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Teaching Auditory-Auditory Identity Matching to Persons with Intellectual Disabilities and Children with Autism: A Pilot Study

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Abstract

The Assessment of Basic Learning Abilities (ABLA) assesses the ease or difficulty with which persons with intellectual disabilities (ID) and children with autism are able to learn a simple imitation and five two-choice discriminations that are hierarchical in difficulty. ABLA Level 6 is a two-choice auditory discrimination. An auditory-auditory identity matching prototype task (AAIM PT) assesses a testee's ability to identify matching sounds. Published research indicates that the AAIM PT is more difficult than ABLA Level 6, and pass/fail performance on ABLA Level 6 and the AAIM PT are predictive of the ease or difficulty with which persons with ID and children with autism are able to learn certain language tasks. It is quite possible that the AAIM PT might be considered as ABLA Level 7. In order to determine if the skills needed to pass AAIM PT are precursors for vocal imitation, a method to teach AAIM must be developed. We therefore developed an experimental procedure for teaching AAIM tasks. In a single-subject AB design with replication within and across one person with ID and two children with autism, all three participants learned two AAIM tasks, and two participants generalized to a third AAIM task. The encouraging results provide a promising starting point for future research on teaching AAIM tasks to persons with ID and children with autism.

Some individuals with intellectual disabilities (ID) are able to learn various tasks relatively quickly but have great difficulty learning seemingly similar tasks. For example, a person with moderate ID might easily learn to return knives, forks, and spoons to their appropriate place in a utensil drawer in a kitchen, but have great difficulty learning to respond appropriately when someone asks, "Give me a fork." In an attempt to explain this finding, Kerr, Meyerson, and Flora (1977) developed the Assessment of Basic Learning Abilities (ABLA) to assess the ease or difficulty with which a testee might learn the types of discriminations needed to perform various tasks.

The ABLA takes approximately 30 minutes to administer and is comprised of six training tasks, which are referred to as levels (see Table 1). The tester attempts to teach each level to a testee, one level at a time, using a standardized set of prompting and reinforcement procedures, until a pass or fail criterion is met, whichever comes first (Martin & Yu, 2000).

*Table 1. A Description of the ABLA Levels, Discriminations Required, and Sample Everyday Behaviours Requiring the Discriminations**

ABLA Levels	*Discriminations*	*Sample Behaviours*
Level 1: Imitation. A tester puts an object into a container and asks the testee to do likewise.	A simple imitation	Children playing Follow-the-Leader
Level 2. Position Discrimination. When a red box and a yellow can are presented in a fixed position, a testee is required to consistently place a piece of white foam in the container on the left when the tester says, "Put it in."	A simultaneous visual discrimination with position, color, shape and size as relevant visual cues	Turning on the cold (vs the hot) water tap
Level 3. Visual Discrimination. When a red box and a yellow can are randomly presented in left-right positions, a testee is required to consistently place a piece of white foam in the yellow can when the tester says, "Put it in."	A simultaneous visual discrimination with color, shape and size as relevant visual cues	Locating one's coat from among other coats hung in a closet, with the coats in no fixed position
Level 4: Match-to-Sample. When a yellow can and a red box are presented in random left-right positions and a testee is presented with a yellow cylinder or a red cube, he/she consistently places the cylinder in the yellow can and the cube in the red box.	A conditional visual-visual quasi-identity discrimination with color, shape and size as relevant visual cues	Sorting socks into pairs
Level 5: Auditory Discrimination. When presented with a yellow can and a red box (in fixed positions), a testee is required to consistently place a piece of white foam in the appropriate container when the tester randomly says, "red box" (in a high-pitched rapid fashion) or "yellow can" (in a low-pitched drawn-out fashion).	A conditional auditory-visual nonidentity discrimination, with pitch, pronunciation, and duration as relevant auditory cues, and with position, color, shape and size as relevant visual cues	Responding to instructions to go left or right, to go to different rooms, or to open different drawers
Level 6: Auditory-Visual Combined Discrimination. This is the same as Level 5 except that the left-right position of the containers is randomly alternated.	A conditional auditory-visual nonidentity discrimination, with the same auditory cues as Level 5, and with only color, shape and size as relevant visual cues	Responding appropriately to requests such as "pass the salt" vs. "pass the pepper" when the salt and pepper shakers are in different places on the table from meal to meal

** Reprinted with permission from Martin and Yu (2000).*

Research on the ABLA with persons with ID has indicated that: (1) the six levels are ordered in difficulty with Level 1 being the least difficult and Level 6 being the most difficult (Kerr et al., 1977; Martin, Yu, Quinn, & Patterson, 1983); (2) the ABLA has good inter-tester and test-retest reliability (Martin et al., 1983); (3) a testee's pass/fail performance on the ABLA has good predictive validity for the ease or difficulty that the testee will experience while learning a vari-

ety of training tasks (Martin, Thorsteinsson, Yu, Martin, & Vause, 2008); (4) a testee's pass/fail performance on the ABLA more accurately predicts learning performance on various training tasks than experienced staff with direct knowledge of the testee (Stubbings & Martin, 1998; Thorsteinsson et al., 2007). Research suggests that these generalizations also hold for children with autism (Murphy, Martin, & Yu, in press; Schwartzman et al., 2009; Viel et al., 2011; Ward & Yu, 2000).

