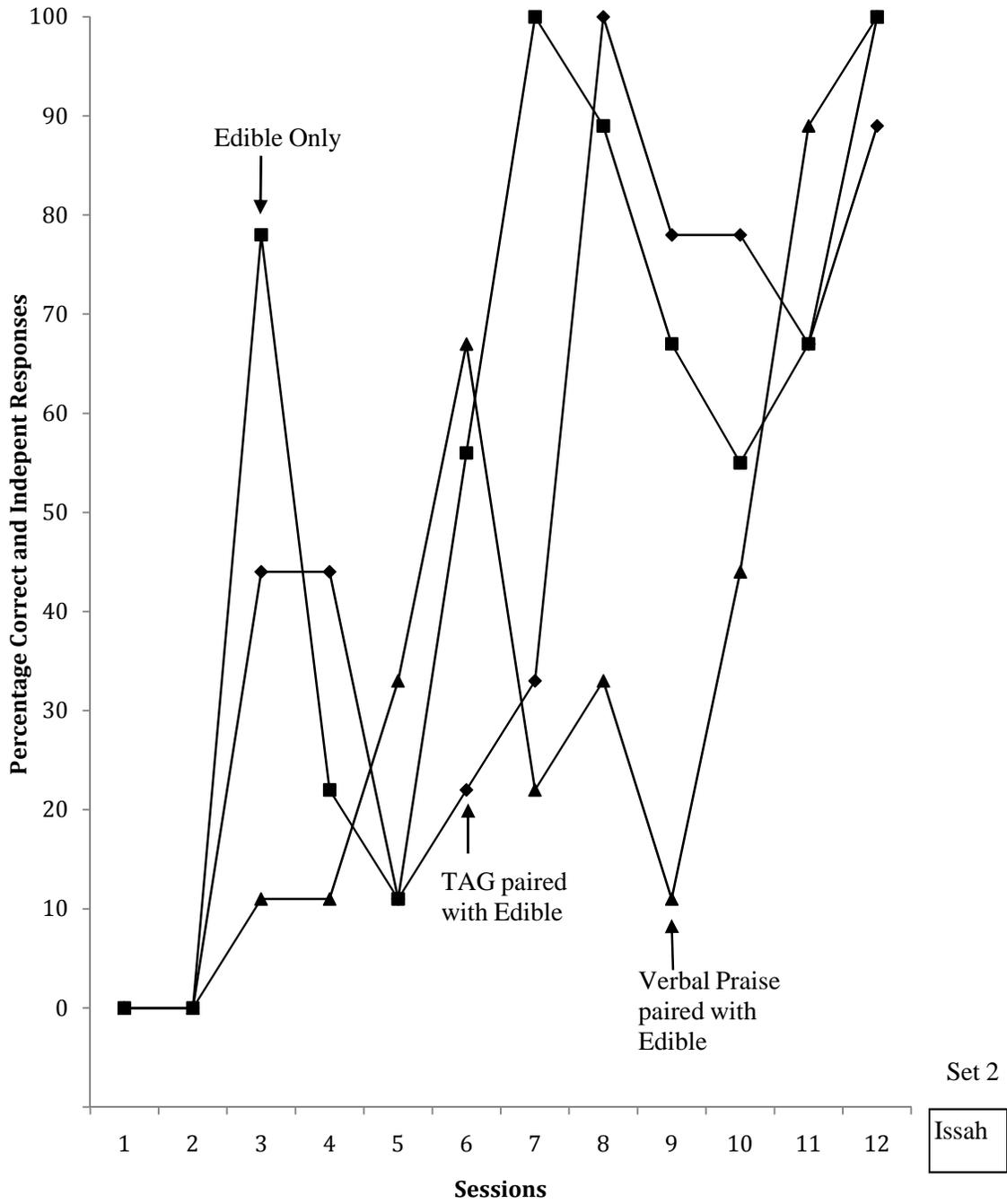


Figure 6. Graph of session-by-session data for Issah for set 2.

