

# Acquisition of Fluent Listener Responses and the Educational Advancement of Young Children with Autism and Severe Language Delays

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We investigated the effects of a “listener emersion” procedure on pre and post numbers of weekly instructional trials (learn units) required to meet instructional objectives in all curricular programs for 8 children with autism (3 and 4 years old) using a multiple probe design across participants. The students had few or no functional verbal repertoires (speech or alternative forms) and their teachers were having difficulty achieving instructional objectives for matching, basic discriminations, and instructional control learning with the students. The dependent variable was the weekly numbers of learn units the students required to achieve instructional objectives in all curricular programs 1 week before, and 2 weeks after the listener emersion. All curricular programs were suspended during the implementation of listener emersion and the students were required to master several sets of listener responses such that the responses could only be controlled by the auditory components of teachers’ audio-taped speech, first to a mastery criterion without a rate requirement and then to mastery with rate of responding criterion. Following listener emersion the students required from one half to ten times fewer learn units to achieve objectives. The results are discussed in terms of the importance of a listener repertoire to children’s advancement and the identification of key developmental levels of verbal behavior.

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Early in the research on the treatment of children with autism, Lovaas (1977) emphasized the importance of “instructional control” on the development of speech and other cognitive repertoires such as matching, pointing, or responding to antecedent stimuli along with vocal antecedent stimuli (multiple vocal and visual control). The term “instructional control” in one usage refers to compliance as in coming under the reinforcement control of a teacher or therapist. Compliance may not be only controlled by the teacher’s speech per se but by visual cues or the sequence of instructional presentation. Although this early level of instructional control is a necessary step, the acquisition of the auditory components of speech is critical to the achievement of true

listener status (Greer, 2002). Skinner’s (1957) treatment of the expression “instructional control”, in his theory of verbal behavior, refers to the control exerted by the auditory properties of speech on responding, specifically the control exerted by vowel-consonant combinations. While Skinner’s verbal behavior was said, even by him, to be concerned with behavior from the perspective of the speaker, the listener plays a considerable role particularly with regard to the behavior of the speaker (Skinner, 1989).

The role and importance of the listener repertoire has received increasing attention in the basic research in verbal behavior and the acquisition of more complex cognitive repertoires or higher order operants (Catania, 1998; Hayes, Barnes-Holmes, & Roche, 2000; Lodhi & Greer 1989; Lowe, Horne, Harris, & Randle, 2003). Lodhi and Greer (1989) identified the observable role

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of the listener in “speaker-as-own listener” component of self-talk in typically developing five year-olds. They found that the children acted as both speaker and listener when they engaged in self-talk during solitary play. Another function of speaker as own listener was identified by Horne & Lowe (1996) and is referred to as “naming.” The repertoire of naming has been associated with the emergence of untaught relations as in the case of children learning a tact for abstract symbols and then emitting listener responses for the tact stimuli without direct instruction, or hearing the tact emitted by another and using it as a speaker without direct instruction (Lowe et al., 2002). Naming is a repertoire that makes the incidental learning of new verbal functions and forms possible thereby providing for the rapid expansion of language function. In addition, research in relational frame theory demonstrated the importance of the listener in derived relations and the transformation of stimulus control in complex verbal behavior (Barnes-Holmes, Barnes-Holmes, & Cullinan, 2001).

The identification of the role of listener repertoires in the development of verbal and complex cognitive repertoires provided new sources of inquiry in analyzing and providing remediation of severe communicative delays. However, mastery of the typical instructional compliance objectives by children with autism and other delays does not necessarily bring the child’s responses under the control of the auditory properties of speech and hence does not assure the acquisition of basic listener repertoires. Without these basic listener repertoires it may be difficult, if not impossible, to make instructional gains beyond minimal instructional compliance. Results of studies by Carr et al. (1978) and Carr and Kologinsky (1983) showed that children with autism who had failed to develop a vocal verbal repertoire, acquired a verbal repertoire following a specific training procedure. Furthermore, results from the Carr et al. study showed that, for at least some of the participants, correct responses were controlled by the visual cues of the stimuli rather than the auditory cues related to those same stimuli.

One scheme for classifying children for instructional purposes is to identify them according to levels and categories of verbal behavior

repertoires rather than traditional developmental or diagnostic criteria (Greer, 1992; Greer, 2002; Greer & Keohane, 2005; Greer & McCorkle, 2003). This categorization scheme has been used successfully for instructional purposes in several schools for children with autism or typically developing children. Also the classification levels have been used successfully for adolescents with environmentally induced language delays (Greer, Keohane, & Healy, 2003; Hart & Risley, 1986). The broad categories include students who are: (a) pre listeners, (b) listeners (students who are vocally verbally governed), (c) speakers (students who can govern the behavior of others verbally with signs or speech), (d) speaker/listeners or individuals who can engage in conversational units with others (Donley & Greer, 1993), (e) speakers as own listeners or the “self-talk” repertoire (Lodhi & Greer, 1989) including naming, (f) readers, (g) writers, (h) writers as own readers or self-editors.

The different levels of verbal behavior have been tied to levels of independence, such that each increment in the students’ verbal repertoires is related to levels of independence (Greer, 2002). Students who are pre listeners, are those without listener repertoires, and they are the most dependent, and arguably the most disabled. In this scheme the verbal levels of the children are used to determine teacher and pupil ratios and types of research-based tactics that are most successful for the particular level of verbal behavior of the students (Greer, 2002).

According to Foxx (1977) and Lovaas (1977) among others, a crucial first step in teaching individuals with developmental disabilities is to teach them basic prerequisites such as eye contact. Hamlet, Axelrod, and Kuerschner (1984) showed that training eye contact prior to instruction increased the levels of compliance by double and triple that of baseline. These findings support previous literature that has stressed the importance of compliance as the first step of instruction (Lovaas, 1977). Compliance instruction brings the child under the control of the teacher’s reinforcement operations.

However, acquiring instructional control as a type of compliance, while an essential first step, does not necessarily mean that the children have

learned the correspondence between the spoken auditory vowel and consonant stimuli of their teachers and children's responding. Even with the most carefully controlled instruction, some pre-listener children learn visual cues for performing instructional control responses to vocal antecedents such as "sit still," "look at me," or "do this." They do not necessarily acquire basic listener repertoires, although some do. The result is that for those who are not under the control of the auditory properties of their teacher's speech, these children's progress reaches a plateau because they are not responding to the discriminative auditory properties of speech; the instructional control is not governed by auditory stimuli but by visual and other contextual cues. Their listener repertoire has not emerged.