The auditory-auditory identity matching prototype task (AAIM PT) assesses a testee's ability to identify matching sounds. Research indicates that the AAIM PT is more difficult than ABLA Level 6 (Harapiak, Martin, & Yu, 1999); hence it could be considered as a possible ABLA Level 7. Research also indicates that the pass/fail performance of participants with ID on the AAIM PT is correlated with various measures of their language ability (Marion et al., 2003). Considering that the ability to recognize that two sounds are the same is a component of vocal imitation, and that the teaching of vocal imitation is an important part of language training programs for person with ID and children with autism, it may be that the skills needed to pass the AAIM PT are precursors for vocal imitation. Before assessing that possibility, a method to teach AAIM must be developed. Thus far we have encountered no published research that has evaluated a procedure to teach AAIM tasks to persons with ID or children with autism. In this paper we describe a pilot study that accomplished that task.

The ABLA Testing Procedure

The testee is typically seated at a table across from and facing the tester. Each ABLA level is tested in sequence. The testing of a level is introduced with a demonstration trial, a guided trial, and a practice trial at that level. Testing trials of a level occur only after the testee makes an independent correct response on the practice trial. On test trials for a level, correct responses are reinforced with praise and an edible, and incorrect responses are followed by an error correction procedure that consists of a demonstration trial, a guided trial, and a practice trial. Testing of a level continues until the testee makes eight consecutive correct responses (which defines a pass on that level), not including correct responses on practice trials during the error correction procedure, or until the testee makes eight cumulative errors (which defines a fail on that level).

For example, consider Level 6 as illustrated in Table 1. On the demonstration trial, while holding the foam, the tester would say, "red box," and then demonstrate placement of the foam into the red box. Then, on the guided trial, the tester would repeat the instruction, give the foam to the testee, and guide the testee to make the correct response. Finally, on the practice trial, the instruction and the foam would be given to the testee who would be allowed a chance to respond independently. If the testee responded correctly, then the tester would provide praise, and then repeat the demonstration trial, guided trial, and practice trial while saying, "yellow can." Once the testee has achieved a correct independent response on both "red box" and "yellow can," then test trials would begin and would continue until the pass or fail criterion was met.

Auditory-Auditory Identity Matching (AAIM)

As stated previously, AAIM refers to a person's ability to identify matching sounds. When assessing the AAIM PT (Harapiak et al., 1999), a testee sits across from the tester and two assistants (sitting on either side of the tester) facing the testee. The ABLA testing procedures are used to assess this task. On test trials the tester provides a sample sound. The tester says, "Pen-pen," quickly in a high-pitched tone on some trials, and, "Block," slowly in a low-pitched tone on other trials. After the tester has provided a sample sound, one assistant provides the matching sound while the other provides the non-matching sound. The assistant who emits the matching sound and the order in which the two assistants emit the sounds are randomized across trials. The testee must learn to point to the assistant who provided the comparison sound that matched the sample sound presented by the tester. Testing continues until the ABLA pass or fail criterion is met, whichever comes first.

For persons with ID the AAIM PT is: (1) more difficult than ABLA Level 6, (2) has good test-retest reliability, and (3) has good predictive valid-

ity for similar auditory matching tasks. Research has indicated that the pass/fail performance on Level 6 of the ABLA has been correlated with measures of expressive and receptive language with typically developing children (Casey & Kerr, 1977), and persons with ID (Barker-Collo, Jamieson, & Boo, 1995; Richards, Williams, & Follette, 2002), and with children with autism (Schwartzman et al., 2009; Viel et al., 2011). Research also indicates that, with persons with ID, the ABLA with the addition of the AAIM PT is more strongly correlated with language performance than just the ABLA alone (Harapiak et al., 1999; Marion et al., 2003; Vause, Harapiak, Martin, & Yu, 2003; Vause, Martin, & Yu, 2000).

As stated previously, it may be that the ability to perform an AAIM discrimination may make it easier to teach vocal imitation to persons with ID and children with autism. Before evaluating that possibility, it is important to develop a procedure to teach AAIM to persons with ID and children with autism who fail the AAIM PT. In an initial exploratory study, the first author examined two fading procedures for teaching AAIM tasks to three participants with ID and two children with autism (Salem, 2012). In both procedures, instead of two assistants speaking the non-matching and matching words (as is done with the AAIM PT), the words were presented through computer speakers. The trainer and a participant sat opposite each other at a small table with the two computer speakers placed on the table, equidistant from and within easy reach of the participant. In one experimental condition (volume fading), on initial trials, the trainer randomly said one of the words, the matching word was randomly presented though one of the speakers at full volume, the non-matching word was presented through the other speaker at zero volume, and the participant was prompted to point to the speaker from which came the matching word. When the participant would reliably do so without prompts, then across trials the volume of the non-matching word was gradually increased. In the other experimental condition (pointing fading), on initial trials, the trainer randomly said one of the words, the matching word was randomly presented through a computer speaker while the trainer pointed to that speaker, the non-matching word was presented through the other speaker, and the participant was guided to point to the speaker that the trainer pointed to. When the participant would reliably imitate the pointing prompt of the trainer without guidance, then across trials, the pointing prompt was gradually removed by increasing the distance between the trainer's pointing finger and the correct speaker until the finger was finally placed equidistant between the two speakers. In both conditions, a guided trial was given with each word at the beginning of every session, correct responses were reinforced, and incorrect responses were followed by a brief time-out. In that initial study, one adult with ID mastered two AAIM training tasks with volume fading but did not learn an AAIM task with pointing fading, and the other four participants were unable to learn an AAIM training task with either procedure after 200 training trials per procedure (Salem, 2012).