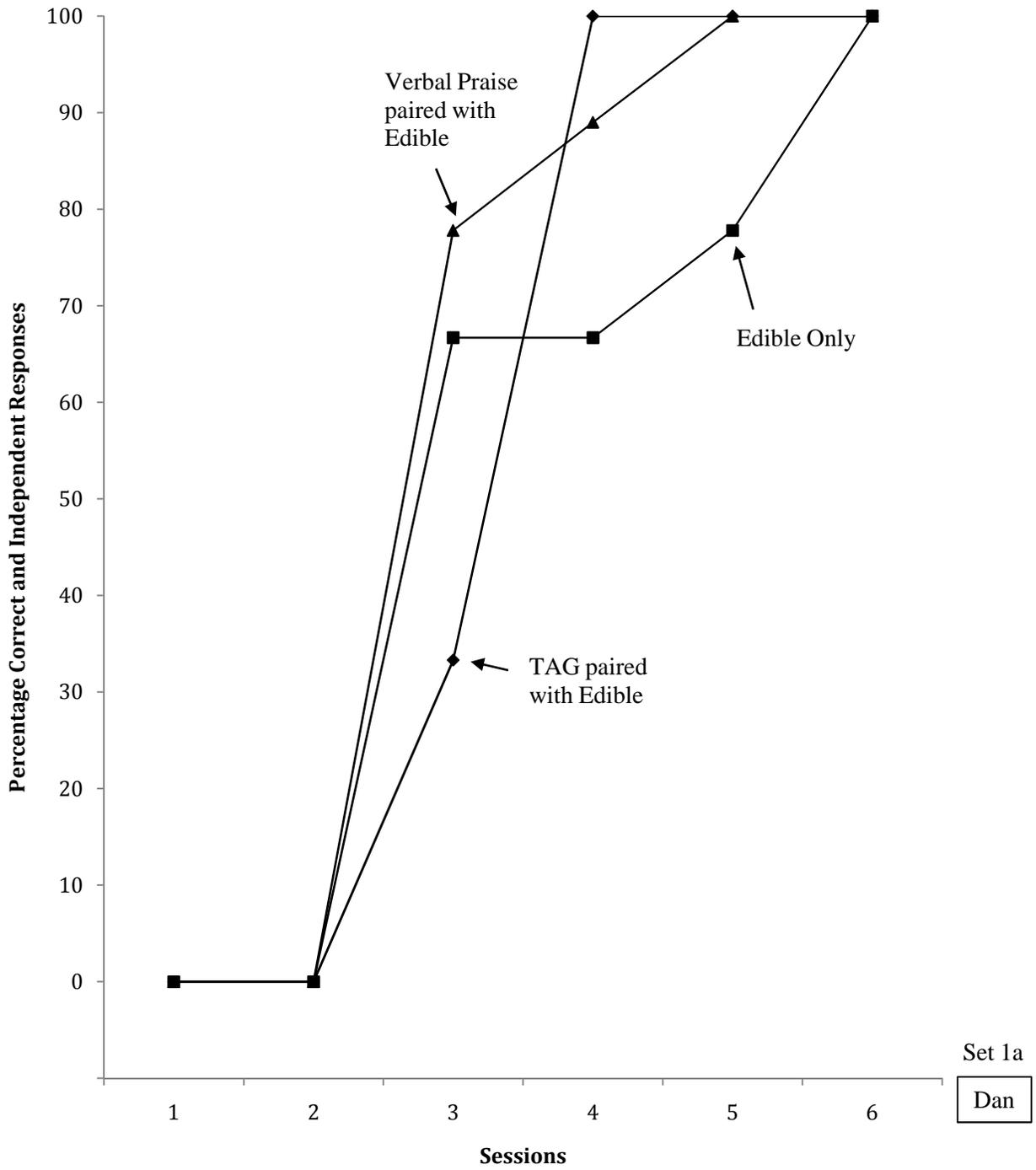


Figure 7. Graph of session-by-session data for Dan for set 1a.

