Assessing and Teaching Auditory Identity Matching Skills With Developmentally Disabled Persons

by

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Abstract

The ability to learn self-care, social, academic, and vocational skills depends on basic discriminative skills, including position, visual, and auditory discriminative skills. Research has demonstrated that a reliable method of assessing these skills is the Assessment of Basic Learning Abilities (ABLA; formerly the AVC Test; Kerr, Meyerson, & Flora, 1977). The present research extended ABLA Test research on the assessment and teaching of developmentally disabled individuals. Study 1 examined an auditory identity matching task as a possible bridge between two existing ABLA Test levels. Results indicated that the task consistently fell between these levels of the ABLA hierarchy, and thus might be a useful adjunct to the ABLA Test. Study 2 evaluated a multiple-component training package designed to teach a failed level of discrimination (i.e., auditory identity matching), and demonstrated that the teaching procedure was effective for three of five participants. Future research directions are also discussed.

Introduction

There has been a substantial amount of research involving the discrimination skill learning of developmentally disabled persons (Hupp, Mervis, Able, & Conroy-Gunter, 1986; Stoddard & McIlvane, 1989; Yu, Martin, & Williams, 1989). Basic discrimination skills include the ability to make two-choice position, visual, and auditory discriminations. These skills are important as they are often a prerequisite for learning self-care, academic, language, and other adaptive behaviours. Furthermore, many teaching programs for the developmentally disabled assume that the learner can readily acquire skills that require basic motor, visual and auditory discriminations. However, this is often an untested and erroneous assumption (Kerr & Meyerson, 1977).

In order to assess the discrimination learning ability of developmentally disabled learners, Kerr, Meyerson, and Flora (1977) developed an assessment instrument known as the Assessment of Basic Learning Abilities (ABLA) Test, formerly known as the Auditory Visual Combined (AVC) Discrimination Test. Subsequent research has demonstrated that the ABLA Test is a reliable and efficient method of assessing the ease

with which learners can acquire several basic discriminations. Moreover, it has substantial potential for use in a variety of settings, including educational and vocational environments (Yu et al., 1989). The purpose of the present research was twofold: a) to examine the potential for the inclusion of an additional basic discrimination level to the existing ABLA Test; and b) to evaluate the effectiveness of a multiple-component training package designed to teach a failed discrimination level.

The Assessment of Basic Learning Abilities (ABLA) Test

The ABLA Test is comprised of a series of six two-choice discriminations or learning-to-learn tasks that measure the ease with which developmentally disabled individuals can acquire basic position, visual, and auditory discriminations (Kerr et al., 1977). Each task was designed to teach the correct response for that particular task rather than to simply test the individual's existing repertoire. In addition, each task requires only a nonverbal, nonlanguage, motor response. The latter feature is beneficial in that many developmentally disabled learners may be capable of performing discriminations

but lack the expressive language skills necessary to demonstrate their knowledge.

The six ABLA Test tasks include: Level 1, imitation - for example, a trainer may put an object into a container and ask the student to do likewise; Level 2, position discrimination - for example, when two containers are presented in a fixed position, a student may be required to consistently place a piece of foam in the container on the left; Level 3, visual discrimination - for example, when two different containers are randomly presented in left-right positions, the student may be required to consistently place an object into one of the containers independent of its position; Level 4, visual match-to-sample - for example, a student demonstrated visual match-to-sample behavior if, when allowed to view a yellow can and a red box and then is presented sequentially with a yellow cylinder or a red cube, they consistently place the yellow cylinder in the yellow can and the red cube in the red box; Level 5, auditory discrimination - for example, when presented with a yellow can and red box and a neutral nonmatching object, a student is under the control of auditory cues if they consistently put the object in the appropriate container when the

examiner says, "red box" or "yellow can"; and Level 6, auditory visual combined discrimination, for example, a student demonstrates this level of discrimination if they correctly put an object into a yellow can or a red box when the position of the containers and the teacher's request for one or the other are randomly alternated.

These six two-choice discriminations were selected because they are representative of skills frequently required in teaching and training programs for the developmentally disabled; in addition, they are relatively easy to administer.

Thus, the ABLA Test offers the advantages of effectively and efficiently assessing necessary discrimination skills. Another advantage for practitioners is that ABLA Test materials can be easily and inexpensively constructed. Only two containers are required: a round yellow can and a square red box with dark red stripes. The ABLA Test also utilizes three manipulanda: a small piece of irregularly shaped foam that is different in color from either of the two containers, a small yellow cylinder, and a small red cube with dark red stripes.

At the beginning of each of the six tasks, the participant is provided with a demonstration of the required response, a physically guided trial, and an opportunity to respond independently. During the assessment of a particular discrimination level, praise and intermittent edible reinforcement are provided for correct responses. Incorrect responses are followed by an error correction procedure that consists of a demonstration trial, a physically guided trial, and an opportunity to respond unassisted. The error correction trials are repeated until either the participant makes a successful correction of the error or reaches the failure criterion (described below). If the participant does not respond within 15 seconds on any trial, the trial is repeated.

These procedures continue for a particular task until either eight consecutive correct responses (i.e., passing criterion) or eight cumulative incorrect responses (i.e., failing criterion) have occurred. A failure to respond is not included in scoring for the pass/fail criteria. Kerr et al. (1977) indicated that the passing criterion of eight consecutive correct responses will occur by chance only four times in 1000 trials. Also, the pass/fail criteria ensure that a

failure is based on a failure to learn even after repeated correction trials, rather than on a failure to respond.

Each task, or level of discrimination, assesses a different type of discrimination. For example, ABLA Test level 4 assesses the individual's ability to learn to visually match a sample stimulus to one of two comparison stimuli. In comparison, a different type of discrimination is tested at ABLA level 5, that is, the auditory discrimination level. This level assesses the participant's ability to learn to discriminate between two different auditory (speech) cues.

Research on the ABLA Test

Although there has been a plethora of research on discrimination learning, research investigating the ABLA Test itself has been relatively limited to date (Yu et al., 1989). However, there have been a number of noteworthy findings.

ABLA Test tasks are hierarchical. Firstly, it has been demonstrated that the ABLA Test discrimination tasks have a consistent hierarchical pass-fail pattern in the order listed previously (Kerr et al., 1977). With few exceptions, individuals who passed a certain level of discrimination also passed at lower levels;

whereas those who failed a certain level of discrimination also failed at higher levels (Kerr et al., 1977; Martin, Yu, Quinn, & Patterson, 1983; Wacker, Kerr, & Carroll, 1983). The same hierarchical order was found when the ABLA Test was used to assess hearing-impaired, multiply handicapped clients using arbitrary physical gestures in place of auditory cues (Wacker, 1981). The findings of these studies suggest that the hierarchical structure among position, visual, and auditory discriminations is consistent and reliable for mildly to profoundly handicapped persons; for young, normal children; and for hearing impaired persons, when physical gestures are substituted in place of auditory cues.

ABLA Test has predictive validity. Secondly, performance on the ABLA Test has been demonstrated to be highly predictive of performance on classroom tasks, measures of language development, and performance of vocational tasks (Martin et al., 1983; Tharinger, Schallert, & Kerr, 1977; Wacker, 1981; & Wacker et al., 1983). More specifically, tasks requiring a level of discrimination that has been passed on the ABLA Test are learned relatively quickly, whereas tasks requiring a level of discrimination that has been failed on the

ABLA Test are learned slowly, if they are learned at all. For example, Tharinger et al., (1977) successfully predicted the performance of five out of six children on a variety of classroom tasks that required auditory or auditory-visual discriminations (e.g., colors, numbers, and reading) based on the children's performance on the ABLA Test.

It has also been found that passing the combined auditory-visual discrimination level (i.e., ABLA Test level 6) is correlated with measures of language skills in both developmentally disabled and nondisabled young children. Meyerson (1977) found that 27 out of 29 developmentally disabled children who passed the auditory-visual task also passed the Distar Reading Program. Conversely, 23 developmentally disabled children who failed the auditory-visual task also failed the Distar. Casey and Kerr (1977) tested a group of nondisabled children between one and three years of age and found that all children who had passed the auditory-visual discrimination level were superior on measures of verbal ability as compared to children who had not acquired this level of discrimination.

Research has also suggested that performance on the ABLA Test might be useful in predicting performance

on vocational tasks. For example, one study demonstrated that the ABLA Test reliably predicted the performance of developmentally disabled clients on a two-choice vocational task and on a sorting task (Wacker et al., 1983). Another study demonstrated that the ability to learn vocational assembly tasks was related to the highest level of discrimination skill that clients had passed on the ABLA Test (Martin et al., 1983). More specifically, clients who had passed a higher level of discrimination were able to meet learning criterion in fewer trials than clients who had not passed that particular level.

Failed ABLA Test levels are difficult to teach. A final important finding with regard to the ABLA Test is that, as mentioned previously, failed ABLA Test discriminations are very difficult to teach using standard reinforcement and prompting procedures. For example, Meyerson (1977) reported that attempts to teach a failed level of discrimination required between 100 and 900 training trials before the failed level was learned, if it was learned at all. In addition, Witt and Wacker (1981) reported that attempts to teach a group of subjects a failed auditory discrimination with a traditional visual prompt-fading procedure were

unsuccessful, even after each individual had received over 500 training trials.

Areas of the ABLA Test in Need of Research

Since its inception, research has explored a variety of areas pertaining to the ABLA Test. For example, research has examined its predictive validity, and has also evaluated procedures designed to teach a failed ABLA Test level of discrimination. However, a number of areas have been identified that require further exploration (Yu et al., 1989). Two such areas are discussed in subsequent sections.

Procedures to teach failed ABLA Test levels. As Yu et al. (1989) indicated, there is clearly a need for training procedures that can effectively and efficiently teach a failed level of discrimination. To date, a small number of studies have addressed this need. For example, Yu and Martin (1986) demonstrated that a teaching procedure that combined within-stimulus prompt fading, a direct response-reinforcer relationship, and response preclusion was effective in teaching a failed visual discrimination (i.e., ABLA Test level 3) to severely developmentally disabled clients. In addition, a modified version of this training package was used to teach a failed visual

match-to-sample discrimination (i.e., ABLA Test level 4) to one moderately handicapped and two severely handicapped clients (Hazen, Szendrei, & Martin, 1989). Research has also demonstrated the potential effectiveness of a multi-component training package to teach a previously failed auditory discrimination (i.e., ABLA Test level 5) (Walker, Graham, & Martin, in press). Nevertheless, further research is required to examine training strategies to teach failed discriminations (Yu et al., 1989)

Addition of tasks to the ABLA Test. In addition to the need for effective training strategies to teach failed ABLA Test discriminations, there is also a need for research on the ABLA Test itself (Yu et al., 1989). For example, previous research has led to speculation regarding the potential usefulness of broadening the existing ABLA Test to include more tasks, or levels of discrimination. The inclusion of additional learning-to-learn tasks might result in a more sensitive measure of an individual's ability to learn practical, self-care, and vocational tasks.