Acquiring listener responses that truly correspond to the auditory properties, and only the auditory components of a teacher or parent's speech as discriminative stimuli, is an essential prerequisite step, and we argue a necessary one, for learning more complex repertoires including the repertoire of "naming" (Horne & Lowe, 1999) or the development of self-talk (Lodhi & Greer, 1989). Without the true listener repertoire, the child cannot be part of the listener component of the verbal community, even if they develop speaker repertoires (Skinner, 1957). Pre-listeners cannot learn a listener response and emit speaker responses that are not directly taught. If they are not part of the verbal community it is difficult, if not impossible, for these children to acquire social repertoires (Culotta & Hanson, 2004). Often, though not necessarily, the acquisition of speaker behavior (vocal or sign or other verbally governing topographies) is dependent on the prerequisite repertoires--true listening (or in the case of signing, the visual stimulus control of signs). One simple test of whether a student has listener responses to speech is to request the student to do something, while the teacher emits a different response (e.g., the teacher says "point to your nose" and simultaneously touches her head). Alternately, one may insert a different vocal statement with the same syllables and inflection as used in a "stand up" command (i.e., the teacher says "cross over"). If in either case the student emits the wrong response to the auditory

properties of the speech, the child does not have true listener responding. If they do what you do, rather than do what you have told them to do, or if they respond to a nonsense instruction in the context of a compliance instructional program, it is likely that they are not responding to the auditory properties of speech.

The purpose of the research reported herein was to investigate the utility of a procedure in which we suspended all instruction except the intervention we describe as "listener emersion." In this procedural tactic we introduced intense instruction that required the student to respond only to the auditory properties of speech rather than other cues. Once the student met the criterion for listener emersion, we returned the student to the instructional goals that they were not achieving prior to the acquisition of a listener repertoire. The goal was to teach the child such that she could only be successful by truly listening and thereby foster the emergence of the listener repertoire. We then tested to see if their acquisition of skills across their instructional curricula would improve. Similar tactics such as speaker immersion (Ross, 1995) or writer emersion (Jadlowski, 2000) have been used to evoke the functional usage of these different speaker and writer repertoires with success. However, this paper presents the first test of such a procedure on the development of true listener responding. Presumably, acquisition of the listener repertoire should result in decreases in instructional interactions needed by the child to acquire repertoires across her curriculum, thereby improving the child's prognosis.

## Method

### *Participants*

There were 8 participants in this study. They all attended a preschool for children with and without developmental delays. The participants ranged in age from 3 to 4 years old. All of the participants emitted pre-listener and pre-speaker levels of verbal behavior. These participants were chosen for this study because they emitted low numbers of correct responses to instructional trials or learn units across all of their curricular programs and their weekly learn units to criterion were much higher than those experienced by other children

in the programs. Learn units are instructional presentations, either incidental or massed, that meet criteria identified in the research literature as strong predictors of learning (Greer, 2002). These students also differed from the peers in their classrooms in terms of instructional history. Research based tactics such as teacher modeling (Rose, 1984), establishing operations (Michael, 1988), and interspersal of known items (Dunlap & Koegel, 1980) were effective in teaching their peers under learn unit conditions; however, when these and numerous other tactics from the literature, were implemented with these participants, they did not achieve targeted skills. Each student is described in detail in Table 1. Each participant was tested by their local agency; and the researchers had no control over which tests were administered or how and what scores were reported. Therefore, the information reported for these varies across participants. All standardized test scores and age equivalences accessible to the researchers were reported.

### *Setting*

The study was conducted in a publicly funded private school for children with and without developmental delays located outside a major metropolitan area. The school utilized the CABAS<sup>®</sup> (Comprehensive Application of Behavior Analysis to Schooling) model of instruction (Greer, 1992). All instructional responses were measured with frequent interobserver checks on the accuracy of teacher recording using the Teacher Performance Rate Accuracy Observation Procedure (Greer, 2002; Ingham & Greer, 1992).

Participants A, G, and H attended a half-day Early Intervention classroom with six students, two teachers, and one teacher assistant. Participants B, D, E, and F attended a full day preschool classroom with six students, one teacher and two teacher assistants. Participant C attended a half-day program with a 1:1 staff-to-student ratio.

### *Definition of Behavior*

The dependent variable in this study was weekly numbers of instructional trials required for each student to achieve criterion for mastery of instructional objectives across all curricular programs. These curricular programs included,

for example, pointing to named objects, pointing to body parts, matching to sample, and following one-step directions (See Table 3). The instructional trials received by the students met all of the criteria identified in the research literature to qualify the trials as learn units (Albers & Greer, 1991; Bahadorian, 2000; Emurian, Wang, & Durham, 2002; Greer, 2002; Greer, 1994; Greer & McDonough, 1999; Ingham & Greer, 1992; Skinner, 1968). The term learn unit refers to individual teaching presentations that have been shown to predict learning. Some "discrete instructional trials" have the components necessary to qualify as learn units; however, not all discrete trials are learn units. Moreover, most types of learn units are not discrete trials such as responding to math problems involving operations or comprehension responses to printed material. To meet the criterion for a learn unit the antecedent or target stimulus discriminative must be presented by the teacher while the child is attending, and the presentation must be unambiguous and consistent with the curricular goal and curriculum script (e.g., teacher says "point to red"). The presentation of the target stimulus discriminative (e.g., a red object, with other colored objects as foils) must include an opportunity for the student to respond (3 seconds for most of these learn units), followed by a reinforcement operation from the teacher for correct responses (delivery of a preferred item and praise) or a correction teaching operation for incorrect responses (teacher points to the correct object and says "This is red."). Stimuli that functioned as reinforcers were determined by assessing student preferences prior to the onset of the study. Incorrect responses must include the teacher's correction and the repeating of the correction by the student in the presence of the target stimulus discriminative (student points to the red object as a necessary part of the correction operation). Corrections were not reinforced.

The criterion for achieving an instructional objective was 90% correct responding across 2 consecutive instructional sessions of 20 learn units each. Learn units to criterion were calculated by adding the total number of learn units received across all instructional programs for an entire school week and dividing that number by the

*Table 1. Description of Participants*

Participant	Age (in years)	Diagnosis / Level of Verbal Behavior	Standardized Testing Scores	Repertoires
A	3.1	Pervasive Developmental Disorder Pre-listener / emergent speaker	Vineland Adaptive Behavior Scales – Interview Edition (1984) Adaptive Behavior Composite: 65 Age Equivalency (in years): 1.9	<ul style="list-style-type: none"> <li>◆ Mandated and tacted using single words</li> <li>◆ Responded to his name</li> <li>◆ Made eye contact with speaker</li> <li>◆ Played with puzzles and coloring materials</li> <li>◆ Not toilet trained</li> <li>◆ Emitted physical and object assaults</li> <li>◆ Emitted echolalia</li> <li>◆ Did not follow one-step directions</li> <li>◆ Generalized imitation</li> </ul>
B	4.6	Autism Pre-listener and pre-speaker	Vineland Adaptive Behavior Scales – Interview Edition (1984) Adaptive Behavior Composite: 46 Age Equivalency: not available	<ul style="list-style-type: none"> <li>◆ Mandated using gestures</li> <li>◆ Emitted few vocalizations (i.e. “mama”)</li> <li>◆ Engaged in stereotypy</li> <li>◆ Did not follow one-step directions</li> <li>◆ Generalized imitation</li> </ul>
C	3.8	Speech delay Emerging listener/emergent speaker	Vineland Adaptive Behavior Scales - Interview Edition (1984) Standard scores were not available Age Equivalency: 12 to 18 months.	<ul style="list-style-type: none"> <li>◆ Made and maintained eye contact</li> <li>◆ Responded to her name</li> <li>◆ Engaged in vocal and physical stereotypy (i.e. hand-mouthing)</li> <li>◆ Did not follow one-step directions</li> <li>◆ Generalized imitation</li> </ul>
D	3.6	Pervasive Developmental Disorder / Emerging listener/emergent speaker	Vineland Adaptive Behavior Scales - Interview Edition (1984) Adaptive Behavior Composite: 62 Age Equivalency (in years): 1.10	<ul style="list-style-type: none"> <li>◆ Visually tracked objects</li> <li>◆ Responded to his name</li> <li>◆ Engaged in vocal and physical stereotypy</li> <li>◆ Emitted assaultive behavior towards peers</li> <li>◆ Followed some one-step instructions</li> <li>◆ Generalized imitation</li> </ul>

number of criteria met during that same week (Greer, 2002).