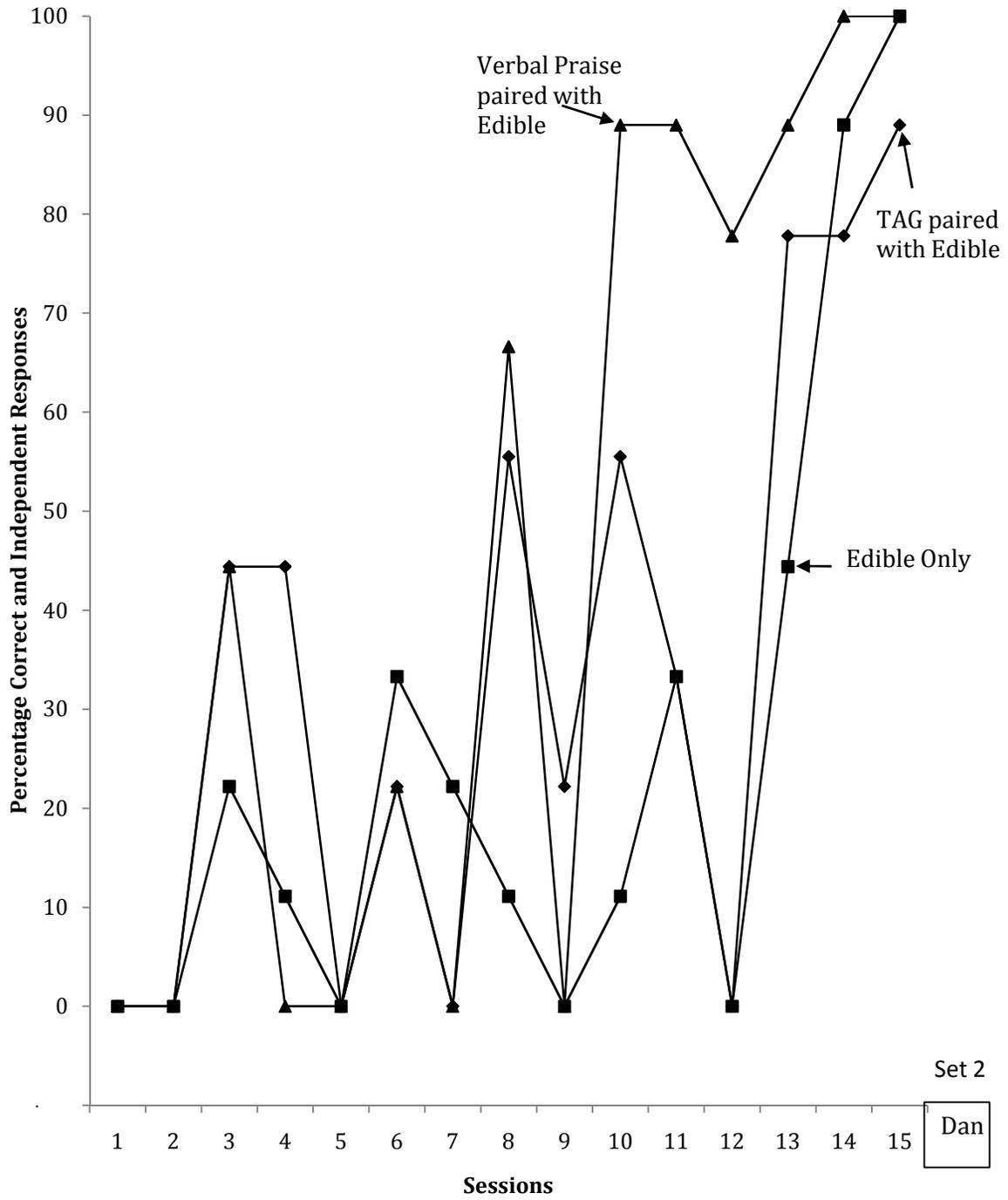


Figure 8. Graph of session-by-session data for Dan for set 2.