One possibility would be to add an auditory matching task between the visual match-to-sample (ABLA level 4) and auditory (ABLA level 5) tasks. For

example, if a participant is given an opportunity to bang a tambourine or ring a bell after hearing a bell ring, and if they respond by ringing the bell, they would be demonstrating auditory matching ability. A rationale for adding an auditory matching task between level 4 (visual matching) and level 5 (auditory discrimination) is as follows: the visual match-to-sample task (ABLA level 4) seems similar to, and therefore a reasonable progression beyond the visual discrimination task (ABLA level 3). However, in comparison, the task requirements of the visual match-to-sample discrimination (ABLA level 4) and the next higher level (ABLA level 5) appear subjectively to be quite different. The visual match-to-sample discrimination requires the ability to make a simultaneous, within-modality, identity match (i.e., a simultaneous visual-visual match). In contrast, the auditory discrimination requires the ability to make a delayed, non-identity, across-modality match (i.e., a delayed auditory-visual match). Therefore, ABLA Test levels 4 and 5 are different on at least three dimensions: (a) simultaneous vs. delayed; (b) identity vs. non-identity; and (c) within vs. across modality.

(These characteristics of matching tasks are discussed further in subsequent sections.)

On both an intuitive and empirical level, learning a delayed, non-identity match is substantially more difficult than making a simultaneous identity match. One possible reason for the increased difficulty might be the delay factor involved in the auditory discrimination task. At the visual match-to-sample discrimination level, the visual cues are continuously present for the individual to discriminate. At the auditory discrimination level, however, the auditory cue is presented only once at the beginning of each trial. Due to the inevitable delay between presentation of the auditory cue and subsequent response, short-term memory is involved in learning this discrimination level. A study by Lamberts (1981) that examined short-term auditory memory in developmentally disabled individuals suggested that there may be an impairment in the ability to recall abstract or linguistic symbols (e.g., words). The hypothesized impairment resulted in poorer performance on tasks requiring short-term auditory memory. According to research by Bonta and Watters (1983), behaving under delay conditions may be especially

difficult for some developmentally disabled individuals because they lack the memory and language skills necessary to perform such tasks. Therefore, it might be simpler for developmentally disabled persons to perform an auditory task which does not require short-term memory, for example, a simultaneous auditory matching task in which both the sample and comparison auditory stimuli are continuously available. The characteristic features of ABLA levels 4, 5, and the proposed intermediate level are summarized in Table 1.

With these considerations in mind, a possible addition to the ABLA Test would be the inclusion of simultaneous and delayed auditory identity matching tasks (i.e., auditory-auditory matching tasks). A pilot study that examined auditory identity matching tasks suggested that auditory identity matching might, as hypothesized, be positioned between the visual match-to-sample and auditory discrimination levels in the ABLA Test hierarchy (Walker, Graham, DeWiele, & Martin, 1989). However, additional participants needed to be tested in order to confirm this possibility.

Overview of the Research

The present research extended ABLA Test research in two areas. In the first study, an auditory identity

Table 1

Characteristics of ABLA Levels 4 and 5 and Proposed Intermediate Level (4a)

ABLA level	Ability required
4 (visual match-to-sample discrimination)	simultaneous visual-visual identity match
4a (proposed new level)	simultaneous auditory-auditory identity match delayed auditory-auditory identity match
5 (auditory discrimination)	delayed auditory-visual nonidentity match

matching task was examined as a potential addition to the existing ABLA Test hierarchy. Pilot data indicated that this was an area worth pursuing, but suggested that further testing was required to confirm the placement of an auditory identity matching task within the ABLA Test hierarchy (Walker et al., 1989).

In the second study, a multiple-component training procedure was examined for teaching a simultaneous auditory identity matching task. Previous research has indicated that it is extremely difficult to teach a failed ABLA Test auditory discrimination (i.e., ABLA level 5) and that more research is needed regarding the development of effective teaching strategies (Meyerson, 1977; Witt & Wacker, 1981). If auditory identity matching is an intermediary level between the visual match-to-sample discrimination level and the auditory discrimination level, and if a procedure can be developed for effectively teaching auditory identity matching, then rapid acquisition of auditory matching skills might be examined in subsequent research as a useful precursor to teaching more complex auditory discriminations, such as speech discriminations. It is possible that improved auditory identity matching skills might enhance auditory discrimination skill in

general, including the delayed, nonidentity speech discrimination in the ABLA Test. However, before examining these possibilities, it is necessary to first investigate a procedure for teaching auditory matching.

The rationale for focusing on testing and teaching within the auditory modality is based on previous research and informal observations of developmentally disabled individuals, which indicate that responsiveness to auditory stimuli substantially enhances an individual's ability to competently interact with the environment (Kerr et al., 1977). Teaching developmentally disabled individuals to listen to or respond to auditory information is a well-known problem in clinical settings (Stoddard & McIlvane, 1989). Moreover, responding to auditory stimuli is often a prerequisite skill for educational and vocational programs (Witt & Wacker, 1981). For example, auditory discrimination skill is required for individuals to look up when called by name, to follow instructions, and to learn to respond appropriately to names of objects. These types of receptive language skills are particularly important for severely disabled individuals who require extensive direction and instruction from others to perform many activities of

daily living (Hupp et al., 1986). Although these skills develop almost automatically in normal children, they may be delayed, or may simply not occur, in developmentally disabled individuals (Streifel, Bryan, & Aikins, 1974). Therefore, auditory discrimination skills have both practical and social importance. However, despite the importance of these skills, there has been minimal research on the testing and training of auditory matching skills.

Study 1

Assessing Auditory Identity Matching

Study 1 evaluated an auditory identity matching task as a possible addition to the existing ABLA Test.

Introduction

In studies of visual match-to-sample ability, there is usually some type of relationship between the sample and comparison stimuli. For each visual match-to-sample task, there are three distinguishing features, depending on whether the task is: (a) identity vs. nonidentity matching, (b) within vs. across-modality matching, and (c) simultaneous vs. delayed matching. These types of distinctions also apply to matching-to-sample in the auditory domain.

Identity vs. Nonidentity Matching

One defining feature of match-to-sample tasks is the identity vs. nonidentity dimension. This refers to whether there is identity, or similarity, between the sample and one of the comparison stimuli along one or more dimensions (e.g., color, shape, and/or size). For example, in the ABLA Test, the visual match-to-sample task (i.e., ABLA Test level 4) involves the presentation of a sample stimulus that is the same as one of the two comparison stimuli on the dimensions of color and shape. In another study, a measuring spoon was matched to a same-color measuring cup while a pencil was matched to a same-color upright narrow cylinder (Hazen et al., 1989). In the latter study, the sample and comparison stimuli were similar in terms of color and shape. In that both tasks involved visual matching of two similar objects, these tasks could be labelled as visual identity matching tasks, or visual-visual matching tasks. In each case, both the sample and comparison stimuli were physically similar on some dimension(s) and were presented to the visual modality.

Some studies have involved matching on an arbitrary basis; for example, a two-dimensional star might be the sample stimulus and a two-dimensional

square and triangle might be the comparison stimuli. The experimenter could arbitrarily decide that the star "matches" the triangle, whereas the star would not match the square. Tasks of this nature might be labelled as visual nonidentity matching tasks (also studied in stimulus equivalence research) (e.g., Dixon & Spradlin, 1976; Wetherby, Karlan, & Spradlin, 1983). In this type of research, both the sample and comparison stimuli are presented in the visual modality, however, there is no apparent or obvious relationship between them beyond the relationship that is defined by the experimental contingencies.

Within vs. Across-Modality Matching

A second defining characteristic of match-to-sample tasks is the modality of presentation. For example, some tasks require matching within the same modality, therefore they could be termed within-modality matching tasks. An illustration of this type of task is the ABLA visual match-to-sample discrimination task (i.e., ABLA level 4), which involves the presentation of both the sample and comparison stimuli within the visual modality.

Another group of matching tasks could be termed nonidentity across-modality tasks. Illustrations of

this type of task are those which involve matching an auditory stimulus (e.g., a spoken word or a pure tone) to a visual stimulus (e.g., a picture of the named object or a geometric drawing), or matching a manual sign (i.e., American Sign Language) to a picture of the signed object (e.g., Bonta & Watters, 1983; Lamberts, 1981). In across-modality studies, the sample and comparison stimuli are presented to different modalities and are physically different.

Simultaneous vs. Delayed Matching

A third characteristic of matching tasks depends on whether the task employs simultaneous matching or delayed matching. In simultaneous matching, the sample and comparison stimuli are continuously present throughout the duration of each trial. For example, in the ABLA visual match-to-sample task the sample and comparison stimuli are presented at the beginning of each trial and remain in view until the individual responds, or until the trial is terminated, whichever event occurs first. Another example of simultaneous matching is a task during which the spoken name for an object is repeated until the individual chooses among the comparison stimuli or until the trial is terminated (e.g., Bonta & Watters, 1983; Walker et al., in press).

Statement of the Problem

Study 1 assessed the auditory identity matching skills of developmentally disabled persons according to a procedure developed by Walker et al. (1989), and examined the placement of auditory matching ability within the ABLA Test hierarchy. The assessment involved the tester presenting a sound; the learner was then required to make a nonverbal, nonlanguage motor response (i.e., similar to the type of response which the ABLA Test requires) which involved "matching" the sample sound. For example, if the tester hit a drum (out of sight of the learner) and the learner was given an opportunity to hit a drum or a bell; a correct response would be the learner hitting the drum. A pilot study with eleven developmentally disabled persons indicated that auditory identity matching fell between the visual match-to-sample discrimination level (i.e., ABLA level 4) and the auditory discrimination level (i.e., ABLA level 5).

The possibility of adding an auditory matching task was chosen for a number of reasons. Firstly, no studies were found which assessed auditory matching abilities in humans. Secondly, as previously indicated, the area of auditory functioning is of both

practical and social importance. If auditory-auditory matching skill is a precursor to learning more complex auditory skills, then such an assessment has potential usefulness in evaluating individual ability and developing effective teaching strategies. Thirdly, it is possible to use "simple" matching sounds as the sample and comparison stimuli. Previous research has demonstrated that simple sounds may be easier for developmentally disabled individuals to learn as compared to abstract linguistic symbols such as words (Lamberts, 1981). In addition, the use of simple auditory stimuli would seem to circumvent the difficulties associated with stimulus overselectivity, that is, the tendency to respond to only a limited portion of a complex cue. The latter difficulty typically results in a failure to correctly discriminate between complex auditory stimuli (Schreibman, 1975; Schreibman, Kohlenberg, & Britten, 1986). Therefore, an assessment of auditory identity matching skill using simple sounds may be a relatively effective means of determining the presence or absence of auditory discrimination ability.