The instructional objectives for the children

were based on curricular standards taken from the CABAS International Curriculum and Inventory of Repertoires for Children from Preschool to

Table 1. Description of Participants (Cont.)

Participant	Age (in years)	Diagnosis / Level of Verbal Behavior	Standardized Testing Scores	Repertoires
E	3.4	Speech delay / Emerging listener/emerging speaker	Bayley Scales of Infant Development – 2 <sup>nd</sup> Edition (1993)  Mental Development Index of below 50 – Significant delay  Age Equivalency (in years): was not available	<ul style="list-style-type: none"> <li>◆ Played appropriately with peers</li> <li>◆ Emitted a few mands and tacts</li> <li>◆ Emitted inappropriate responses to corrections and during demand situations</li> <li>◆ Did not follow one-step instructions</li> <li>◆ Generalized imitation</li> </ul>
F	3.2	No formal diagnosis Emerging listener/speaker	Vineland Adaptive Behavior Scales - Interview Edition  Adaptive Behavior Composite: 64  Age Equivalency (in years): 2.3	<ul style="list-style-type: none"> <li>◆ Played appropriately with toys</li> <li>◆ Made and maintained eye contact</li> <li>◆ Dressed himself independently</li> <li>◆ Emitted personal and object assaults</li> <li>◆ Did not follow one-step instructions</li> <li>◆ Generalized imitation</li> </ul>
G	2.6	Developmental delay / Pre-listener/emergent speaker	Vineland Adaptive Behavior Scales - Interview Edition  Adaptive Behavior Composite: 80  Age Equivalency: 2.0	<ul style="list-style-type: none"> <li>◆ Manded and tacted using single words</li> <li>◆ Responded to his name</li> <li>◆ Played appropriately with peers</li> <li>◆ Emitted tantrums and was non-responsive in demand situations</li> <li>◆ Did not follow one-step instructions</li> <li>◆ Generalized imitation</li> </ul>
H	2.5	Pervasive Developmental Disorder / Pre-listener/pre-speaker	Vineland Adaptive Behavior Scales - Interview Edition  Adaptive Behavior Composite: 73  Age Equivalency (in years): 1.7	<ul style="list-style-type: none"> <li>◆ Emitted a few one-syllable vocalizations</li> <li>◆ Did not maintain eye contact</li> <li>◆ Played appropriately with peers</li> <li>◆ Did not follow one-step instructions</li> <li>◆ Generalized imitation</li> </ul>

Kindergarten (Greer & McCorkle, 2002). It is a criterion referenced assessment for pre school, kindergarten, and first grade children (pre-junior infant through senior infant in Ireland and the UK) that also identifies the critical instructional

goals that cover the range of repertoires needed by children to succeed at the second grade level. Initially, all of the children were assessed on their entering repertoires, or those repertoires they had on entering the school, and they were placed in



scripted instructional programs for objectives that were appropriate to their existing levels of achievement and their Individual Education Programs. The standards in this curriculum constitute the long-term objectives in the children's curricula and the standards incorporate curricular standards from the departments of education of New York State, New Jersey, England, and Ireland. The attainment of a long-term objective or PIRK standard constituted a tally of the achievement of an objective or criterion. The criterion for the attainment of an objective remained constant throughout the experiment—two successive 20 learn-unit sessions at 90% or better accuracy.

#### *Data Collection*

Data were collected during all pre and post listener emersion instructional sessions for learn units and instructional objectives and converted to learn units to criterion, the dependent variable. Correct and incorrect responses to learn unit presentations and the achievement of objectives were recorded on a data collection form. A correct response to a learn unit presentation by the teachers was recorded as a plus (+), and an incorrect response was recorded as a minus (-). Data were immediately graphed following each session as the number of correct responses per session indicating the attainment or not of instructional objectives. Teachers were calibrated to a 100% standard for both accuracy of presentation and consequences as well as accuracy of data collection and their instruction was monitored on a regular basis (Greer, Keohane, & Healy, 2002). In addition, teachers plotted data on each session immediately after running the session to make decisions on the attainment of objectives or the necessity of introducing new research-based tactics using a standard and research based-decision protocol (Keohane, 1997). Supervisors inspected the graphs of students' programs to determine attainment of objectives and they monitored each teacher's decision accuracy.

#### *Interobserver Agreement*

Interobserver agreement was collected using the Teacher Performance Rate Accuracy (Ingham & Greer, 1992). During these observations, an observer simultaneously and independently col-

lected data on student responses and teacher's adherence to the learn unit protocol (i.e., instructional fidelity in presenting learn units). Interobserver agreement scores were calculated by dividing the numbers of point-by-point agreements by the total numbers of agreements plus disagreements and multiplying that number by 100%. That is the students' responses for each learn unit presentation was compared learn unit by learn unit.

Interobserver agreement was collected for 24 instructional sessions for each of the student's instructional programs with their teachers and the point-by-point agreement ranged for each observation ranged from 95% to 100% with a mean of 95.5%. In addition, inter-scorer agreement on the identification of objectives was assessed using a standard decision protocol (Keohane, 1997) for all objectives attained and was 100% as assessed by visual inspection by the school supervisors.

#### *Design*

A multiple probe design across participants (Cooper, Heron, & Heward, 1987) was used where we compared the numbers of learn units to criterion 1 week prior to the implementation of listener emersion and the numbers of learn units to criterion for 2 successive weeks immediately following listener emersion. The students received the listener emersion procedure in a weekly time-lagged fashion to meet the criterion of the multiple probe design.

The sequence of the design was as follows: (a) we determined the weekly learn units the students required to meet their instructional goals 1 week prior to the introduction of the listener emersion tactic, which served as the pre-intervention measure. (b) Next, all instructional programs were suspended and the students received the listener emersion tactic until they met the listener emersion criterion. (c) After the students met the listener emersion treatment objective, they were reintroduced to the instructional programs they were doing prior to the emersion intervention, and we again determined the weekly numbers of learn units each child required to achieve instructional criteria as the post intervention measure. Each of the components of the design is described in detail below.