We next examined a procedure for teaching AAIM in which the participant was actively involved in producing the sample sound and comparison sounds (by squeezing sound sacs), and then placing the two sound sacs that produced the matching sounds into a toy airplane, the operation of which we assumed was a natural reinforcer. We examined this procedure with the two children with autism and one of the adults with ID who participated in the initial exploratory study. The results of this second pilot study, which we will refer to as the toy-airplane study, were very positive, and we describe the details of that study in this paper.

Method

Participants and Setting

The protocol for this research was approved by the University of Manitoba Psychology/ Sociology Research Ethics Board, and the St.Amant Decision of Research Access Committee, and permission was received in writing to have the results for each participant and the particulars listed below published. Two children with autism spectrum disorder (P1 and P2) were recruited from the St. Amant Autism Program, which serves children with autism spectrum disorder in Manitoba. Both of these children were male and were 6 and 10 years of age. Sessions with these children were conducted at their homes, according to parental preference.

One participant (P3) with ID was recruited from St.Amant, a residential and community resource facility devoted to helping and supporting persons with ID in Winnipeg, Manitoba. P3 was female and was 25 years of age. According to her health records, P3's level of ID was in the moderate range. Sessions for P3 were conducted in a quiet assessment room equipped with a table and several chairs.

All three participants participated in the initial exploratory study on volume fading and pointing fading described previously. At the beginning of the toy-airplane study all three participants passed ABLA Level 6 (assessed as described previously), failed the AAIM PT (assessed as described previously), and failed the Airplane Task with AAIM Sounds (assessed as described later for Phase 1, Baseline).

During all sessions, participants were seated at a table across from the trainer. If an assistant was present he/she was seated near the participant and was oriented in such a way so as to be able to see both trainer and participant responses without being able to see what the trainer recorded.

Materials

Materials required for ABLA Level 6 included a yellow can, a red box with black diagonal stripes, and an irregular shaped piece of white foam.

A recording device, Build-A-Sound®, was used to record and produce sounds. This device was approximately 2.5 cm in diameter and a recording could be played back as many times as needed by pressing a button located in the center of the device.

After the appropriate sounds were recorded, the recording devices were covered in cotton stuffing and sewn within a black or white fleece sack. This was done to help protect the devices from rough use, reduce the likelihood that the sound would be recorded over, and help color code the containers of the sounds for use within the study. A fleece sack with a recording device in it will be referred to as a sound sack.

A small Wiggles® airplane was used as a receptacle for the sound sacks (see Figures 1 and 2). The airplane had two indentations on its dorsal side, each of which was large enough to hold one sound sack. The plane had a spinning propeller, a pull cord, and three wheels. If the cord was pulled and released, then the plane would vibrate and the propeller would spin.

The caregivers for each participant were interviewed to determine possible edible reinforcers to use in the study. At the beginning of each assessment or training session a participant was presented with six different edibles (for example, chips, chocolate, Jell-O, gummy bears, and Cheetos) and then asked to, "Pick one." The edible chosen by the participant was then presented following each correct response during that session. Other reinforcers from the remaining five were added within a session if the participant requested them.

Research Design

A single-subject AB design with replication within and across three participants was used. (The AB design is a two phase design consisting of a no-intervention baseline phase (A) and an intervention phase (B). It allows for evaluation of pre-intervention and intervention problem status.) P1 and P2 were taught first, and they both experienced the seven phases described below. When P3 was taught, she was given a modified set of phases (described later) based on the results with P1 and P2.

Phase 1, Baseline of Airplane Task with "Tugboat" and "Telephone" Sounds

The Baseline Phase was conducted with the apparatus shown in Figure 1. On each trial, the participant was presented with a sample sound sack and given the instruction, "Make it sound." After the participant activated the sound sack (either the tugboat whistle or the telephone ring would play) by squeezing it, then the airplane was presented and the participant was instructed to place the sound sack into the airplane (the trainer tapped the airplane and physically guided the participant to place it into the airplane if needed). Two comparison sound sacks that were the same colour as the sample (both black or both white) were then presented to the participant and the participant was instructed to "find the same." One comparison sound sack would play the same sound as the sample, and

the other comparison sound sack would play a sound different from the sample. The left-right position of the correct comparison sound sack was randomly alternated across trials.

The participant was required to pick up each comparison, activate it one or more times, and then either place it into the airplane (if the sound matched the sample) or put it down (if the sound didn't match the sample). Each time the participant activated a comparison sound sack, the trainer would activate the sample sound sack. A correct response was defined as the participant placing the comparison sound sack that matched the sample sound sack into the airplane after activating it.

After activating a comparison sound sack, if it was the correct sound sack and if the participant put the correct sound sack into the airplane, then he/she was allowed to pull the airplane's cord (which made it vibrate and spin its propeller). He/she was also given an edible and praised.

Figure 1. Baseline phase materials

After activating the incorrect comparison sound sack, if the participant attempted to put it into the airplane the trainer would immediately cover the receptacle to block the response, and remove the airplane and sound sacks from the table while saying, "That's not the same." The trainer did not speak to or look at the participant for 8–10 seconds following this statement.

If the participant attempted to place both of the comparison sound sacks into the airplane simultaneously the trainer would remove the airplane and all the sound sacks. The airplane (with the sample inside it) and both of the comparison sound sacks (outside of the airplane) would be returned and the participant was instructed to, "Pick one." If the participant attempted to place both comparison sound sacks into the airplane again, all the materials were removed and the trial was repeated.

At the beginning of the baseline assessment, a demonstration trial, a guidance trial, and an opportunity for an independent response were conducted for each sound being trained.

Test trials in the Baseline Phase continued until a participant met a pass criterion of eight consecutive correct responses, or a failure criterion of eight cumulative errors.