Method

Participants

Thirty-eight developmentally disabled residents of the St. Amant Centre and twelve developmentally disabled clients at the Work and Social Opportunities (W.A.S.O.) sheltered workshop were initially selected to participate in the study. Participants were identified with the aid of personnel at the St. Amant Centre and W.A.S.O. based on their level of functioning on the ward and/or in the workshop setting. All participants were initially assessed on the ABLA Test discrimination tasks. The procedure for these tasks was described in Kerr et al., (1977), and was summarized previously.

Initially, it was hoped that at least five participants could be found who tested at each of the following levels: (a) participants who passed ABLA level 1 but failed at higher levels; (b) participants who passed ABLA level 2 but failed at higher levels; (c) participants who passed ABLA level 3 but failed at higher levels; (d) participants who passed ABLA level 4 but failed at higher levels; (e) participants who passed ABLA level 5 but failed level 6; and (f) participants who passed ABLA levels 1 through 6.

Unfortunately, there was an unequal distribution of participants found at each of the levels, with more participants passing at the higher discrimination levels of the ABLA Test hierarchy and relatively fewer participants who passed only at the lower discrimination levels of the ABLA Test. In addition, there were 16 potential participants who were unable to complete any of the ABLA Test tasks due to physical impairment or a low level of functioning. Therefore, of the initial 50 potential participants, 34 were able to complete the ABLA Test requirements and were included in Study 1.

In addition to the ABLA Test assessment, standard information from agency files was obtained regarding level of functioning and visual and/or hearing impairments. After the ABLA Test assessment was completed, the participants were assessed on the auditory matching tasks (described below).

Setting and Materials

The majority of the participants were tested in an assessment room in the Psychology Department of the St. Amant Centre. Dimensions of the room were approximately 2 m by 2.7 m. The remainder of the participants were tested in a separate room at the

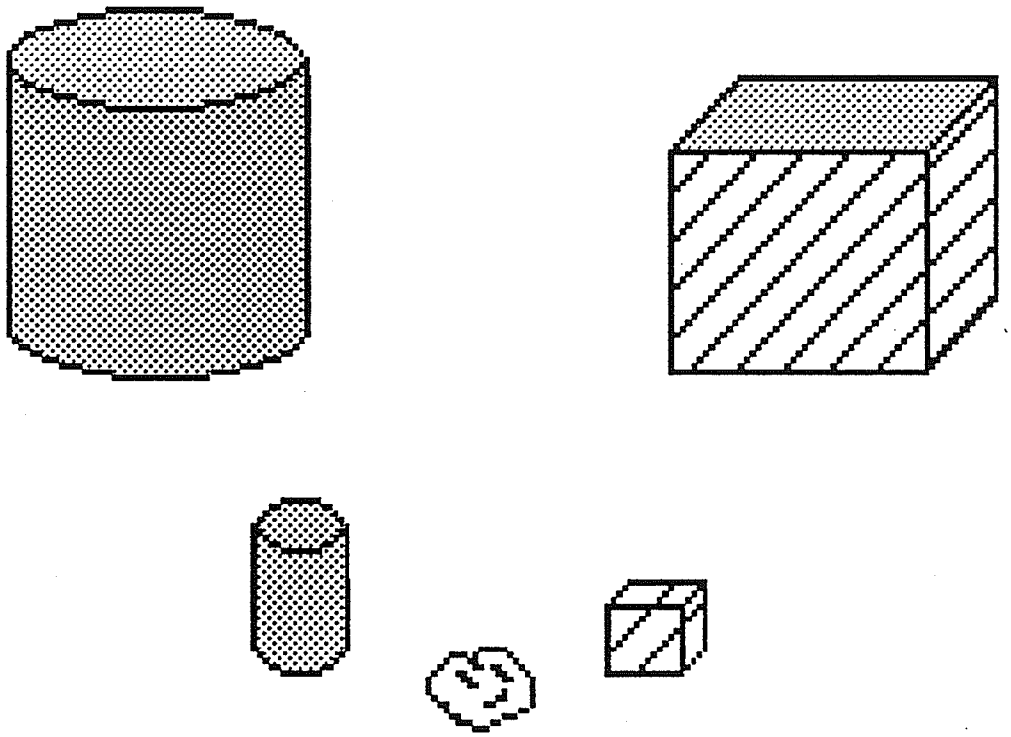
W.A.S.O. sheltered workshop, the dimensions of which were approximately 4 m by 10 m. In all cases, during the ABLA Test and auditory matching assessments, the participant was seated at a table or in a wheelchair across from the tester. For some sessions, an additional observer was also seated across from the participant.

The ABLA Test tasks involved two containers: a yellow can measuring 13 cm in diameter and 16.5 cm in height, and a red box with dark red stripes measuring 15 cm x 15 cm x 10 cm. There were three manipulanda used in the various tasks of the ABLA Test: a small piece of irregularly shaped green foam, a small yellow wooden cylinder, and a small red wooden cube with dark red stripes. The materials for the ABLA Test are shown in Figure 1.

Data sheets identical to those used by Kerr et. al (1977) were used for data collection for the ABLA Test (see Appendix A).

For the auditory matching assessment, each participant was tested on two auditory identity matching tasks: a) simultaneous, and b) delayed. Both tasks utilized two sets of stimuli: table bells and tambourines.

Figure 1 Illustration of ABLA materials



For both tasks, a table bell and tambourine were placed in front of the participant and remained stable during testing. In addition, a table bell and tambourine were placed side by side on the floor at the tester's feet. A piece of white foam board approximately 70 cm x 45 cm was used as a screen such that the stimuli on the floor were kept out of view of the participant during testing. The materials for the auditory matching assessment are shown in Figure 2.

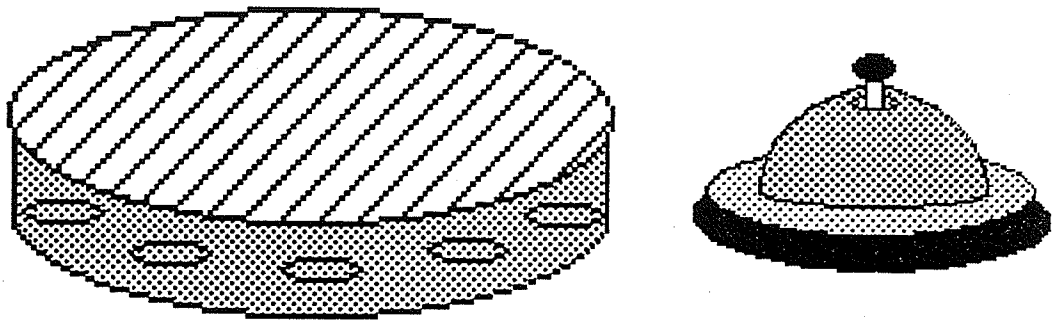
Data sheets modeled after the Kerr et al. (1977) ABLA auditory task were used for data collection for the auditory matching assessment (see Appendix B).

Procedure for Testing Auditory Identity Matching

Preliminary demonstration and imitation trials. At the beginning of each assessment, for both simultaneous and delayed matching, imitation and demonstration trials were conducted with each stimulus presented individually (i.e., table bell and tambourine were presented one at a time to the participant). These trials were conducted according to Kerr et al.'s (1977) procedure for the imitation level of the ABLA Test (i.e., ABLA level 1).

First, two table bells were placed on the table, one in front of the participant and one in front of the

Figure 2 Illustration of AIM assessment materials



tester. The tester demonstrated ringing her bell while saying "make the same sound" and ringing the participant's bell. Following this, a physically guided trial was done with the tester saying "make the same sound" while guiding the participant to make a sound on their bell. Next, the participant was instructed to "make the same sound" while the tester produced a sound using her bell. This provided the participant with an opportunity for an independent response. Following an independent response, the participant was given four additional independent response trials with the tester giving the instruction "make the same sound" while producing a sound using her bell.

The same procedure was carried out with the tambourine placed on the table in front of the participant (i.e., demonstration trial, physically guided trial, and opportunity for independent response). The instruction used by the tester was the same as that used for the trials with the bell. Following an independent response to the tambourine, the participant was given four additional independent response trials in the same manner as those described for the bell.

A response was scored as correct if the participant followed the instruction and "made the same sound." If the participant had not responded to the instruction within 10 seconds, the demonstration trial, guided trial, and opportunity for independent response were repeated. Passing criterion was four consecutive correct responses to each stimulus.

Simultaneous auditory identity matching. For this task, a bell and tambourine were placed on a table in front of the participant and remained stable during testing. A bell and tambourine were also placed side by side at the tester's feet on the tester's side of the foam board screen (i.e., under the table and out of sight of the participant). At the beginning of the task, the participant was given a demonstration of the required response, a physically guided trial, and an opportunity to perform the response independently.

The demonstration trial involved the tester using foot movements to make a sound on one of the two stimulus objects for approximately 3 seconds while saying "make the same sound;" then the tester made a matching sound on one of the participant's stimulus objects (e.g., tester rang her bell for 3 seconds, then rang participant's bell; thus "matching" the sounds).

The guided trial involved the tester making a sound with the bell or tambourine on the floor, then guiding the participant to make the appropriate matching sound on the bell or tambourine on the table. Following the guided trial, the participant was given an opportunity for an independent response. Once the participant had made one correct response to each stimulus, scoring began.

On each scoring trial, the tester began by saying the participant's name in order to ensure attending behavior. In addition, the tester gave the prompt "make the same sound" as an instructional cue for the subject. Subsequently, the tester presented one of two distinctive sounds (i.e., ringing the bell or hitting the tambourine) continuously for a period of 10 seconds. For this task, "continuous" sound presentation was defined as sound presentation for a cumulative period of 10 seconds, but with individual sounds presented approximately 2 seconds apart. The tester presented the sounds by ringing the bell or hitting the tambourine with her feet. The presence of the foam board screen between the client and participant ensured that the client did not receive any visual localization cues with respect to the identity

of the correct stimulus. If the participant had not responded within 5 seconds, the instructional cue ("make the same sound") was repeated. The identity of the correct stimulus was randomly alternated according to the data sheet.

Responses were defined as correct if the participant responded to the correct stimulus and made the appropriate "matching" sound to the sound that had been presented (e.g., tester hit tambourine that was hidden under the table, participant hit tambourine that was on top of the table). Responses were defined as incorrect if the participant responded to the incorrect stimulus (e.g., tester hit tambourine that was hidden under the table, participant rang bell that was on top of the table). If the participant had not responded within 10 seconds, the tester discontinued sound presentation, moved the stimuli away for a few seconds, and then began a new trial.

Following correct responses, praise and intermittent edible reinforcers (e.g., one out of every three correct responses) were provided. Incorrect responses were consequated by the error correction procedure used by Kerr et al. (1977). These procedures were continued until either eight consecutive correct

responses (passing criterion), or eight cumulative errors had occurred (failing criterion). Pass or fail criteria were based on Kerr et al.'s (1977) criteria for the ABLA Test. A failure to respond was not included in scoring for the pass-fail criteria.