### *Pre-intervention Baseline Procedures*

During baseline or pre-listener emersion conditions, data were collected across the students' instructional programs. The data collected were the number of correct and incorrect responses to learn unit presentations that the student emitted for all of their instructional objectives and the numbers of objectives achieved. Instructional objectives were determined by the PIRK (Greer & McCorkle, 2002) that inventoried the student's existing repertoires and specified the international standards for performance and the children's Individualized Education Programs (IEP). Data were also collected on the numbers of objectives the student had mastered under these conditions. At the end of the week, the student's weekly learn units to criterion were calculated and graphed as a standard classroom protocol for all students in the school.

### *Listener Emersion Procedures*

During the period of time in which listener emersion was being implemented, all of the student's instructional programs were placed on hold, except for mand and tact programs. The listener emersion procedure involved teaching four different sets consisting of either 4 or 5 presentations of various listener skills presented in equal numbers of opportunities for 20 learn unit sessions. These listener skills included behaviors such as: following one step vocal instructions when presented with a vocal antecedent such as "stand up," imitating a gross motor movement when modeled by the instructor, matching objects when given the vocal antecedent "Match (object name)," pointing to objects when given the vocal antecedent "Point to (object name)" and finally a nonsense direction was presented to the student where the student was required to emit no change in behavior when given a nonsense direction. Nonsense directions included "la la," "trash the graph," and "go to the moon" or other commands that were not possible to do. The instructions were presented in such a way that the student could not predict the instruction based on an order effect and the auditory inflection and numbers of syllables in the nonsense commands were consistent with the components of the commands that were true instructions.

At least one of the sets for each participant was presented such that the vocal antecedents were presented by an audio device. Different voices were used for different learn units on the audio reproductions device. In one instance, directions were delivered over a mobile phone using different adult voices.

Once the student met criterion on a single set, the student was taught the set to a rate mastery criterion, while other sets remained on mastery instruction. Thus a student at any given time could be receiving percentage mastery instruction on one or more sets and rate instruction at the same time in one or more sets. Mastery for all sets did not need to be achieved before the student was placed on rate instruction.

The initial teaching tactic included using a simultaneous stimulus prompt (Schuster, Gast, Woolery, & Gultinan, 1988) with learn units when first teaching each listener emersion set. The simultaneous stimulus prompt procedure, also called zero second time delay, involves presenting learn units to students in which the answer is supplied immediately by the teacher, followed by the student emitting the prompted response, after which the student's response is reinforced. If the student emits the correct response before the teacher supplies the correct answer the response is also reinforced. After three sessions of supplying the correct answer immediately or reinforcing instances of the child anticipating the teacher to the correct answer, a 1-3 second intraresponse time delay is inserted and the student's response is only reinforced for responding correctly and corrections are done for incorrect responses. This procedure has been found to reduce prompt dependency and has been found superior to other prompt training procedures. Subsequently, various tactics were implemented as needed to occasion criterion level responding (See Table 2 for a listing of tactics). These tactics were all research-based procedures as found in Cooper, Heron, & Heward (1987) or Greer (2002) (See Table 2 listing the tactics that were used).

Each of these sets was taught first to 90% mastery and then to 100% mastery with a rate or "fluency" criterion. Once the child met the fluency criterion, we reintroduced the student's previous instructional programs. During the



listener emersion instruction each one of the instructions in the sets were presented an equal and counterbalanced number of times for a total of 20 learn units per session. However, once the student was ready to master the rate criterion, one presentation consisted of 20 correct responses at the rate criterion. Some students required rate training in increments or sub-objectives for the rate. That is, they were first required to meet successively faster rates for five instructional presentations at a target rate, then 10 presentations, then 20 presentations at the target rate for each child. Once the child met criterion on two successive 20 instructional presentations at the target rate he was determined to have met the criterion for listener emersion. Each of these groupings (i.e., five responses at the goal rate) constituted a single learn unit. Thus, the achievement of two consecutive 20 accurate responses at the target rate constituted the achievement of criterion (See Greer, 20002 for the procedures for identifying the relevant responses for children as they progress through curricula).

We varied the composition of skills in each set based on each child's individual instructional history, coordination, and physical development. The variation and the process for the selection of tactics used to instruct the student to meet mastery and rate criteria for the sets were based on the protocol outlined in Greer (2002) for determining appropriate individualized tactics for each child. The number of weeks required for achieving the criterion for listener emersion also varied and ranged from 3 to 16 weeks with a mean of 7.3 weeks and a mode of 6 weeks. In addition, the terminal rate criterion ranged from 12 to 30 correct responses per minute with a mean of 18 correct responses per minute. Differences in rate for each child were based on the latency of responding characteristic for the child. Thus, children who typically responded at slower rates of movement were assigned lower rate criterion. Table 2 the specific sets and the individual variations in tactics required for the children to achieve the listener emersion criterion.

For Participant A, each of the listener emersion sets contained a vocal 1-step direction, a gross motor imitation, a match to sample, a point to (object), and a nonsense direction. For

the fourth listener emersion set, all antecedents were delivered by different instructor's voices via audiotape recorder (i.e., the voices differed for each command). In addition to learn units (Greer, 1994), the only tactic that this student required in order to meet mastery criterion was a simultaneous stimulus prompt (Schuster, Gast, Woolery, & Guiltinan, 1988). His rate criterion was set at 17 correct responses in one minute for 20 presentations (See Table 2).

For Participant B, three of the listener emersion sets contained a vocal 1-step direction, a gross motor imitation, a match to sample, and a nonsense direction. The fourth listener emersion set consisted of a compilation of directions taken from the other three sets. Once rate criterion was mastered across these sets, the first set was again presented to the student using tape-recorded antecedents. This participant required the implementation of a simultaneous stimulus prompt (Schuster et al., 1988) as well as changes in the schedule of reinforcement in order to meet mastery criterion. The rate criterion for this participant was set at 16 correct responses per minute (See Table 2).

For Participant C, each of the four listener emersion sets contained 2 vocal 1-step directions, a body part identification (i.e. "Point to your nose"), and a nonsense direction. This participant required simultaneous stimulus prompts (Schuster et al., 1988) as well as additional response prompts (physical and faded physical prompts) in order to meet mastery criterion. The rate criterion was set at 18 correct responses per minute. Once the student met both a mastery and rate criterion for the prior 4 sets, a fifth set (comprised of one direction from each of the previous sets) was taught using tape-recorded antecedents to a rate criterion of 18 correct responses per minute for 20 presentations (See Table 2).