Phase 2, Teaching Airplane Task with "Tugboat" and "Telephone" Sounds

Visual matching. The teaching of the Airplane Task with sounds began with a visual matching phase using the apparatus shown in Figure 2. On some trials, the sample phone ring was presented in a white sound sack, the matching phone ring was in another white sound sack, and the non-matching tugboat whistle was in a black sound sack. On other trials, a sample tugboat whistle was presented in a black sound sack, the matching tugboat whistle was presented in another black sound sack and the non-matching phone ring was presented in a white sound sack. The participant could respond by matching either based on the colour of the sound sacks or the sounds they made. The procedure for this phase was the same as Phase 1 except that matching based on color was possible in Phase 2. We expected that the participants should be able to complete a matching task based on color

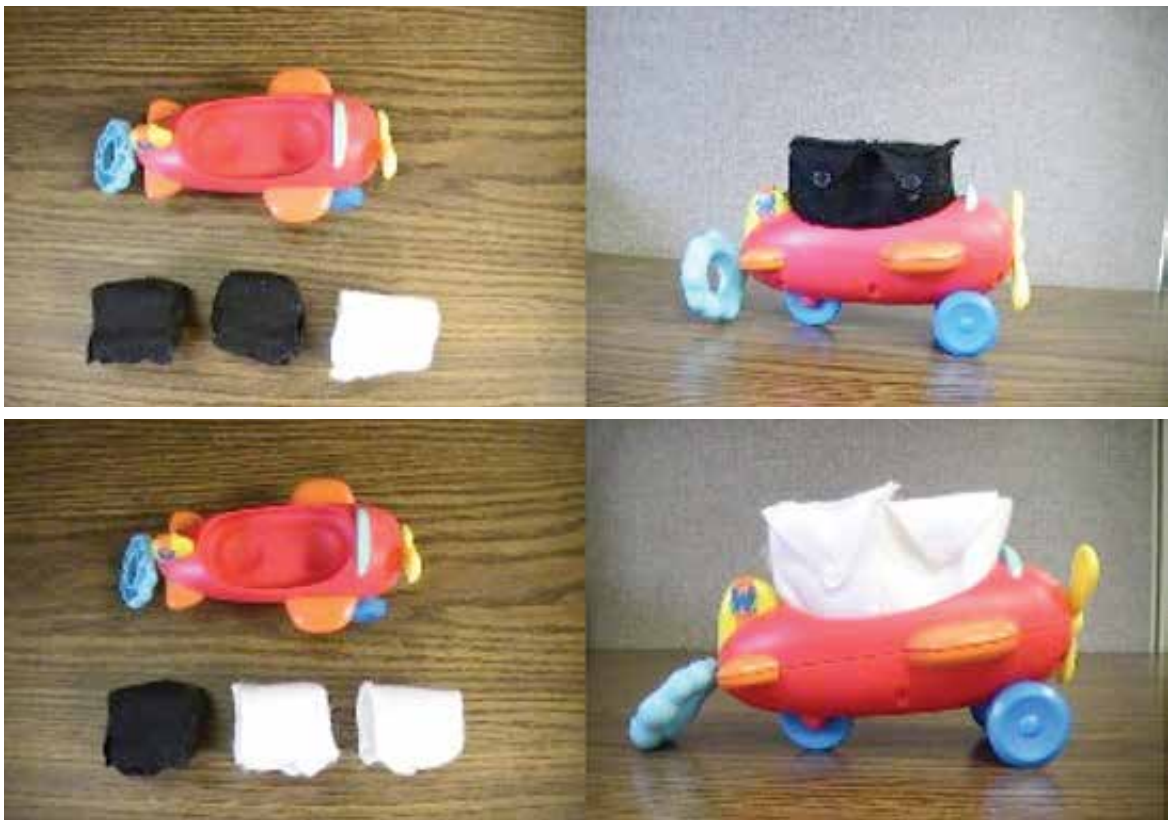

Figure 2. Experiment 2 materials for visual matching

given that they all had passed ABLA Level 4. Therefore, this phase was included to teach the participants what to do with the task materials (e.g., how to activate the sounds, where to place the sound sacks, how to operate the plane). Training in Phase 2 continued until the participant met a pass criterion of eight consecutive correct responses.

Auditory matching. This part of training began after a participant met the mastery criterion for visual matching. During auditory matching training, a participant was taught to match two tugboat whistle sounds, and two phone ringer sounds, with all sounds coming from black sound sacks.

The procedures used to teach auditory matching were the same as those described for the Baseline Phase. The mastery criterion for auditory matching was set at eight correct responses out of ten trials in one session.

Phase 3, Post-Phase 2 Assessments

Following Phase 2, participants were assessed on the AAIM PT using the procedure that was previously described. They were also tested on a modified AAIM PT called AAIM PT with sound sacks. In this assessment the words were presented with sound sacks, rather than being spoken by the trainer and assistants. That is, the words "Pen-pen" and "Block" were each recorded in separate sound sacks. The procedure for testing the AAIM PT with sound sacks was the same as AAIM PT except that, instead of saying, "Pen-pen," or saying, "Block," the trainer and the assistants produced the sample and comparison words by squeezing the corresponding sound sacks, all of which were black in colour.

Phase 4, Teaching Airplane Task with PT Words

The participants were taught the airplane task using the same procedures as those described in Phase 2, under the subheading "Auditory

matching," except that instead of the sound sacks emitting the tugboat whistle and the phone ring when squeezed, they emitted the spoken word "Pen-pen" (said at a high pitch rapidly) and "Block" (said at a low pitch slowly).