Delayed auditory identity matching. The procedure for this task was similar to the procedure used for simultaneous matching, but with a few modifications. Each session began with the demonstration and imitation trials described previously. Following these trials, the participant was given a demonstration trial, a physically guided trial, and an opportunity for independent response.

On each trial, the tester began by saying the participant's name, then gave the prompt "make the same sound." Following this, the tester presented one of two sounds (i.e., either a bell sound or a tambourine sound) according to the data sheet. The sound was presented only two times at the beginning of each trial; for example, two quick rings on the bell or two quick hits on the tambourine that was hidden on the floor. Following sound presentation, the participant was allowed 10 seconds in which to respond using the bell or tambourine that were on the table. During this

10 second period, the tester did not make any sound on the bell or tambourine that were on the floor.

Correct and incorrect responses and pass or fail criteria were the same as those described for the previous task.

Interobserver Reliability Assessments

Interobserver reliability data on participants responses (correct vs incorrect) were collected for 30% of the ABLA Tests and auditory identity matching assessments. Interobserver reliability checks on data collection were obtained by having two observers independently and simultaneously record responses. Interobserver agreement was calculated by dividing the number of agreements by the total number of agreements plus disagreements, and multiplying by 100. Interobserver agreement was 100% for all sessions.

Results

In total, thirty-four participants were assessed on the ABLA Test and the auditory identity matching tasks. Their results are shown in Table 2.

Fifteen of the thirty-four participants passed all six discrimination levels of the ABLA Test. All of these participants also passed the auditory identity matching tasks. One participant passed ABLA levels 1

Table 2

Results of Assessment of Basic Learning Abilities (ABLA) Test and Auditory Identity Matching (AIM) Assessment

Participant	Highest level passed on ABLA	AIM (P=passed, F=failed) simultaneous	delayed
1	6	P	P
2	6	P	P
3	6	P	P
4	6	P	P
5	6	P	P
6	6	P	P
7	6	P	P
8	6	P	P
9	6	P	P
10	6	P	P
11	6	P	P
12	6	P	P
13	6	P	P
14	6	P	P
15	6	P	P
16	5	P	P
17	4	P	P
18	4	P	P
19	4	P	P
20	4	F	F
21	4	F	F
22	4	F	F
23	4	F	F
24	4	F	F
25	3	F	F
26	3	F	F
27	3	F	F
28	3	F	F
29	2	F	F
30	2	F	F
31	2	NR	NR
32	1	F	F
33	1	NR	NR
34	1	NR	NR

through 5, failed ABLA Test level 6, and passed the auditory identity matching tasks.

Eight of the thirty-four participants passed ABLA levels 1 through 4, but failed at higher levels. Of these eight, three passed the auditory identity matching tasks and five failed these tasks.

Four of the thirty-four participants passed ABLA levels 1, 2, and 3, but failed at higher levels. Three participants passed ABLA levels 1 and 2 but failed at higher levels, and three participants passed ABLA level 1 but failed at higher levels. Of these ten participants, none passed the auditory identity matching tasks.

Discussion

The results of the present research provide support for the positioning of the auditory identity matching tasks between ABLA levels 4 and 5. In their initial ABLA research, Kerr et al. (1977) found that individuals who passed at a particular level of the ABLA Test also passed at lower levels of the hierarchy. If, as hypothesized, the auditory identity matching tasks fall between ABLA levels 4 and 5, then it would be expected that those individuals who passed ABLA levels 5 and 6 would also pass the auditory identity

matching tasks. This expectation was confirmed in the present study.

In addition, Kerr et al. (1977) found that if individuals fail a particular level of the ABLA Test, then they will typically fail at higher levels of the hierarchy. In accordance with the hypothesis that auditory identity matching is a higher (more difficult) level than ABLA level 4, the present study found that all individuals who failed at ABLA level 4 or lower also failed the auditory identity matching discrimination tasks.

Additional support for the placement of the auditory identity matching tasks between ABLA level 4 and 5 is found with those participants who passed ABLA levels 1,2,3, and 4, but failed at higher levels. According to Kerr et al.'s (1977) demonstration of the hierarchical ordering of the ABLA discrimination tasks, if auditory identity matching is an intermediary between ABLA levels 4 and 5, this group would be expected to contain some individuals who pass the auditory identity matching tasks and others who fail these tasks. In Study 1, there were eight individuals who passed ABLA levels 1 through 4 but failed at higher levels. Three of these individuals passed the auditory

identity matching tasks and five of them failed the tasks. This finding lends support to the hypothesized placement of the auditory identity matching tasks.

During the development of the original ABLA Test Kerr and Meyerson (1977) tested one hundred and seventeen developmentally disabled individuals and found few exceptions to the hierarchical character of the ABLA Test discrimination levels. Likewise, the present research demonstrated consistency with respect to the placement of the proposed auditory identity matching level within the hierarchy of ABLA Test discrimination levels. There were no exceptions to the predicted ordering of tasks, that is, the ordering which would place auditory identity matching between ABLA levels 4 and 5.

The present research suggests that auditory identity matching falls between ABLA levels 4 and 5, as previously hypothesized. The next step in this line of research is to evaluate whether this proposed new level is a useful addition to the existing ABLA Test hierarchy. One method of conducting such an investigation would be to examine whether learning an auditory identity matching discrimination facilitates learning a subsequent auditory speech discrimination,

such as the one at ABLA Test level 5. Kerr et al. (1977) suggested that the ABLA auditory discrimination (level 5) was the most difficult level in the hierarchy to learn. Therefore, any strategy to enhance mastery of this level would be beneficial. Prior to investigating whether teaching auditory matching skills enhances a subject's ability to learn auditory discrimination, it is first necessary to develop a procedure for teaching auditory matching skills to participants who have failed the auditory matching assessment. Study 2 explored this latter area.

Study 2

Teaching Auditory Matching

Study 2 focused on teaching simultaneous auditory identity matching to participants who failed both ABLA level 5 and the simultaneous auditory identity matching task described previously.

Introduction

Previous research has demonstrated that a failed discrimination on the ABLA Test is very difficult to teach and typically requires hundreds of training trials before the discrimination is learned, if it is learned at all (Kerr et al., 1977; Yu et al., 1989). Clearly, there is a need for additional research to

develop effective training strategies to rapidly teach a failed discrimination on the ABLA Test (Yu et al., 1989). As Kerr et al. (1977) demonstrated, mastery of a new level of discrimination makes it easier for the learner to acquire new educational, language, social, or vocational tasks. For example, the acquisition of a previously unlearned auditory discrimination could enable the learner to respond to instructions or learn new educational tasks. Carr and Dores (1981) suggested that individuals who fail to discriminate among speech stimuli might also fail to develop both receptive and expressive speech. It is conceivable that learning auditory matching might be a precursor to learning both receptive and expressive language.

It has been proposed that a teaching strategy should include a number of component procedures in order to attain total treatment success (Azrin, 1977). In accordance with this proposal, previous research has indicated that multiple-component training packages may be an effective method of teaching a failed level of discrimination (e.g., Hazen et al., 1989; Yu & Martin, 1986). The rationale behind multiple-component teaching packages is that the combination of a number of previously successful components might be more

effective than any one of the components on its own. Furthermore, because of differential effectiveness of procedures across individuals, the inclusion of a number of components could increase the likelihood that at least one of the components will be effective for each participant.

Factors Affecting Discrimination Learning

The difficulty associated with establishing new discriminations that have been failed on the ABLA Test has been confirmed in numerous studies in the past (Martin & Yu, 1986; Wacker et al., 1981; & Yu et al., 1989). At least some of the difficulty may be attributable to confounding factors that interfere with discrimination acquisition. For example, stimulus overselectivity, inappropriate stimulus control, and lack of motivation on the part of the learner may interfere with mastery of a new discrimination.

Stimulus overselectivity. Stimulus overselectivity has been described as the tendency to selectively respond to only one or a few components of a complex stimulus instead of responding to the stimulus in its entirety. Stimulus overselectivity has been demonstrated in the visual modality as well as in the auditory modality, and has often resulted in a

failure to correctly discriminate between complex stimuli. For example, Schreibman et al. (1986) found that autistic children selectively responded to either the intonation or content component of a complex auditory stimulus, but had difficulty discriminating between complex stimuli when intonation and content components were combined.

It might be possible to circumvent the difficulties associated with stimulus overselectivity by utilizing simple sounds as compared to complex auditory stimuli. For example, the use of simple tones should comprise a simpler discrimination than the use of chords.

Inappropriate stimulus control. A common problem noted in working with developmentally disabled learners is their tendency to respond to an inappropriate stimulus, that is, inappropriate stimulus control. One method of increasing the likelihood of an appropriate response on the part of the learner has been to use within-stimulus prompting. A within-stimulus prompt involves the exaggeration or alteration of the training stimulus along the dimension relevant to the final discrimination; then, the exaggerated dimension is gradually faded (Deitz & Malone, 1985; Schreibman,

1975). In comparison, an extra-stimulus prompt involves the presentation of the training stimulus with an additional prompt that reliably controls the desired behavior, but is not functionally related to the task (Touchette & Howard, 1984). Some examples of extra-stimulus prompts are gestural and physical prompts.

Extra-stimulus prompts can also be thought of as response prompts that initially increase the probability of a correct response. Although this type of prompt may initially control the desired response, it is expected that response prompts will be gradually faded in order to transfer stimulus control from these prompts to the task-relevant stimuli (i.e., the discriminative stimuli; Touchette & Howard, 1984). There have been a variety of procedures described for fading extra-stimulus prompts including graduated guidance, the system of least prompts, most-to-least prompting, and position prompt-fading (e.g., Horner & Keiletz, 1975; Smeets & Streifel, 1976; & Yu, Sparks, and Graham, 1990).

In position prompt-fading, the positions of the stimuli to be discriminated are manipulated in order to increase the probability of correct responding by the

learner. Initially, the correct stimulus is placed in close proximity to the learner while the incorrect stimulus is placed further away. The position prompts are then gradually faded such that at the final discrimination the correct and incorrect stimuli are equidistant from the learner. The initial placement of the correct stimulus closer to the learner increases the likelihood of their responding appropriately to the correct stimulus.

A number of studies have demonstrated that position prompting is an effective component of a training strategy to teach a failed discrimination. For example, Yu et al. (1990) used position prompting as a component of a training package to teach visual match-to-sample discriminations. Graham (1990) also included position prompting in a multi-component training package to teach a visual match-to-sample discrimination.