For Participant D, each of the four listener emersion sets contained 2 vocal 1-step directions, a body part identification, and a nonsense direction. This participant required no other tactics than simultaneous stimulus prompts (Schuster et al., 1988) with learn units in order to meet the mastery criterion. The rate criterion was set at 12 correct responses per minute. A changing criterion procedure for rate was implemented in

Table 2. *Listener Emersion Procedural Information*

Participant	Composition of Sets	Tactics Implemented	Terminal Rate Criterion	Learn Units to Mastery	Duration of LE Procedure
A	Gross motor imitation, match to sample, point to sample, and one-step direction	Learn units, simultaneous stimulus prompt	17 correct responses per minute	775 learn units	3 weeks
B	Gross motor imitation, match to sample, one-step direction, and nonsense direction	Learn units, simultaneous stimulus prompt, schedule of reinforcement	16 correct responses per minute	1439 learn units	3 weeks
C	Three one-step directions, nonsense direction	Learn units, simultaneous stimulus prompt, response prompt	18 correct responses per minute	2489 learn units	10 weeks
D	Three one-step directions, nonsense direction	Learn units, simultaneous stimulus prompt, response delay, changing criterion procedure for rate	12 correct responses per minute	1003 learn units	16 weeks
E	Three one-step directions, nonsense direction	Learn units, simultaneous stimulus prompt, response prompt, distribution of learn units across programs, interspersal of known items	17 correct responses per minute	1922 learn units	6 weeks
F	Three one-step directions, nonsense direction	Learn units, simultaneous stimulus prompt, differential reinforcement of higher numbers of responses for rate learn units	30 correct responses per minute	795 learn units	6 weeks
G	Gross motor imitation, two one-step directions, nonsense direction	Learn units, simultaneous stimulus prompt, teacher model, response prompt, fading, reducing size of the STO, changing criterion procedure for rate	20 correct responses per minute	2394 learn units	8 weeks
H	Gross motor imitation, two one-step directions, nonsense direction	Learn units, changing criterion procedure for rate	14 correct responses per minute	700 learn units	7 weeks

order to achieve this terminal objective. Once the student met both a mastery and rate criterion, a fifth set (comprised of one direction from each of the previous sets) was taught using tape-recorded antecedents to a rate of 12 correct responses per minute (See Table 2).

For Participant E, each of the four listener emersion sets contained 2 vocal 1-step directions, a body part identification (i.e. "Point to your nose"), and a nonsense direction. In addition to

learn units this participant required simultaneous stimulus prompts (Schuster et al., 1988), response prompts (physical and faded physical prompts), response delays, and distribution of learn units across programs, in order to meet mastery criterion. The rate criterion was set at 17 correct responses per minute. Once the student met both a mastery and rate criterion, a fifth set (comprised of one direction from each of the previous sets) was taught using tape-recorded antecedents with

*Table 3. Instructional Programs in Place Pre- and Post-Listener Emersion*

Participant	Pre- Listener Emersion	Post- Listener Emersion
A	Eye Contact Gross motor imitation Sit still in a chair Following one-step directions Matching identical objects Mands Tacts Pointing to body parts Pointing to objects	Eye Contact Gross motor imitation Sit still in a chair Following one-step directions Matching identical objects Mands Tacts Pointing to body parts Pointing to objects
B	Eye Contact Sit still in a chair Matching identical objects Matching identical pictures Block Structure imitation Mands Tacts Following one-step directions Pointing to objects	Eye Contact Sit still in a chair Matching identical objects Matching identical pictures Block Structure imitation Mands Tacts Following one-step direction Pointing to objects
C	Eye contact Gross motor imitation Sit still in a chair Following one-step directions Matching identical pictures Matching identical objects Mands Tacts Play with playdoh Play with puzzles Looking at books	Following two-step directions Imitating actions with objects Matching identical pictures Matching identical objects Mands Tacts Play with playdoh Play with puzzles Coloring Looking at books Building with blocks
D	Eye contact Gross motor imitation Sit still in a chair Following one-step directions Matching identical pictures Matching identical objects Finds a hidden object Tracks objects visually Mands Tacts Play with puzzles Looking at books	Following two-step directions Matching identical objects Matching non-identical objects Matching identical pictures Finds a hidden object Mands Tacts Coloring Play with puzzles Looking at books Building with blocks

Table 3. *Instructional Programs in Place Pre- and Post-Listener Emersion (Cont.)*

Participant	Pre- Listener Emersion	Post- Listener Emersion
E	<p>Eye contact  Gross motor imitation  Sit still in a chair  Following one-step directions  Mands  Tacts  Acorn Reader program  Pointing to numbers on a page  Pointing to letters on a page  Textually responding to letters  Reciprocate greetings with "hi"  Coloring  Play with playdoh</p>	<p>Mands with autoclitics  Tacts with autoclitics  Acorn Reader program  Pointing to numbers on a page  Pointing to letters on a page  Textually responding to letters  Textually responding to numbers  Reciprocate greetings with "hi"  Coloring  Play with playdoh  Imitating symbols</p>
F	<p>Eye contact  Gross motor imitation  Sit still in a chair  Following one-step directions  Matching Dolch® words  Acorn Reader program  Pointing to numbers on a page  Pointing to letters on a page  Textually responding to letters  Textually responding to numbers  Play with playdoh  Coloring</p>	<p>Following two-step directions  Gross motor imitation (two-step)  Matching Dolch words  Acorn Reader program  Edmark reading (Level 1)  Pointing to numbers on a page  Pointing to letters on a page  Textually responding to letters  Textually responding to numbers  Play with playdoh  Coloring</p>
G	<p>Eye contact  Gross motor imitation  Sit still in a chair  Following one-step directions  Pointing to objects  Mands  Tacts  Pointing to body parts</p>	<p>Eye contact  Gross motor imitation  Sit still in a chair  Following one-step directions  Pointing to objects  Mands  Tacts  Pointing to body parts</p>
H	<p>Eye contact  Gross motor imitation  Sit still in a chair  Following one-step directions  Pointing to objects  Mands  Tacts  Pointing to body parts</p>	<p>Eye contact  Gross motor imitation  Sit still in a chair  Following one-step directions  Pointing to objects  Mands  Tacts  Pointing to body parts</p>

different adult voices (See Table 2).

For Participant F, each of the four listener emersion sets contained 2 vocal 1-step directions, a body part identification (i.e. "Point to your nose"), and a nonsense direction. In addition to learn units, this participant required simultaneous stimulus prompts (Schuster et al., 1988) only in order to meet mastery criterion. A changing criterion procedure was implemented in order for the student to meet his fluency criterion of 30 correct responses per minute. Once the student met both a mastery and rate criterion, a fifth set (comprised of one direction from each of the previous sets) was taught using tape-recorded antecedents (See Table 2).

For Participant G, each of the four listener emersion sets contained a gross motor imitation, a vocal 1-step direction, a body-part-identification (i.e. "Point to your nose"), and a nonsense direction. In addition to learn units, this participant required a simultaneous stimulus prompts (Schuster et al., 1988), a teacher model (Rose, 1984), response prompts with a fading procedure, and reductions of response requirements as short-term objectives leading to acquisition of mastery criterion for the long-term objective. A changing criterion procedure, as described above, was implemented in order for the student to meet his fluency criterion of 20 correct responses per minute (See Table 2).

For Participant H, each of the four listener emersion sets contained a gross motor imitation, a vocal 1-step direction, a body-part-identification (i.e. "Point to your nose"), and a nonsense direction. Learn units were the only tactic used in order for this student to meet mastery criterion. A changing criterion procedure was implemented in order for the student to meet his fluency criterion of 14 correct responses per minute (See Table 2).