Phase 5, Post-Phase 4 Assessments

Following mastery of Phase 4 the participants were assessed on the AAIM PT and the AAIM PT with sound sacks as described for Phase 3. They were also given an auditory matching assessment with different words. The procedure for the generalization assessment was the same as that described for Phase 1 except that the sound sacks emitted the words "Cat-cat" said quickly and in a high pitched tone of voice and "Dog" said slowly and in a low pitched tone of voice.

Phase 6, Repeat of Phase 4 with Stronger Mastery Criterion

After reaching the mastery criterion in Phase 4, the participants failed the Post-Training assessments conducted in Phase 5. On the possibility that the mastery criterion might have been met by chance in Phase 4, Phase 6 was a repeat of Phase 4 but with a more stringent mastery criterion. Specifically, in Phase 6, the participants were re-taught the task from Phase 4 until they correctly responded for at least 80% of the trials within a session for two consecutive sessions, with each session consisting of 20 trials.

Phase 7, Final Assessments

In this phase we repeated the three assessments that had been previously conducted in *Phase 5.*

Inter-Observer Reliability and Procedural Integrity

Inter-observer reliability checks were conducted for 70% of the sessions and procedural integrity checks were conducted for 66% of the sessions, using the same procedures described for Experiment 1. The average percent agreement score per session across all participants was 99%, ranging from 89% to 100%, and the experimenter carried out the procedures correctly at 100% accuracy during all checks.

Results

Participant 1

Phase 1, Baseline of Airplane Task with "Tugboat" and "Telephone" Sounds. P1 failed the assessment of the Airplane Task with Sounds in 22 trials.

Phase 2, Teaching Airplane Task with "Tugboat" and "Telephone" Sounds. P1 mastered the visual matching part of training in 91 trials. P1 met the mastery criterion (eight correct responses in ten trials) for the auditory matching part of training in 18 trials within the first session (see Figure 3).

Phase 3, Post-Phase 2 Assessments. P1 failed both the AAIM PT and the AAIM PT with sound sacks. He responded correctly on 47% of the trials for AAIM PT and 56% of the trials for AAIM PT with sound sacks.

Phase 4, Teaching Airplane Task with PT Words. P1 mastered the Airplane Task with PT words in 97 trials over four sessions (see Figure 3).

Phase 5, Post-Phase 4 Assessments. In this phase, P1: (1) failed the AAIM PT with 50% correct responses; (3) failed the AAIM PT with sound sacks with 40% correct responses; and (3) failed the Auditory Matching Generalization Assessment with 60% correct responses.

Phase 6, Repeat of Phase 4 with a Stronger Mastery Criterion. P1 re-mastered the Airplane Task with PT words in nine sessions (180 trials). He responded at chance levels of accuracy for the first 100 trials. At this point it was noted that P1 had chosen the sound sack on the right only ten times, and had a strong tendency to choose the left sound sack over the right. A priming task was added at the beginning of each subsequent session in order to increase his tendency to choose the sound sack on the right as well as the sound sack on the left.

In the priming task, P1 was presented with two of the sound sacks, one that played "Pen-pen" and one that played "Block." The sound sacks were presented in random left-right positions. The trainer instructed P1 to, "Give it to me," and held her hand out. P1 was reinforced (praise and an edible were provided) if he selected the sound