In addition to being an effective teaching strategy, there are a number of other advantages associated with position prompt-fading as compared to within-stimulus fading procedures (Yu et al., 1990). Firstly, the position prompt-fading procedure minimizes the probability of the learner attending to an

irrelevant stimulus. Secondly, in comparison to within-stimulus procedures, position prompt-fading procedures do not require extensive modification of the training stimuli. The latter feature suggests that position prompt-fading might be a more practical alternative for educational and vocational staff. Finally, position prompt-fading is considerably less invasive than other extra-stimulus prompting procedures such as pointing or physically guiding the learner.

Thus far, position prompt-fading has been utilized only to teach visual discriminations; however, it seems reasonable that it might also be effective to teach auditory discriminations. Therefore, position prompt-fading could be a useful and easily implemented component of a multi-component teaching package for teaching auditory identity matching.

Lack of motivation. Motivating developmentally disabled individuals is typically a very difficult task; as a result, these persons are often labelled as unresponsive or unmotivated (Egel, 1981). This lack of motivation has been demonstrated informally as well as empirically (e.g., Koegel & Egel, 1979), and has been found to complicate efforts to implement effective teaching procedures.

One method that has been suggested to improve motivation is stimulus variation and novelty. A practical implementation of stimulus variation and novelty has been in the form of reinforcer variation, for example, giving the individual a choice of a variety of edible reinforcers. Several studies have documented the effectiveness of this strategy. For example, Egel (1980) found that autistic children demonstrated higher rates of bar pressing in a varied-reinforcer condition than in a constant-reinforcer condition. Likewise, Egel (1981) demonstrated that a varied presentation of edible reinforcers resulted in high levels of correct responding and on-task behavior with no deleterious satiation effects.

Reinforcer variation has also been implemented and found effective with sensory reinforcers (Rincover, Newsom, Lovaas, & Koegel, 1977). It has been demonstrated that a sensory reinforcer such as vibration can act as a powerful reinforcer for developmentally disabled individuals, and may be more powerful than praise or approval reinforcement alone (Johnson, Firth, & Davey, 1978). Therefore, the utilization of a variety of reinforcers has substantial

potential as a strategy for increasing motivation and decreasing the likelihood of satiation. Based on previous research, it seems reasonable to suggest that varying the types of reinforcers that are presented to the learner could ameliorate motivational deficits and satiation difficulties.

Statement of the Problem

Study 2 examined a multiple-component training package that included: (a) the use of relatively simple auditory stimuli, (b) position prompt-fading, and (c) reinforcer variation. The primary hypothesis was that this multi-component training package would be effective in facilitating the acquisition of a two-choice, auditory identity matching discrimination. A secondary hypothesis was that once a participant met passing criterion on the training task, they would also pass the auditory identity matching assessment that was described previously. The latter hypothesis was based on Kerr et al.'s (1977) finding that learning a particular level of discrimination facilitated generalization to other tasks requiring the same kind of discrimination.

Method

Participants

There were five participants in Study 2. Three participants were residents of the St. Amant Centre and two participants were clients at the W.A.S.O. sheltered workshop. All five participants were assessed on the ABLA Test and the auditory identity matching assessment (described in Study 1) prior to the commencement of training. Participants were those individuals who passed ABLA Test levels 1 through 4 but failed at higher levels, and also failed the simultaneous and delayed auditory identity matching tasks.

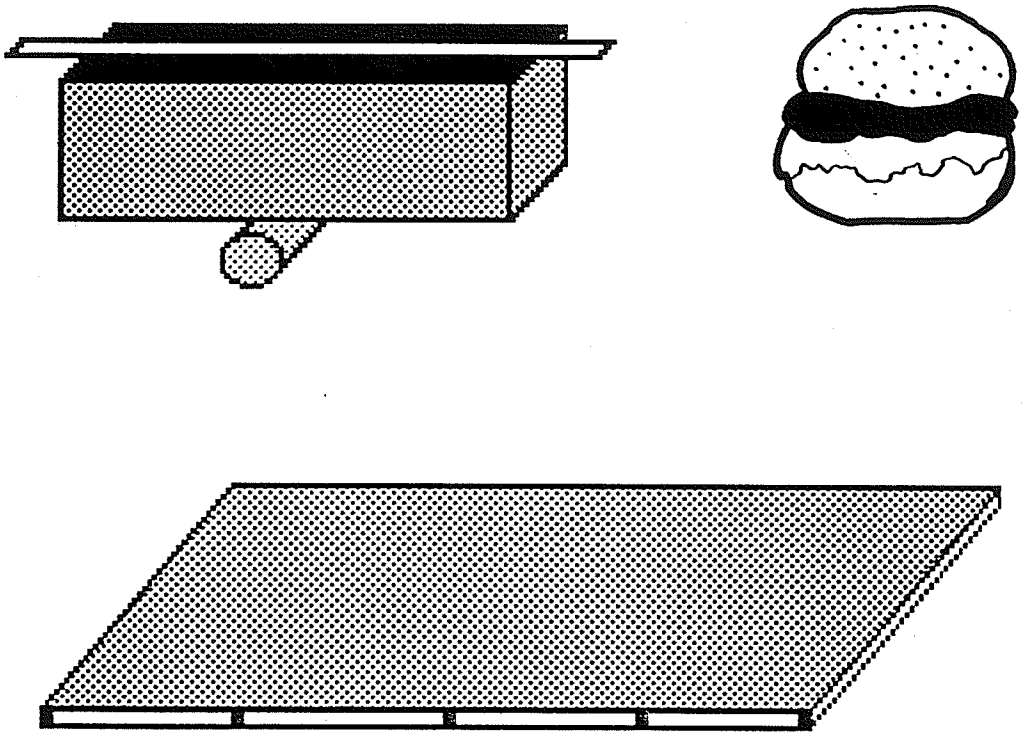
Setting and Materials

Teaching sessions took place in an experimental room in the Psychology Department of the St. Amant Centre or in a separate room at the W.A.S.O. sheltered workshop (the same as those described in Study 1). During the teaching sessions, the participant was seated at a table or in a wheelchair across from the experimenter. During some sessions, there was also an additional observer seated across from the participant. Each teaching session was approximately thirty minutes in duration.

The training task involved two sets of stimuli, one each for the experimenter and participant. Each set included two stimuli: a round, brown rubber squeak toy in the shape of a hamburger (5 cm in height, and 7.5 cm in diameter), and a rectangular-shaped, red tin can (7.5 cm by 7.5 cm by 9.5 cm) with eight glass marbles placed inside. The bottom of the tin can was attached to a wooden dowel, 15 cm in length and 2 cm in diameter; the glass marbles were 1.5 cm each in diameter. In addition, there was a flat piece of red wood (15 cm by 1 cm by 0.6 cm) mounted lengthwise on top of the tin can to facilitate the learner's ability to operate the tin can apparatus, such that when the tin can apparatus was rolled from side to side, it produced a sound as the marbles moved inside the tin can. The materials used for the training task are shown in Figure 3.

In addition to the two stimuli, a wooden rectangular tray (30.5 cm by 122 cm by 1.2 cm) was used on which to present the stimuli to the participant. The tray had black markings on one edge which served as guidelines for position prompt-fading. Three sets of markings were used: a midpoint mark used to designate the exact center of the tray; "prompt level 1" markings

Figure 3 Illustration of training task materials



that were 30.5 cm on either side of the midpoint; and "prompt level 2" markings that were 61 cm on either side of the midpoint. The stimuli were presented to the participant on top of the wooden tray such that the markings were visible only to the experimenter (see Figure 3).

Sounds were produced either by pressing downward on the squeak toy or by using the flat piece of wood as a lever that would cause the can to roll from side to side and produce a sound as the glass marbles moved inside the tin can.

Data sheets modeled after Kerr et al.'s (1977) ABLA auditory task were used for data collection (see Appendix C). A procedural reliability checklist was also used for the training task (see Appendix D).

Procedure for Teaching Auditory Identity Matching

At the beginning of all sessions, the participant was seated at a small table or in their wheelchair across from the experimenter. The wooden tray was placed on top of the table (or wheelchair arms) such that the prompt-fading markings were visible only to the experimenter.

There were a series of four stages included in the procedure for teaching auditory identity matching. The

stages corresponded to different levels of prompts that were available to the participant (see Table 3 for summary of stages). During all teaching sessions, if the participant met passing criterion at a particular stage, they progressed to the next stage in the series. However, if the participant reached failure criterion at a particular stage, they were returned to the previous stage in the series. Following the initial session, each teaching session began at a "lower" stage (i.e., greater degree of prompting) than that at which the previous session had been terminated. For example, if the participant finished the second teaching session at Stage 3, the third teaching session began with Stage 2 prompts.

Stage 1: Preliminary demonstration and imitation trials. Initially, imitation and demonstration trials were conducted for each of the two sounds. These trials were conducted similar to Kerr et al.'s (1977) procedure for the imitation level of the ABLA Test (i.e., ABLA level 1). For the imitation trials, there was only one stimulus (i.e., either squeak toy or tin can; see Table 2) present on the tray that was in front of the participant. The stimulus was placed at the center point of the apparatus tray directly in front of

Table 3

Summary of stages used in training procedure

Stage	Procedure
1; Imitation and Demonstration Trials	
	- one stimulus (either squeak toy or tin can) presented on tray and directly in front of participant
	- same stimulus placed on table in front of experimenter
2; Level 2 position prompt and Visual Prompt	
	- both stimuli presented to participant on tray; "correct" stimulus placed directly in front of participant; "incorrect" stimulus placed at far left-hand or far right-hand side of tray
	- "correct" stimulus placed on table in front of experimenter and visible to participant
3A; Level 2 Position Prompt only	
	- both stimuli presented on tray to participant as in Stage 2

(table continues)

Summary of stages used in training procedure

Stage	Procedure
	- experimenter's stimuli out of sight of participant
3B; Level 1 Position Prompt only	
	- both stimuli presented to participant on tray; "correct" stimulus placed directly in front of participant, "incorrect" stimulus placed at the right- or left-hand level-1 prompt marking on tray
	- experimenter's stimuli out of sight
4; No Visual or Position Prompt	
	- stimuli equidistant from participant
	- experimenter's stimuli out of sight

the participant. The experimenter had the same stimulus as the participant's placed on the table in front of her.

First, the experimenter demonstrated a sound with her stimulus (i.e., either squeak toy sound or marbles in can sound) while saying "make the same sound." Following this, a physically guided trial was conducted with the experimenter producing a sound and saying "make the same sound" while guiding the participant to produce the sound that the experimenter had produced. Next, the experimenter produced a sound and the participant was instructed to "make the same sound," thus providing an opportunity for an unassisted response. Following an independent response, the participant was given additional independent response trials with the experimenter giving the instruction "make the same sound." This procedure was conducted with each of the two sounds presented individually (i.e., imitation trials were done with squeak toy alone and with tin can apparatus alone). For each of the imitation trials the experimenter presented a sound "continuously" for 10 seconds while saying "make the same sound." For these trials, "continuously" was defined as presenting the sound for a cumulative period

of 10 seconds, but individual sounds were presented at two second intervals.