## Results

The results of this study showed that the listener emersion procedure was effective in decreasing each of the participant's learn units for achieving instructional objectives (Figures 1, 2, 3). Participant A did not meet any criteria during the week before listener emersion was introduced,

although 250 learn units were presented to this student; thus we show the total of 250 for the week (Figure 1). In the weeks subsequent to listener emersion, this participant's weekly learn units to criterion decreased to 60 during the first week and 56 during the second week (Figure 1). Participant B's learn units to criterion during the week prior to listener emersion were 924 (Figure 1). Following listener emersion, his weekly learn units to criterion decreased to 110 for each of the two subsequent weeks (Figure 1). Participant C's learn units to criterion during the week prior to listener emersion were 930 (figure 1). In the weeks subsequent to listener emersion, this participant's weekly learn units to criterion decreased to 129 during the first week and 90 during the second week (Figure 1).

Participant D's learn units to criterion during the week prior to listener emersion were 1455 (Figure 2). Following listener emersion, this participant's weekly learn units to criterion decreased to 540 during the first week and 227 during the second week after listener emersion (Figure 2). This student still required a relatively high number of learn units to achieve criterion; however, the emersion procedure halved the numbers of learn units to criterion from the pre to the first week of post intervention instruction. Moreover, in the second week following the intervention he again halved the numbers of learn units required to meet criterion. The mean numbers of learn units across the entire school of over 110 preschoolers was approximately 120 learn units to criterion, so participant D was still having difficulties compared to most of the other children.

Participant E's learn units to criterion during the week prior to listener emersion were 520 (Figure 2). In the weeks subsequent to listener emersion, this participant's weekly learn units to criterion decreased to 204 during the first week and 182 during the second week after listener emersion (Figure 2). Participant F's learn units to criterion during the week prior to listener emersion were 410 (Figure 2). In the weeks subsequent to listener emersion, this participant's weekly learn units to criterion decreased to 100 during the first week and 158 during the second week after listener emersion (Figure 2).

Participant G's learn units to criterion dur-

ing the week prior to listener emersion were 480 (Figure 3). In the weeks subsequent to listener

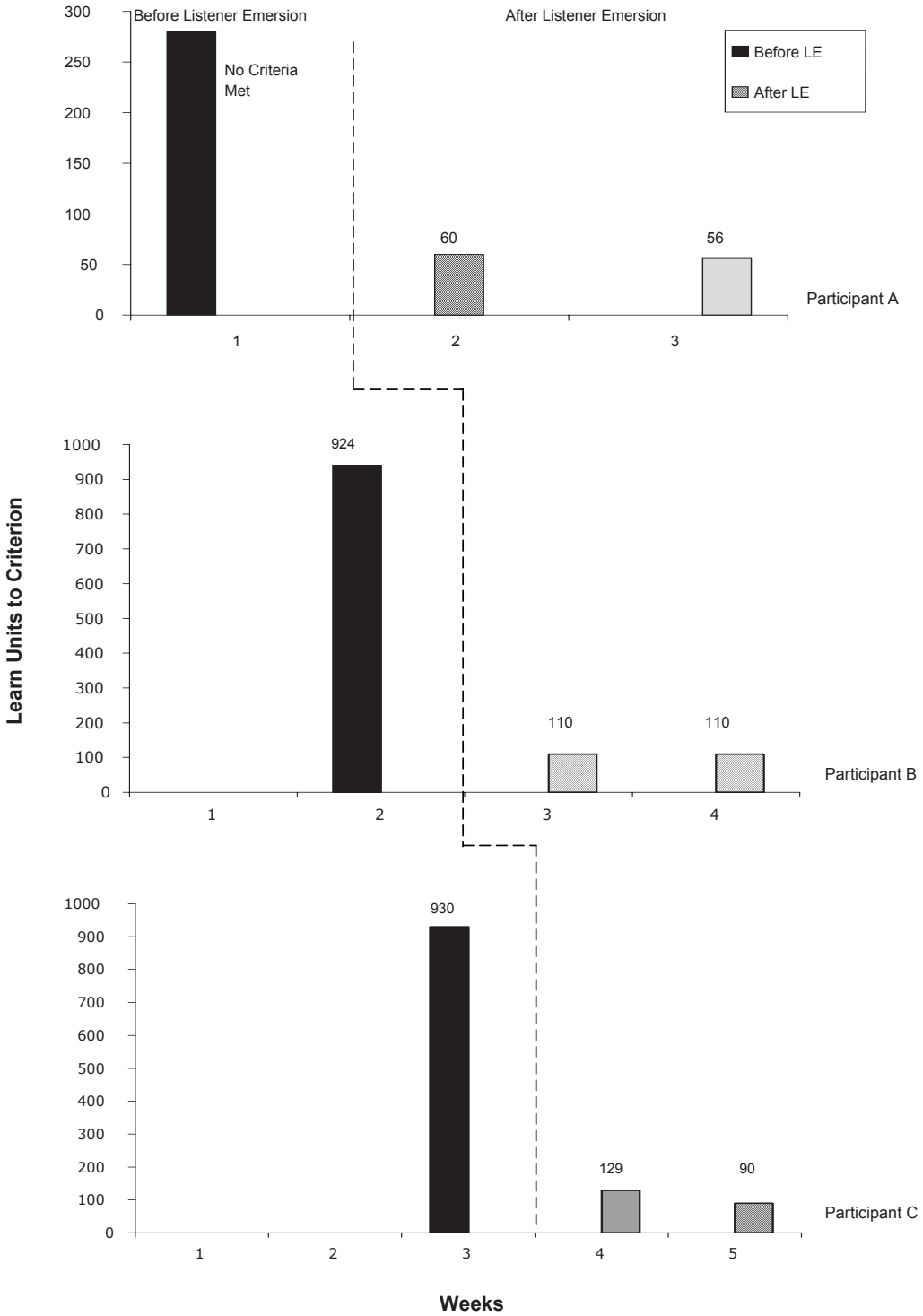


Figure 1. Weekly learn units to criterion pre- and post-listener emersion- Participant A, B, and C.



emersion, this participant's weekly learn units to criterion decreased to 47 and 66 for each of the two weeks following listener emersion (Figure 3).