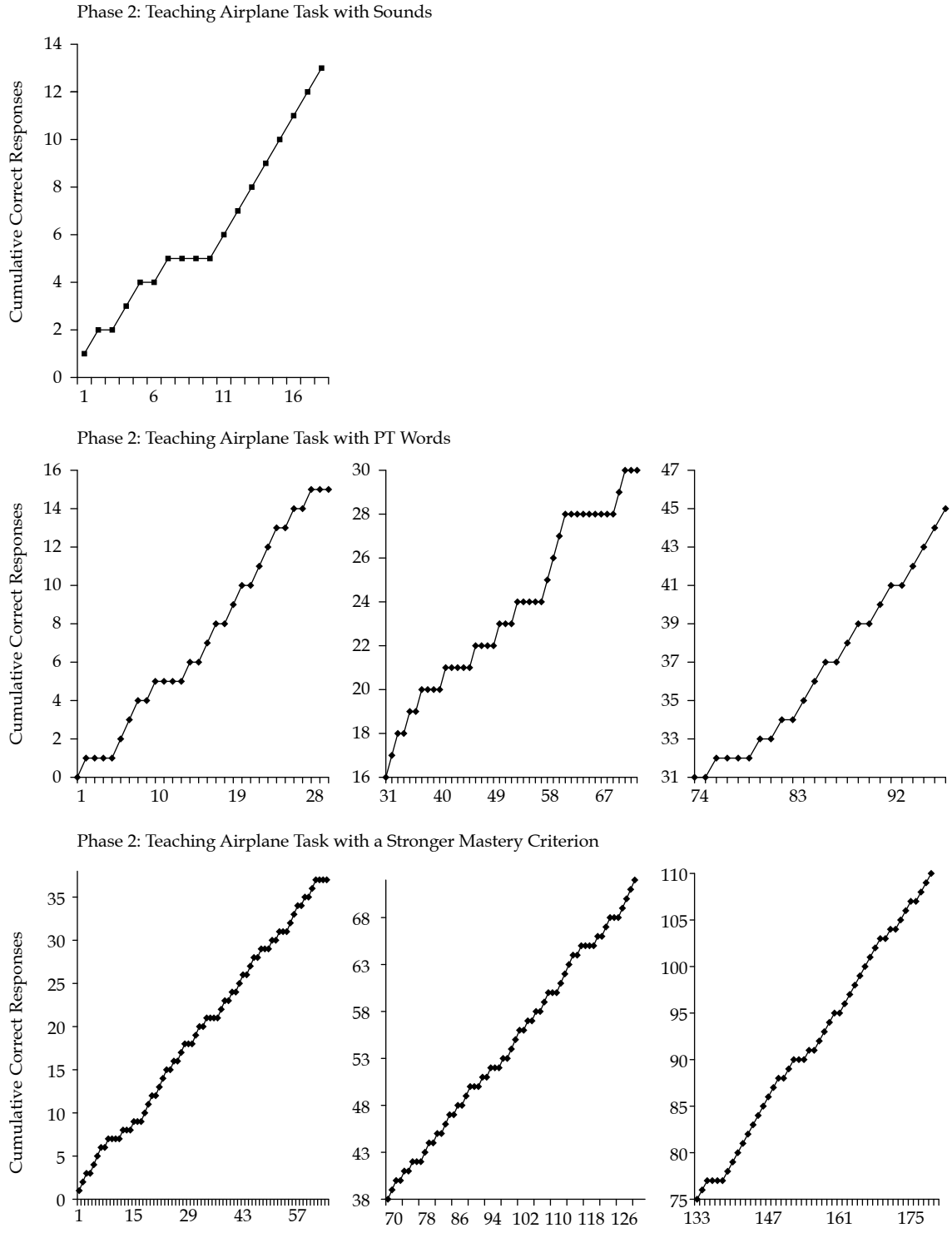

Figure 3. Cumulative correct responses during training for P1 in Phases 2, 4, and 6. In a cumulative graph, each response for a condition is cumulated or added to the total previous responses of the current and all previous sessions for that condition. The slope of the line in a cumulative graph indicates the rate of response, and instances of a flat line across several trials, such as trials 7 to 10 in Phase 2, indicates no progress on those trials. This type of graph is very useful for analyzing the rate of correct responding across a large number of trials, and for comparing response rates between phases.

sack on the right, activated it, and then handed it to the trainer, no matter what sound it made. If P1 activated and handed the left sound sack, the trainer said, "No," and removed both sound sacks. The trainer then re-presented both sound sacks, re-presented the instruction and prompted him to hand the trainer the sound sack on the right by touching it with her free hand. The trainer then provided him with praise and an edible. The priming task was done before sessions 6 to 9 (from trials 100–180) and it was done until P1 responded correctly and independently for three consecutive trials at the beginning of each session. Following the introduction of this priming task P1's choosing of the sound sack on the right increased until it equaled that of choosing the sound sack on the left. Mastery was achieved within four sessions (80 trials) after introducing the priming procedure (see Figure 3).

Phase 7, Final Assessments. In this phase, P1: (1) failed the AAIM PT with 50% correct responses; (2) failed the AAIM PT with sound sacks with 50% correct responses; and (3) passed the Auditory Matching Generalization Assessment with 71% correct responses.

Participant 2

Phase 1, Baseline of Airplane Task with "Tugboat" and "Telephone" Sounds. P2 failed the Airplane Task with sounds in 11 trials.

Phase 2, Teaching Airplane Task with "Tugboat" and "Telephone" Sounds. P2 mastered the visual matching part of training in 91 trials and mastered the auditory matching part of training in 169 trials (see Figure 4).

Phase 3, Post-Phase 2 Assessments. P2 failed both the AAIM PT and the AAIM PT with sound sacks. He performed with 60% accuracy on each of these assessments.

Phase 4, Teaching Airplane Task with PT Words. P2 mastered the Airplane Task with PT words in 80 trials (four sessions, see Figure 4).

Phase 5, Post-Phase 4 Assessments. In this phase, P2: (1) failed the AAIM PT with 60% correct responses; (2) failed the AAIM PT with sound sacks with 67% correct responses; and (3) failed the Auditory Matching Generalization Assessment with 53% correct responses.

Phase 6, Repeat of Phase 4 with a Stronger Mastery Criterion. P2 re-mastered the Airplane Task with PT words in six sessions (120 trials, see Figure 4).

Phase 7, Final Assessments. In this phase, P2: (1) failed the AAIM PT with 68% correct responses; (2) failed the AAIM PT with sound sacks with 60% correct responses; and (3) failed the Auditory Matching Generalization Assessment with 62% correct responses.

Participant 3

Phase 1, Baseline of Airplane Task with "Tugboat" and "Telephone" Sounds, and Additional Assessments. P1 failed the Airplane Task with sounds assessment in 23 trials.

Based on the results with P1 and P2, some additional assessments were included with P3. P3 was assessed on the AAIM PT procedure with the Phase 2 training sounds (tugboat whistle and telephone ring) being emitted from sound sacks when the trainer or assistants activated them, and the Auditory Matching Generalization Assessment. She failed each of these assessments. She responded with 69% accuracy on the AAIM PT, 62% accuracy on the AAIM PT procedure with sound sacks and the training sounds, and 57% accuracy on the Auditory Matching Generalization Assessment.

Phase 2, Teaching Airplane Task with "Tugboat" and "Telephone" Sounds but with Stronger Mastery Criterion. P3 mastered the visual matching part of training in 20 trials using the stronger mastery criterion (80% correct responses per session across two consecutive sessions) from Phase 6 with P1 and P2. P3 mastered the auditory matching part of training in 180 trials (see Figure 5).

Phase 3, Post-Phase 2 Assessments (same as Phase 5 for P1 and P2). In this phase, P3: (1) failed the AAIM PT with 68% correct responses; (2) failed the AAIM PT procedure with the whistle and telephone sounds with 73% correct responses; (3) failed the AAIM PT with sound sacks with 73% correct responses; and (4) failed the Auditory Matching Generalization Assessment with 55% correct responses.