For the imitation trials, responses were scored as correct if the participant made the sound that matched the sound that had been presented by the experimenter. For example, if the experimenter had presented the tin can sound, a correct response was defined as the participant making the tin can sound by operating the tin can apparatus. If the participant had not responded within 15 seconds the teaching stimuli were removed from the table, the trial was discontinued, and a new trial was initiated. A failure to respond was not included in the percent correct computations (i.e., with percent correct being the dependent variable). Passing criterion for Stage 1 was four consecutive correct responses to each stimulus. Once the participant had met passing criterion for Stage 1, they proceeded to Stage 2.

Correct responses were followed by social reinforcement and an additional reinforcer, whose type was varied across trials. Reinforcers available included edibles (e.g., dry cereal, fruit juice), sensory reinforcers (e.g., visual stimuli such as pictures, auditory stimuli such as music and

sound-producing toys), and tactile reinforcers (e.g., touch and vibration from a hand-held massaging device). In addition to obtaining information from staff members regarding individual reinforcers, a variety of reinforcers were informally pretested for each participant prior to the beginning of training to evaluate their effectiveness. Reinforcer selection was based on the participant's perceived enjoyment of the reinforcer. For example, if they smiled, clapped, manipulated the reinforcer (e.g., touching picture books, clapping to music etc.), chose a particular type of edible, and so forth, then it was judged that these items would be effective reinforcers.

In all stages following Stage 1, both stimuli were placed on the participant's apparatus tray and their left-right positioning remained the same across trials. The squeak toy was consistently on the experimenter's left-hand side and the tin can was consistently on her right-hand side.

Stage 2: Training trials with level-2 position prompt and visual prompt. During Stage 2 trials, the tray was placed in front of the participant with both stimuli placed on top. On each trial, the "correct" stimulus was placed directly in front of the

participant at the midpoint of the apparatus tray, while the "incorrect" stimulus was placed at the level-2 position prompt marking on the tray (i.e., either on the experimenter's far left-hand or far right-hand side). In addition, the experimenter had the "correct" stimulus placed on top of the table directly in front of her, thus providing a visual prompt for the participant. The identity of the correct and incorrect stimuli were varied randomly across trials according to the data sheet.

At the beginning of Stage 2 training trials, the participant was given a demonstration of the required response, a physically guided trial, and an opportunity to perform the response independently. The demonstration trial involved the experimenter producing a sound with the stimulus that was in front of her for approximately 3 seconds; then, while saying "make the same sound," the experimenter produced a matching sound on the "correct" stimulus that was directly in front of the participant. For the physically guided trial, the experimenter produced a sound on the stimulus that was in front of her, then, while saying "make the same sound," guided the participant to produce a matching sound on the "correct" stimulus that was directly in

front of him or her. Following the guided trial, the participant was given an opportunity to respond unassisted. This procedure was conducted for each of the two sounds. Once the participant had made one correct response to each stimulus, scoring commenced.

On each scored trial, the experimenter began by saying the participant's name in order to ensure attending behavior and then gave the instructional prompt "make the same sound." Following this, the experimenter presented one of two distinctive sounds (i.e., the squeak toy sound or the tin can sound) by operating the stimulus that was directly in front of her continuously for a period of 10 seconds.

Correct responses were defined as the participant producing a sound that matched the sound produced by the experimenter. Correct responses were consequated with social reinforcement and an additional reinforcer that was administered in the same manner as that described for the Stage 1 imitation trials. Incorrect responses were defined as the participant producing a sound that did not match the sound that had been presented by the experimenter. If the participant responded incorrectly, the experimenter said "no, (name)", removed all stimuli from the table and

administered a brief time-out (e.g., 5 seconds) before the next trial was presented. If the participant had not responded within 15 seconds, the teaching stimuli were removed from the table and a brief time-out (e.g., 5 seconds) was implemented before the next trial was presented.

Passing criterion for Stage 2 was defined as eight consecutive correct responses. If the participant demonstrated mastery at Stage 2, they progressed to Stage 3. Failure criterion was defined as eight cumulative incorrect responses. In case of failure at Stage 2, the participant was returned to Stage 1.

Stage 3: Training trials with no visual prompt and gradual position-prompt fade. Stage 3 was comprised of two substages, which were labelled as Stage 3A and 3B. Stage 3 was different from Stage 2 in two respects. Firstly, during all Stage 3 trials, the visual prompt was removed by placing the experimenter's stimuli out of sight of the participant. This was accomplished by placing the stimuli in a cardboard box whose opening faced the experimenter. Thus, the participant could not see the stimuli as they were being manipulated to produce the sound.

Secondly, the position prompt was gradually faded in Stage 3 from a level-2 position prompt to a level-1 position prompt. During Stage 3A there was a level-2 position prompt; that is, the correct stimulus was placed in the center of the apparatus tray, directly in front of the participant, while the incorrect stimulus was placed at the level-2 position prompt. As in Stage 2 trials, depending upon the identity of the correct and incorrect stimuli, the incorrect stimulus was placed either on the experimenter's far right-hand or left-hand side. During Stage 3A, correct and incorrect responses were defined and consequated in the same manner as described for Stage 2. Passing criterion was four consecutive correct responses while failing criterion was four cumulative incorrect responses. When the participant met passing criterion, they progressed to Stage 3B. If the participant reached failing criterion, they were returned to Stage 2.

Stage 3B was similar to Stage 3A with one modification: the position prompt was faded from a level-2 position prompt to a level-1 position prompt. For all Stage 3B trials, the correct stimulus was placed in the center of the apparatus tray, directly in front of the participant. Depending upon the identity

of the incorrect stimulus, it was placed at either the right-hand or left-hand side level-1 position prompt marking. Correct and incorrect responses were defined and consequated in the same manner as described previously. Pass/fail criterion were identical to that described for Stage 3A. When a participant met passing criterion for Stage 3B, they progressed to Stage 4. If they reached failure criterion, they were returned to Stage 3A.

Stage 4: Training trials with no visual or position prompt. At stage 4, there were no visual or position prompts. The two stimuli were placed equidistant from the center of the apparatus tray and from the subject. The left-right positioning of the stimuli did not change across trials. In their final positions, the stimuli were approximately 52 cm apart, with each being 26 cm away from the midpoint of the apparatus tray. On each trial, the experimenter gave the instructional prompt "make the same sound" and presented one of the sounds by manipulating one of her stimuli. The identity of the "correct" stimulus was randomly alternated across trials according to the data sheet. Correct and incorrect responses were defined and consequated in the same manner as described

previously. Mastery criteria for Stage 4 was eight consecutive unprompted correct responses, failure criterion was eight cumulative incorrect responses. In case of a failure at this level, participants were returned to Stage 3A. When participants met mastery criterion for this stage, and therefore for the training task, they were subsequently retested on both the auditory matching assessment and the ABLA Test auditory discrimination task.

Those participants who mastered the training task also received a series of posttraining assessments to evaluate learning retention. One-week, one-month, and three-month posttraining assessments were done in which the participant was retested on the final stage of the training task, the auditory identity matching tasks, and the ABLA Test.

Reliability Assessments

Interobserver reliability and procedural reliability checks were collected for 30% of the training sessions. Interobserver reliability assessments involved having two observers independently and simultaneously record the participant's responses (i.e., correct vs incorrect). Procedural reliability assessments involved having two observers independently

complete a procedural reliability checklist in order to ensure that training procedures were implemented correctly and consistently. The checklist summarized the sequence of steps that was to be followed for each trial of the training session (see Appendix D).

Interobserver agreement and procedural reliability agreements were calculated by dividing the number of agreements by the number of agreements plus disagreements, and then multiplying by 100.

For training task sessions, interobserver agreement on participants responses was 100% for all training sessions. The procedural reliability data demonstrated that the experimental procedures were implemented accurately throughout the training sessions. Mean interobserver agreement for this measure was 99.5%.

Experimental Design

A multiple-baseline-across-individuals research design was used in order to evaluate the effectiveness of the training package (for a description of the design, see Martin & Pear, 1988). The baseline measures were the ABLA Test and auditory identity matching tasks described previously. Following the baseline assessments, each participant received

training on the training task described previously. The training package was implemented sequentially across two groups of participants in order to assess experimental control. One multiple-baseline-across individuals was comprised of the three participants at the St. Amant Centre. The second multiple-baseline included the two participants at the W.A.S.O. sheltered workshop. For all participants except the first in each sequence, the baseline assessments were repeated immediately prior to the commencement of training in order to ensure that there had not been any change in the participant's status since the time of the initial assessment.

Results

The results of the baseline assessments and training package implementation are shown in Figures 4 and 5. The results for Participants 1,2, and 3 (St. Amant residents) are shown in Figure 4, and the results for Participants 4 and 5 (W.A.S.O. workshop clients) are shown in Figure 5. All five participants failed the baseline assessments on the ABLA Test (i.e., failed level 5; the auditory discrimination level), as well as the auditory identity matching assessment. After the training package was introduced, three of the five

participants (i.e., Participants 1, 2, and 5) achieved mastery criterion on the training task. Two of the five participants (i.e., Participants 3 and 4), however, failed to learn the training task even after over two hundred training trials each.

The three individuals who reached passing criterion did so in 46, 53, and 52 trials respectively. Participant 1 achieved passing criterion in only one training session, while Participant 2 required two sessions, and Participant 5 required three sessions. All three participants progressed steadily through thetraining stages with relatively few errors; furthermore, once they has reached the final stage of the training program, none had to return to a prior stage for additional prompted training trials. Thus, with these three participants, the training effect was relatively large and immediate.