Participant H's learn units to criterion during the week prior to listener emersion were 440 (Figure 3). In the weeks subsequent to listener emersion,

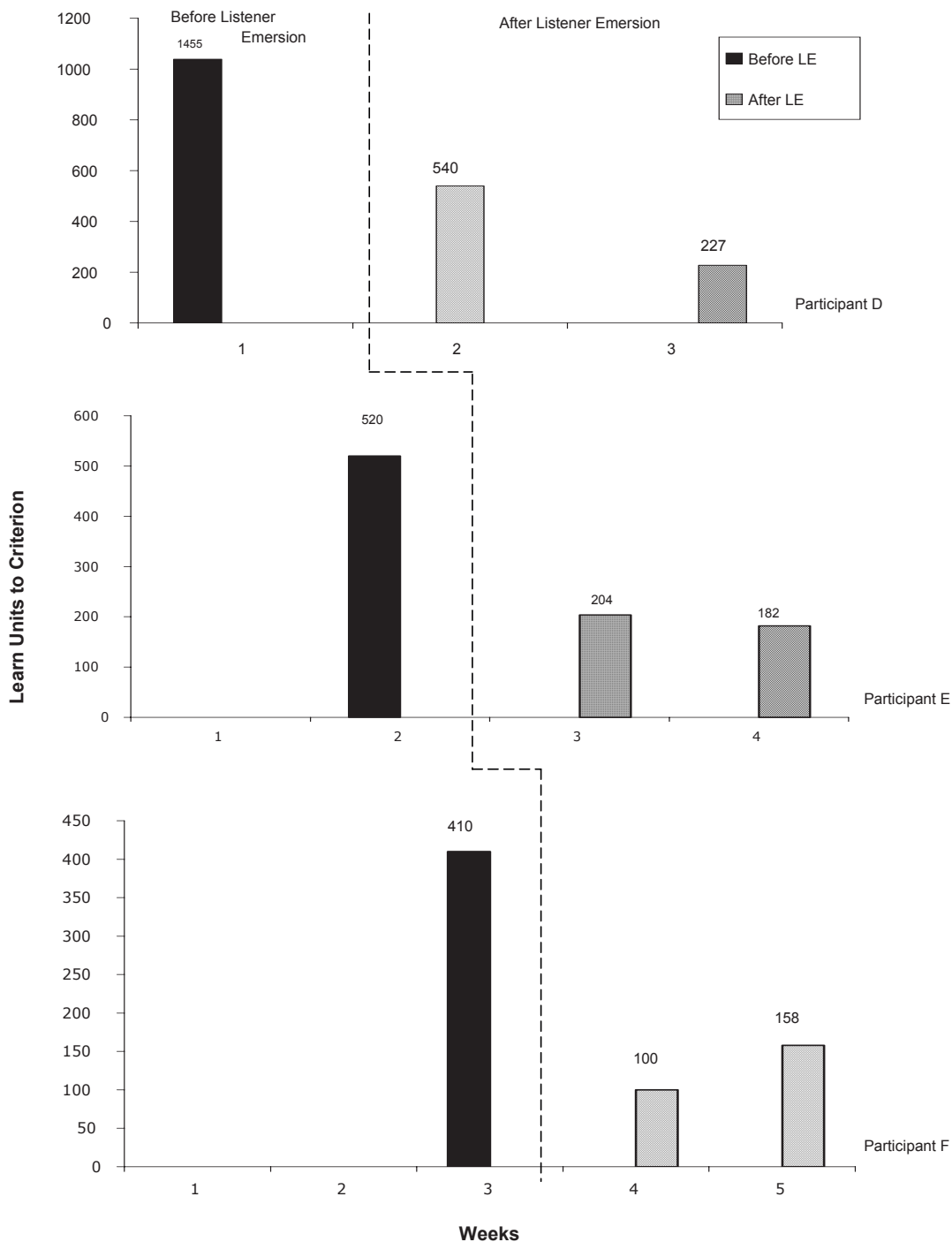


Figure 2. Weekly learn units to criterion pre- and post-listener emersion- Participant D, E, and F.

this participant's weekly learn units to criterion decreased to 110 and 100 for each of the two weeks following listener emersion (Figure 3).

### Discussion

These results showed that the listener emersion procedure was effective for each of these participants. The changes between the pre and post listener emersion represent major advances for all of the children. It is possible that the stan-

dard instructional practices, without the listener emersion, may have resulted in reduced numbers of learn units to criteria over a year or more of instruction. This possibility could be tested with a longitudinal group design. However, given our experience with similar children, we believe that the magnitude of these changes would likely not have occurred without benefit of the listener emersion tactic. The emersion procedure led to much more rapid achievement of listener status. Once the student acquired the listener repertoire they could move more rapidly up the verbal behavior ladder (Greer & Keohane, 2005).

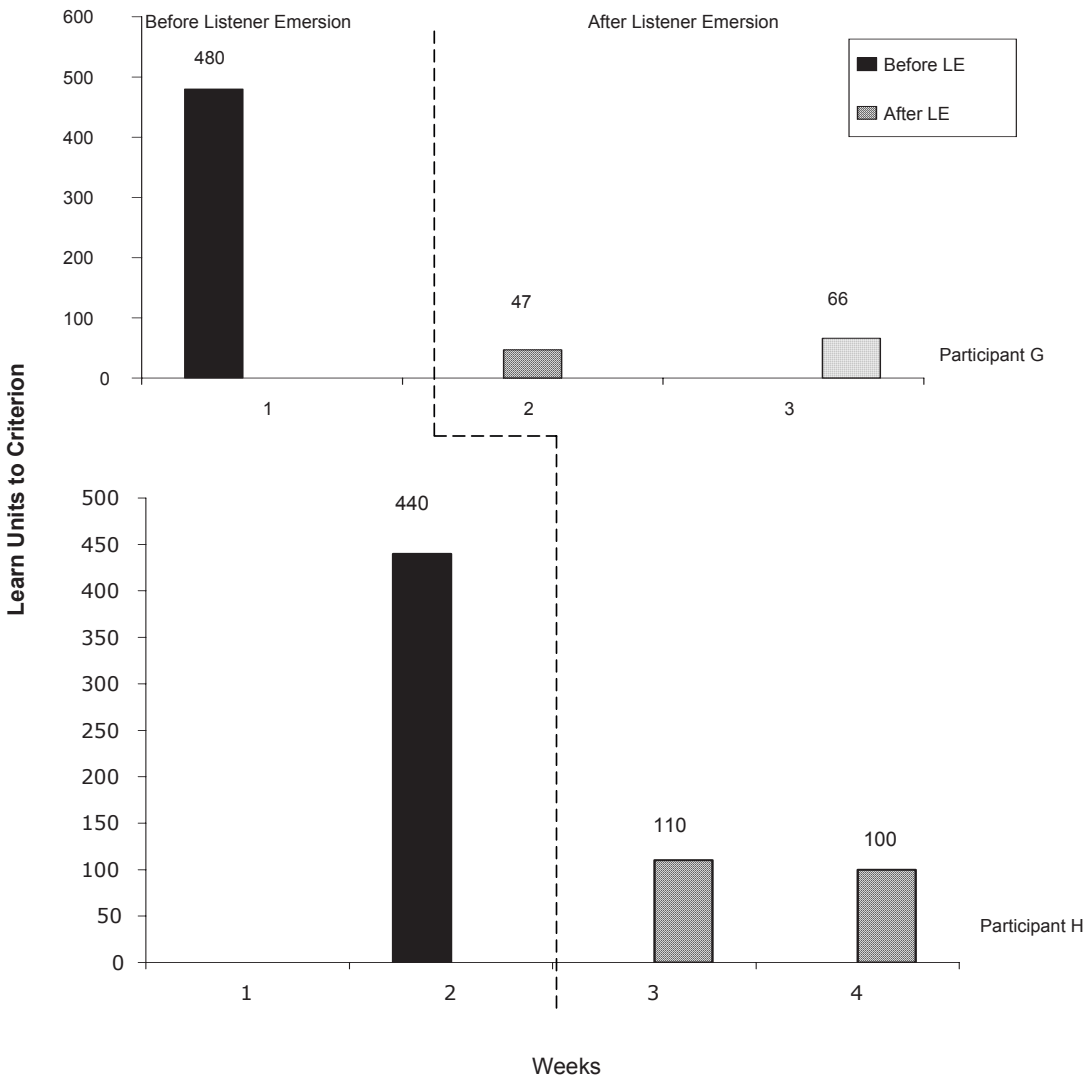


Figure 3. Weekly learn units to criterion pre- and post-listener emersion- Participant G and H.