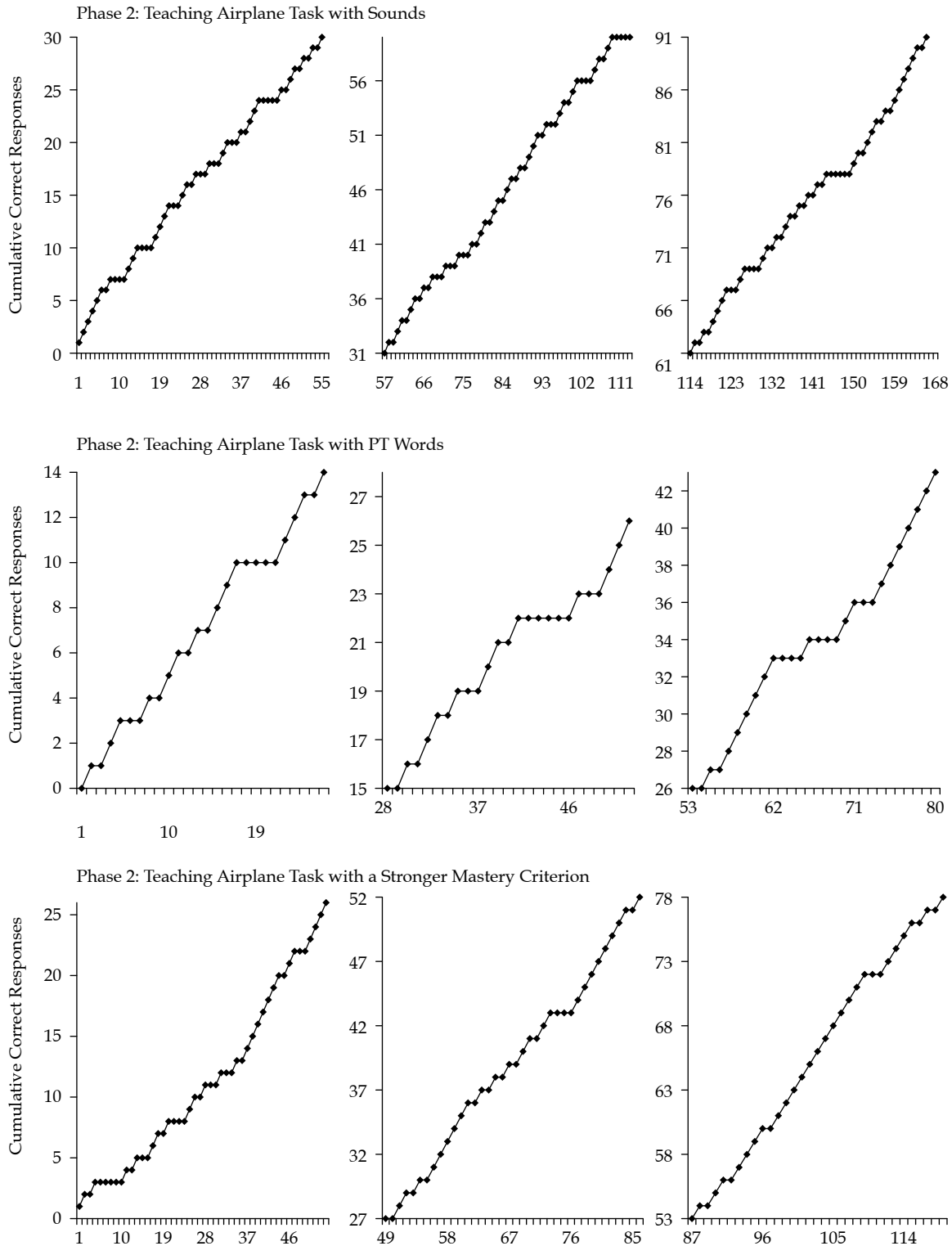

Figure 4. Cumulative correct responses during training for P2 in Phases 2, 4, and 6.