For two participants, the training package was not effective. Participant 3 received 239 training trials over 8 training sessions, and reached Stage 4 of training (i.e., the final stage, in which no visual or position prompts were available) a number of times. However, each time the final stage was reached it was failed, resulting in a return to a prior stage and

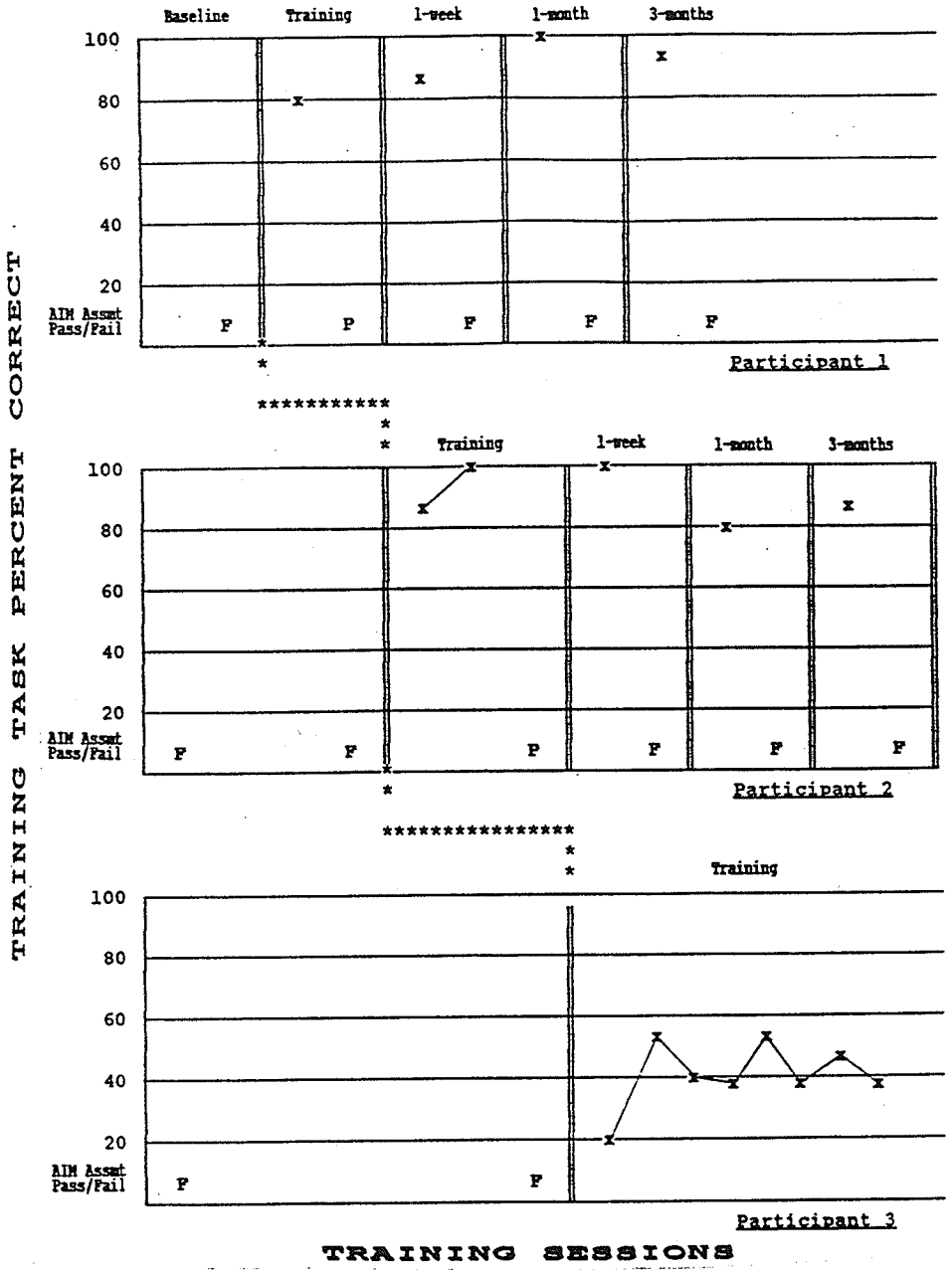


Figure 4. Results of AIM assessments and training task for Participants 1, 2, and 3. Shaded squares represent percentage of unprompted correct responses on training task per session, and P/F indicates whether the AIM assessment was passed or failed.

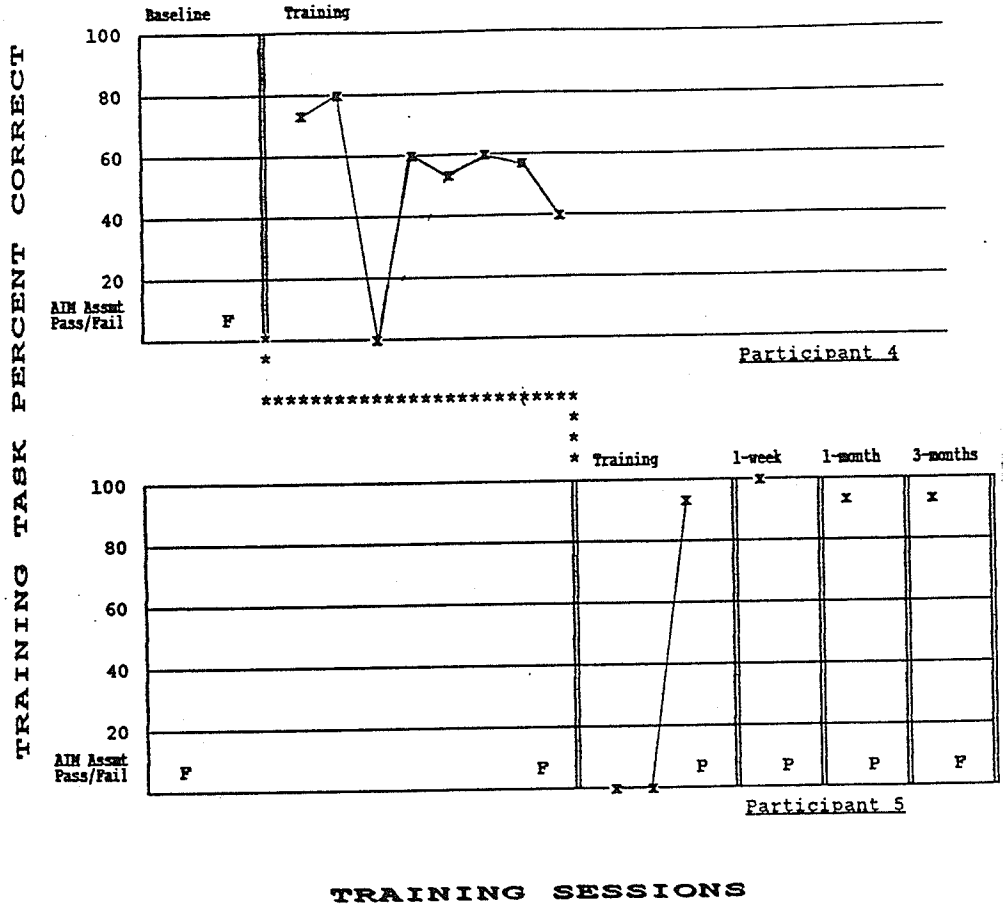


Figure 5. Results of AIM assessments and training task for Participants 4 and 5. Shaded squares represent percentage of unprompted correct responses on the training task, and P/F indicates whether the AIM assessment was passed or failed.

additional prompted training trials (i.e., with a visual and/or position prompt).

Participant 4 received 228 training trials across 8 training sessions. As can be seen in Figure 5, performance deteriorated over time. Similar to Participant 3, this participant reached Stage 4 on numerous occasions, but always reached failure criterion and was returned to a previous stage for additional prompted training trials.

Discussion

Study 2 was designed to evaluate the effectiveness of a multiple-component training package comprised of the presentation of "simple" sounds, position prompt-fading, and reinforcer variation. The primary hypothesis was that the training package would be effective in teaching participants an auditory identity matching discrimination. This hypothesis was supported for three of five participants, all of whom mastered the training task quickly and in relatively few trials.

A secondary hypothesis was that if participants learned the training task discrimination, then they would subsequently pass the auditory identity matching assessment that had been failed on baseline measures. The secondary hypothesis was also supported for the

three participants who had passed the training task. After passing the training task, Participants 1, 2, and 5 also met passing criterion for the simultaneous and delayed auditory identity matching tasks. After passing the training task and the auditory identity matching tasks, each participant was assessed on the ABLA auditory discrimination task (i.e., ABLA Test level 5). None of the three participants who passed the training task met passing criterion on the ABLA Test auditory discrimination task.

The latter finding might be an indication that, as suggested by Lamberts (1981), speech discriminations are more complex and thus more difficult to learn than sound discriminations. In this research, Lamberts (1981) examined two forms of auditory information, namely auditory "signs" and "symbols." An auditory "sign" was defined as a sound that was representative of a meaningful event; for example, the sound of a door opening would represent the event of another individual entering the room. In comparison, an auditory "symbol" was defined as an abstract linguistic entity that had no meaning other than that which had been arbitrarily assigned to it. Lamberts (1981) found that tasks involving "signs" were more easily learned by

developmentally disabled individuals as compared to tasks involving abstract linguistic symbols.

With respect to the present research, the sounds that were used in both the training task and the auditory identity matching tasks could be part of a larger category of relatively "simple" sounds that include the sounds that Lamberts (1981) defined as "signs." Within this framework, it is conceivable that the ABLA auditory speech discrimination (or "symbol" discrimination) would be more difficult to learn than both the training task and the auditory identity matching sound discriminations.

In addition to the immediate posttraining auditory identity matching assessments and ABLA Test, there were further posttraining assessments done at one week, one month, and three months to assess retention. Two consistent findings among these results were that all participants passed the training task discrimination and failed the ABLA Test auditory discrimination at all posttraining assessments. In comparison, the results of the one-week, one-month, and three-month posttraining auditory identity matching assessments demonstrated considerable variability.

At the one-week posttraining auditory matching assessment, Participant 1 passed both auditory identity matching tasks, but failed the same tasks at the one-month and three-month assessments. It is not completely clear why this pattern of results was obtained. As stated previously, it is expected that once a particular level of discrimination has been passed, new tasks that require the same type of discrimination will be learned relatively easily (Kerr et al., 1977). Therefore, because they require the same type of discrimination skill, it would be expected that an individual's passing the training task would facilitate their passing the auditory identity matching tasks. Thus, the results of the one- and three-month assessments on the auditory identity matching tasks are contrary to expectations. It is possible that boredom or a loss of reinforcer effectiveness might have contributed to failure on these tasks, although there was no objective evidence to support these speculations.

Similar to the posttraining auditory matching assessment results for Participant 1, the results for Participant 2 also demonstrate considerable variability. At the one-week and one-month

posttraining assessments, this participant passed the delayed auditory identity matching task, but failed the simultaneous auditory identity matching task. At the three-month posttraining assessment, both the simultaneous and delayed auditory identity matching tasks were failed. These results are somewhat contradictory to what would be expected. It was suggested previously that a simultaneous matching task might be easier than a delayed matching task due to the continuous availability of the sample stimulus in the simultaneous task. For Participant 2, however, the results indicate the opposite; that is, the delayed matching task was in some way easier than the simultaneous one.

There are a number of possible explanations for these contradictory results. Casual observations of Participant 2 suggested that, while the sound was being presented during the simultaneous auditory matching task, she was very excited as indicated by her laughing and clapping her hands. She did not seem to be attending to the task, and it is possible that it was more reinforcing for her to laugh and clap than it was to attend to the experimenter's instructions and the task requirements. In comparison, during the delayed

auditory matching trials, she did not exhibit these types of behaviors and seemed to be attending to the task. Perhaps her failure to pass the simultaneous matching task on some assessments is partially attributable to a lack of attention to the task and the presence of a competing source of reinforcement (i.e., self-stimulation in the form of laughter and clapping).