Many of the programs were the same before and after the listener emersion procedure. They could not master these programs before the listener emersion. Children can emit correct responses to, but not master many of the programs like these by responding to visual cues, program sequence, or simply by chance without coming under the discriminative control of the spoken word. The listener emersion procedure isolates the spoken stimulus such that the child must respond to the spoken stimulus and cannot rely on visual or sequential cues. The procedure resulted in the students acquiring true listener responses providing them with basic listener literacy. This is critical because more complex repertoires such as the development of the listener component of naming and the speaker as own listener component of naming is not possible without basic listener literacy (Greer & Keohane, 2005; Greer, Stolfi, Chavez-Brown, & Rivera-Valdes, 2005). The development of basic listener literacy provides the foundation for advancing the child's verbal development. Indeed the role of the listener in verbal behavior has taken on increased importance in recent research in verbal behavior (D. Barnes-Holmes, Y. Barnes-Holmes, & Cullinan, 2000; Greer, Yuan, & Gautreaux, in press; Horne & Lowe, 1996; Lowe, Horne, Harris, & Randle, 2002). The listener repertoire is a necessary, if not sufficient, component of naming and other speaker as own listener repertoires in self-talk (Lodhi & Greer, 1989).

Differences in the children's attainment of objectives before and after the listener emersion were not attributable to the quality of instruction, since many, if not all of the tactics applied to the listener emersion procedures were done in the pre-listener emersion instruction. The difference was that the tactics were used in the listener emersion to evoke spoken control of the responding; whereas, prior to the intervention the programs did not isolate the spoken stimulus. The same criteria for invoking new tactics for learning problems were in effect throughout. Therefore, it was the development of spoken stimulus control rather than differences in tactics used that led to the basic listener literacy.

We chose the term listener emersion because it seemed particularly appropriate. The *Oxford*

*English Dictionary 2<sup>nd</sup> Edition* describes one usage of the term emersion as follows, "The action of coming out or issuing (from concealment or confinement). Somewhat rare." (OED, p. 177) Thus, once a child has acquired the listener repertoire, the child may be said to have come out of confinement to a pre listener status. The acquired an essential component of what is necessary to progress along the verbal behavior continuum. This is a continuum that moves from pre-listener to listener, listener to speaker, speaker listener exchanges or conversational units (Chu, 1998; Donley & Greer, 1993), speaker as own listener in the naming function or self-talk function (Lodhi & Greer, 1989; Lowe et al., 2002), reader, writer, and writer as own listener (Greer, 2002).

Future research might include whether it is better to determine the rate criterion based on each child's existing repertoire or whether one standard rate criterion is more effective. However, currently we think it is necessary to base the children's rate criteria on their general rates of movement and instructional histories. Research needs to identify possible pre-requisite skills that children need to have to be successful in mastering listener emersion. Currently, we believe that before entering the emersion program the child should make eye contact for up to 10 seconds on command, sit still when asked to do so in massed learn units up to 10 seconds for each learn unit, and have generalized imitation. Children can, and often do, master these programs by context, even when they do not have listener repertoires. However, we believe that these prerequisites provide the student with minimal compliance repertoires that they need to enter the emersion procedure. The child needs to be under the visual and sequential control by the teacher's or therapist's reinforcement.

We reported eight students in this paper, but have replicated the effect with numerous students in 5 CABAS Schools; therefore we believe the effect is robust. This procedure, when used accurately with those students who are experiencing learning difficulties, like those students in the present paper, will result in these students moving to a level of achievement that would not be possible without the listener repertoire. That is, students who cannot acquire a listener repertoire

cannot acquire naming, speaker as own listener, and probably they cannot attain reader repertoires. In addition, they remain essentially outside of the first step of becoming social.

It is possible that the levels of verbal behavior that we have described represent important empirically based learning and developmental milestones and we have described the database for this assertion in a recent paper (Greer & Keohane, 2005). It is even possible that when students cannot meet certain criteria indicative of these levels of verbal behavior they cannot move forward educationally. An individual who is a pre-listener is totally dependent on others. A few students who do not have the repertoires of listener, as specified in the listener emersion program, do have, or can develop mand and tact forms and functions without necessarily mastering listener emersion; however, unless they achieve the listener repertoire, we believe their progress in verbal and other cognitive educational objectives will be minimal. Functioning as speaker as own listener, as in naming or self-talk, is key to more advanced levels of verbal behavior that in turn constitute the basis of cognitive and social advancement. In fact, some would suggest that to be truly verbal one needs the naming repertoire or other advanced levels of verbal behavior (Barnes-Holmes, Barnes-Holmes, & Cullinan 2000; Premack, 2004), such as the capacity to learn a spoken or signed word in one function (i.e., as a tact) and use the same form in another function (i.e., as a mand without direct instruction) (Greer & Nirgudkar, 2003; Nuzzolo & Greer, 2004). It is possible that verbal behavior is the essential ingredient and measure of social and socialization (Chu, 1998) and without the listener repertoire the student cannot be truly social.

The levels of verbal behavior that we propose are key milestones in developmental progress that were extrapolated from Skinner's theory. Skinner's theory was devoted to communicative behavior from the point of view of a typically developing speaker. However, it is obvious that without a listener repertoire an individual cannot truly participate in a verbal community beyond rudimentary functions and Skinner's work incorporated the role of the listener in the behavior of the speaker as in his treatment of verbal episodes. Research

in relational frame theory as an explanation for sophisticated cognitive and verbal repertoires has increasingly emphasized the role of the listener (Barnes-Holmes et al., 2000), as has research in naming (Lowe, Horne, Harris, & Randle, 2002) and the critical milestone of self-talk (Lodhi & Greer, 1989). Thus, the acquisition of a listener repertoire of responding to the vowel consonant speech sounds of their teachers, that we operationally identify as meeting the listener emersion criterion, may constitute a true learning milestone for individuals with severe language delays and may be a naturally occurring milestone for typically developing children (Greer & Keohane, 2005).

While much more research is needed in what constitutes a true listener repertoire and how to attain the repertoire with children who do not have it, acquisition of basic listener literacy identified in the listener emersion objective is a step in the process of learning more about listening and its evolution towards speaker-as-own-listener. Clearly, these data show that mastering the criterion set forth for listener emersion led to very significant improvements in the educational progress of the children we studied and in several applications with children across 5 CABAS schools.

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