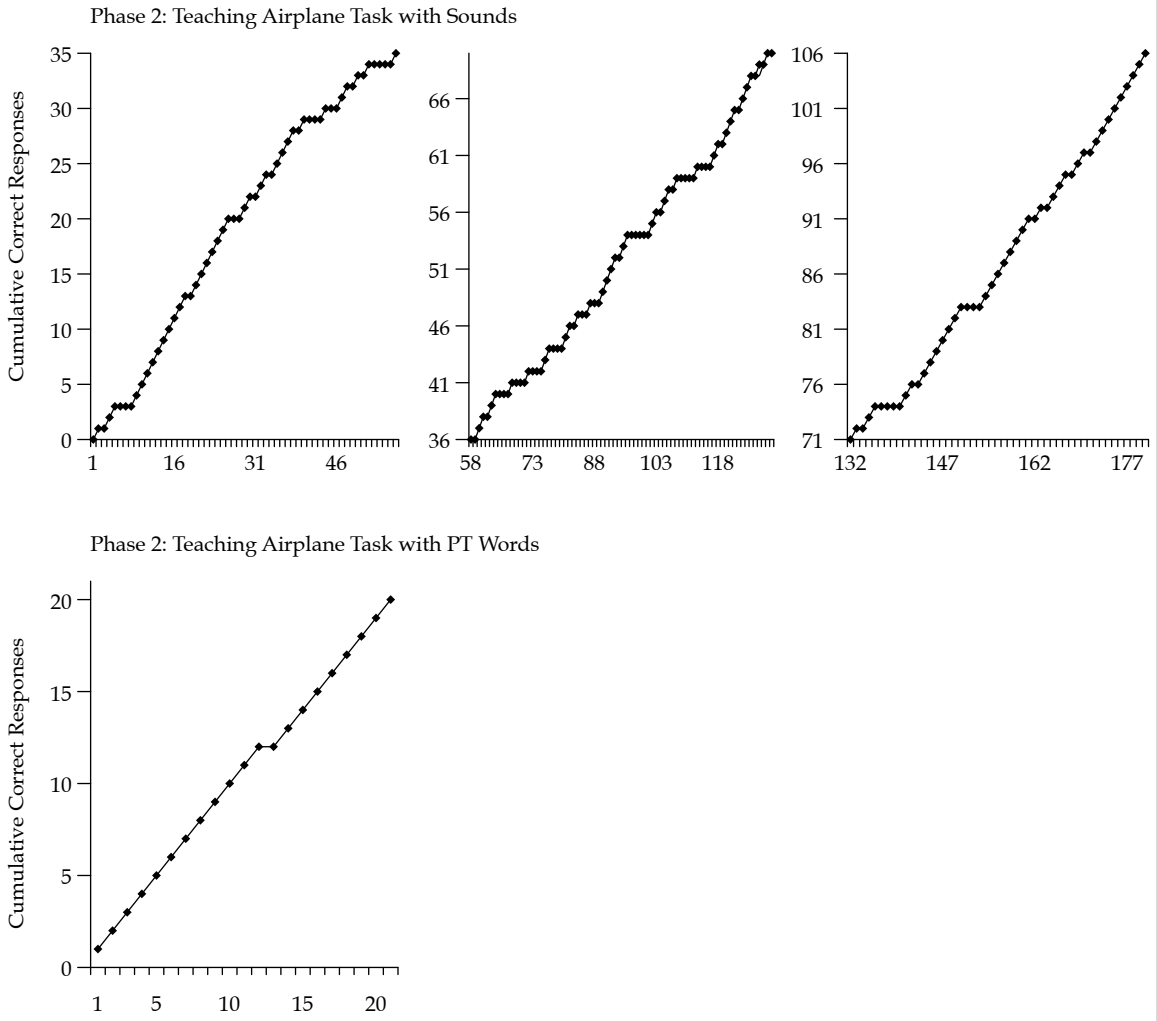

Figure 5. Cumulative correct responses per trial for training for P3 in Phases 2 and 4.

Phase 4, Teaching Airplane Task with PT Words. P3 passed this task in 21 trials, using the stronger mastery criterion (80% correct responses per session across two consecutive sessions) and responded with 95% accuracy (see Figure 5).

Phase 5, Final Assessments. P3 passed the AAIM PT assessment, and responded with 80% accuracy. P1 also passed the Auditory Matching Generalization Assessment with 95% accuracy. Because P1 passed the AAIM PT assessment, we also tested her on the AAIM PT procedure but with the words "Tree-tree" and "Book." She failed the AAIM PT with "Tree-tree" and "Book" (she responded with 74% accuracy).

General Discussion

We examined a procedure for teaching AAIM in which the participant was actively involved in producing the sample sound and comparison sounds (by squeezing the sound sacks), and then placing the two sound sacks that produced the matching sounds into a toy airplane, the operation of which we assumed was a possible natural reinforcer. The three participants each mastered two AAIM training tasks with this procedure; P3 subsequently passed the AAIM PT, and P1 subsequently passed a generalization assessment. The fact that P1 and P2 did not pass the AAIM PT after mastering two AAIM tasks raises several possibilities. First, P1 and P2 were children with autism and P3 was an adult with ID. The

difference in diagnosis and the difference in age may both have been contributing factors. A second possibility is to consider the differences in the procedural aspects of AAIM PT as compared to the Airplane Training Task. Future research might examine ways of slowly adjusting the Airplane Training Task until it more closely resembles the characteristics of the AAIM PT, as a strategy for producing generalization of AAIM from the airplane task to the AAIM PT.

Another consideration is that the AAIM PT may not be the best prototype for assessing the ability of persons with ID and children with autism to readily learn an AAIM discrimination. That is, persons with ID and children with autism are not often required to sit opposite a trainer and two assistants, listen to them sequentially, and then respond by pointing to a person based on what was said.

In this experiment we used a single-subject AB design with replication within and across the three participants. Although future research should examine the training procedure using a more rigorous research design, such as a multiple-baseline design across participants, the fact that we were able to teach two AAIM discriminations to each of the three participants suggests that the novel procedure with the airplane apparatus was responsible for each participant's mastery of the AAIM discriminations. Another limitation of this experiment is that it included only three participants. In order to clearly establish the external validity of the training procedure, it should be replicated with additional participants with ID and additional children with autism.

In summary, the results of our experiment suggests that a training procedure in which a participant is involved in producing the sample and comparison sounds, and which incorporates a natural, built-in reinforcer (e.g., the operation of a toy airplane) into the training procedure, has considerable potential for teaching AAIM discriminations to persons with ID and children with autism.

Key Messages From This Article

People with disabilities: Being able to communicate with people is a very important part of life. There are many ways to do so however, most people respond the best to speaking. This study looked for ways to teach the building blocks of speaking.

Professionals: Helping people with disabilities to communicate can involve a great deal of time and effort. In our attempt to do this, we may have to start teaching at the most basic level, recognition that sounds match.

Policymakers: Helping people with disabilities develop the ability to communicate will improve their quality of living. The most prominent form of communication is speech, so this form of communication should be targeted.

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