The results of the one-week, one-month, and three-month posttraining auditory matching assessments for Participant 5 are the most consistent of all three participants. After passing the training task, at both the one-week and one-month posttraining assessments, this participant passed both simultaneous and delayed auditory identity matching. However, at the three-month posttraining assessment, he failed the auditory matching tasks. With the exception of the last posttraining assessment, these results are consistent with Kerr et al.'s (1977) finding that once a particular type of discrimination has been learned, subsequent discrimination tasks that require the same type of discrimination will be learned more readily.

In general, all three participants who passed the auditory identity matching assessment immediately following their training period showed only partial

generality over time with respect to these tasks. It is possible that the failure to show consistent generality over time was the result of the absence of specific procedures to program for generalization. For example, in the participants daily routines there appeared to be very little exposure to auditory matching tasks. This lack of regular exposure to tasks with similar contingencies to the training task is a possible explanation for the observed lack of generality over time. As Stokes and Baer (1977) argued, there is a need to actively program generalization rather than passively expecting that generalization will occur as a function of the training procedures.

Participants 3 and 4 failed to learn the training task discrimination, even after over 220 training trials each. For Participant 3, there were very few sessions in which higher than 50% correct was achieved in terms of unprompted training trials. This suggests that performance was at, or below, chance levels when there was no prompt available. Performance improved when either a visual and/or position prompt was available, however, it deteriorated when the prompt was removed.

There are a number of possible explanations for the failure of the training package with Participant 3, including participant inattentiveness and a lack of reinforcer effectiveness. The experimenter's observations suggested that the participant did not consistently attend to the experimenter's instructions or to task demands. Although the experimenter included the participant's name in the instruction at the beginning of each trial to enhance attending behavior, this did not appear to consistently control attending to the task. In addition, although the various reinforcers were informally pretested with each participant, it was not clear that any of the reinforcers were particularly effective for Participant 3.

Participant 4 also failed to learn the training task discrimination, even after 228 training trials. During the first few training sessions, Participant 4 obtained relatively a high proportion of unprompted correct responses; for example, during the first two sessions, this participant obtained 75% and 77% unprompted correct responses. In addition, there were several occasions on which Participant 4 was very close to achieving passing criterion. However, over the

course of the remainder of the training sessions, performance demonstrated a deteriorating trend. For the final training session, this participant was successful on only 42% of the unprompted training trials.

The possible explanations for this deterioration are similar to those suggested for Participant 3, that is, inattentiveness, and a lack of reinforcer effectiveness. For example, this participant would frequently look around the room while the experimenter was giving instructions, and did not seem to be attending to the task. This participant also exhibited a number of behaviors which may be characterized as "boredom," including looking around the room, sighing and signs of restlessness (e.g., drumming fingers on tabletop).

Although reinforcers were informally pretested and staff members recommendations solicited regarding suitable reinforcers for all participants, it might have been beneficial to conduct a more comprehensive initial reinforcer assessment as well as to evaluate reinforcer preference on an ongoing basis. Mason, McGee, Farmer-Dougan, and Risley (1989) utilized a reinforcer assessment package to initially select

reinforcers; in addition, they conducted mini-assessments at every session. They found that a thorough and frequent reinforcer assessment resulted in improved task performance and a decreased frequency of maladaptive behaviors. This type of reinforcer assessment might have been more useful, particularly for Participants 3 and 4, as compared to the informal reinforcer selection procedure that was used in the present study.

Regarding the reinforcers, a variety of reinforcers were utilized, however, none seemed to consistently affect the Participant 4's behavior. In consultation with the workshop staff who worked daily with this participant, it was determined that her work behaviors were characterized by the same lack of attention to tasks. Furthermore, no reinforcers had been found that were effective in ameliorating this deficit. In this workshop, it is possible that the attention received from staff in response to off-task behavior (e.g., staff member approaching and saying "Let's go, get back to work") was a more powerful reinforcer than the reinforcers obtained for on-task behaviors.

For Participants 3 and 4, it is possible that the training task would have been easier to learn if more "meaningful" sounds had been used. For example, Lamberts (1981) used sounds that were representative of a meaningful event to teach developmentally disabled learners a task (e.g., the sound of a toilet flushing or the sound of a door closing were defined as "meaningful" sounds). Another possibility is that the sounds utilized in the present study were not sufficiently different from each other; therefore, it might have been difficult for Participants 3 and 4 to consistently discriminate between them. Soraci, Barlean, Haenlein, and Baumeister (1986) found that developmentally disabled individuals had a lower sensitivity to changes in auditory relational information, that is, it was more difficult for them to differentiate between two different auditory stimuli. Although the sounds utilized in the training task were different in both pitch and duration of sound, it is conceivable that Participants 3 and 4 experienced some difficulty in differentiating between them.

As stated previously, there has been relatively little research in the area of teaching auditory matching discriminations. The present study

demonstrated that a multiple-component training package that included the use of simple sounds, position prompt-fading, and reinforcer variation has considerable potential for teaching an auditory matching-to-sample task. The present study also indicated that there might be an intermediary between ABLA Test levels 4 and 5; namely, the level of auditory identity matching. While these findings are a useful addition to the existing body of ABLA Test research, they also generate a number of areas of concern that need to be addressed in future research.

First, additional research would be beneficial in the investigation of a teaching procedure that is effective with a greater number of participants. While the present research indicated that the training package used was effective for three of five participants, it is important to develop a training procedure that would be effective for most, if not all, participants. This might be achieved by including additional, or different, components in the multi-component training package.

Second, as mentioned previously, future research could address the issue of generality over time. As Stokes and Baer (1977) argued, it is necessary to

actively program for generalization, rather than passively hoping that it will occur as a consequence of the training procedures and the participant's natural environment. In the present research, the participants who passed the training task demonstrated limited generality of learning. Perhaps future research could investigate the implementation of appropriate generalization strategies.

Finally, it is important to investigate whether learning a relatively simple sound discrimination facilitates the acquisition of more complex auditory discriminations; such as speech discriminations. This particular line of research would be valuable in providing information regarding whether the proposed new ABLA Test level of auditory identity matching is, in fact, a useful addition to the existing ABLA Test. Furthermore, if mastering simple auditory discriminations does facilitate learning more complex auditory discriminations, then this might provide useful practical information for those individuals involved in working with the developmentally disabled population (e.g., teachers, vocational staff, and caregivers).

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Appendix A

ABLA Test Data Collection

Task #1 (Demonstration)
Present one container at a time
Trials: *Red Box*

1 2 3 4 5 6 7 8
9 10 11 12 13 14 15 16

Yellow Can

1 2 3 4 5 6 7 8
9 10 11 12 13 14 15 16

Task #2 (Position)
Correct stimulus is yellow can (Can & Box remain stable)
Trials:

1 2 3 4 5 6 7 8
9 10 11 12 13 14 15 16
17 18 19 20 21 22 23 24
25 26 27 28 29 30 31 32

Task #3 (Visual)
Correct stimulus is yellow can (or same as Task #2) positioned as indicated below.
Trials:

L R L L R L R R
1 2 3 4 5 6 7 8

R L L R L R R L
9 10 11 12 13 14 15 16

L L R L R R L R
17 18 19 20 21 22 23 24

R R L R L L R L
25 26 27 28 29 30 31 32

L R R L R L L R
33 34 35 36 37 38 39 40

Task #4 (Matching-to-Sample)
Red Box and Yellow Can alternate as indicated. Present Red Cube (box) or Yellow Cylinder (can) as indicated below.
Trials:

R R L R L L R L
C B B C C B B C
1 2 3 4 5 6 7 8

L L R R R L L R
B C B C B B C B
9 10 11 12 13 14 15 16

L L R L R R L R
B C C C B C B B
17 18 19 20 21 22 23 24

L R L L R R L L
B B C C C B B C
25 26 27 28 29 30 31 32

L R L L R R L L
B B C C C B B C
33 34 35 36 37 38 39 40

Task #5 (Auditory)
Correct stimulus is the one you ask for as indicated below. (Containers remain stable.)
Trials:

B B C B C C B C
1 2 3 4 5 6 7 8

C B C C B C B B
9 10 11 12 13 14 15 16

C B B C B C C B
17 18 19 20 21 22 23 24

B C B B C B C C
25 26 27 28 29 30 31 32

B C C B C B B C
33 34 35 36 37 38 39 40

Task #6 (AVC)
Correct stimulus is what you ask for as indicated below. Containers alternate as indicated below.
Trials:

R R L L R R L L
B C C B C B C B
1 2 3 4 5 6 7 8

L L R R L L R R
C C B C B B B C
9 10 11 12 13 14 15 16

L L R L R R L L
C C B C B C C B
17 18 19 20 21 22 23 24

R L R R L L R R
B C B B C C B C
25 26 27 28 29 30 31 32

Appendix B

Auditory Identity Matching Data Collection

Name:_____ simultaneous ___

Date:_____ delayed ___

Tester:_____

Observer:_____

T	B	B	T	B	T	B	T
T	B	T	B	B	T	B	B
T	B	T	T	B	T	T	B
T	T	B	T	B	B	T	B
B	T	B	B	T	B	T	T

T = tambourine sound

B = bell sound

Appendix C

Training Task Data Sheet

Name:_____ Time start:_____

Date:_____ Time finish:_____

Tester:_____

Observer:_____

S= squeak toy

T= tin sound

Stage 1	S	S	S	S	S	S	S	S	4 cons.
	T	T	T	T	T	T	T	T	4 cons.
Stage 2	T	S	T	T	S	T	S	S	
	T	S	S	T	S	T	S	T	8 cons.
	S	T	T	S	T	S	T	S	
Stage 3A	T	S	T	T	S	S	T	S	4 cons.
	S	S	T	S	S	T	S	T	
Stage 3B	S	T	T	S	T	S	S	T	4 cons.
	T	S	S	T	T	T	S	S	
Stage 4	S	T	T	S	T	T	S	S	8 cons.
	T	S	T	S	T	T	S	T	
	T	S	T	T	S	S	T	S	

Appendix D

Procedural Reliability Checklist

	1	2	3	4	5	6	7
(1) began at correct stage (i.e., 1,2,3a,3b,4)							
(2) **if at stage 1:** - did imitation trials **if at stage 2:** - stim. visible + Level 1 position prompts **if at stage 3A:** - stimuli hidden + Level 1 position prompts **if at stage 3B:** - stimuli hidden + Level 2 position prompts **if at stage 4:** - stimuli hidden + no position prompts							
(3) gave instructional prompts ("---, make the same sound)							
(4) presented sound at approx. 2 sec. intervals for 10 sec.							
(5) recorded response (√P, √NP, X, NR)							
(6) if response correct, then: (a) verbal praise (b) varied reinforcer							
(7) if response incorrect: (a) "No" (b) removed teaching app. (c) 5 sec. time-out							
(8) if NR after 15 sec., then: (a) removed teaching app. (b) 5 sec. time-out (c) began new trial							

√P = prompted correct response
√NP = unprompted correct response
X = incorrect
NR = no response