The Effects of the Verbal Developmental Capability of Naming on How Children Can Be Taught

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Abstract

Naming, a verbal developmental capability that is a source for children to acquire language incidentally, may affect how they learn best in school. We tested the presence/absence of Naming (Experiment I) and the induction of Naming (Experiment II) on the rates of learning under 2-instructional conditions (9 -participants, ages 5-7) using a counterbalanced reversal design across matched pairs for Experiment I and stage 2 of Experiment II. In stage 1 Experiment II we used a delayed multiple probe design across participants to show the induction of Naming and then in stage 2 we tested the effects of the induction of Naming on rate of learning. The dependent variable in each study was numbers of instructional trials to meet curricular objectives. In Experiment 1, we compared learning under (a) standard learn unit presentations (SLUs) or instructional trials that met the criteria for learn units and (b) model demonstration learn units (MLUs)-- learn units with antecedent instructions. In Experiment I, MLUs correlated with faster rates of learning for all 4-participants with Naming. For the 4-participants who lacked Naming, MLUs did not accelerate learning. In Experiment 2, we induced Naming for those 4-participants and then MLUs accelerated rates of learning. The findings suggest that the onset of Naming allows children to learn and be taught in new ways.

Key words: Incidental language acquisition, Naming, Language developmental cusps, Development and instruction interactions, Development and effective instruction.

Los Efectos del Desarrollo de la Capacidad Verbal de Nombrar sobre Cómo Puede Enseñarse a los Niños

Resumen

Nombrar, una capacidad del desarrollo verbal que es una fuente para que los niños adquieran incidentalmente el lenguaje, puede incidir sobre un mejor aprendizaje en la escuela. Se probó la presencia/ausencia de nombrar (Experimento I) y la inducción de nombrar (Experimento II) sobre las tasas de aprendizaje bajo dos condiciones de instrucción (nueve participantes entre 5 y 7 años) usando un diseño de reversión contrabalanceado a través de pares igualados para el Experimento I y para la Fase 2 del Experimento II. En la Fase 2 del Experimento II se usó un diseño de sondeos múltiples demorados a través de los participantes para mostrar la inducción de nombrar y luego en la Fase 2 se probaron los efectos de la inducción de nombrar sobre la tasa de aprendizaje. La variable dependiente en cada estudio fue el número de ensayos instruccionales para cumplir los criterios curriculares. En el Experimento I se comparó el aprendizaje bajo a) presentaciones estándar de unidades de aprendizaje (SLU) o ensayos instruccionales para cumplir el criterio de las unidades de aprendizaje y b) la demostración con un modelo de las unidades de aprendizaje (MLUs) unidades de aprendizaje con instrucciones antecedentes. En el Experimento I

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los MLUs correlacionaron con tasas más rápidas de aprendizaje para los cuatro participantes que nombraban. Para los cuatro participantes que no nombraban, los MLUs no aceleraron el aprendizaje. En el Experimento II se indujo nombrar para los mismos cuatro participantes y MLUs aceleraron la tasa de aprendizaje. Estos hallazgos sugieren que el inicio de nombrar permite a los niños aprender y ser enseñados de nuevas maneras.

Palabras clave: Adquisición incidental del aprendizaje, Nombrar, Cúspides en el desarrollo del lenguaje, Interacciones en el desarrollo y la instrucción, Desarrollo e instrucción efectiva.

The subject matter of verbal behavior constitutes the identification of language function or language as behavior as it relates to extensions of the elementary principles of behavior (Skinner, 1957). Verbal behavior development refers to the acquisition of particular language behaviors that constitute key developmental milestones as a function of experience (Greer & Longano, 2010; Greer & Ross, 2008; Greer & Speckman, 2009). Thus, verbal behavior is not synonymous with vocal behavior, since language function may include non-vocal behaviors such as gestures or signs. Inquiry into language as behavior does not conflict with the study of other aspects of language (e.g., linguistics, neuroscience of language), Rather, the analysis of verbal and its development, when combined with study of the other features of language, provides a more complete picture of language. One contribution that the analysis of verbal behavior has made to a more complete understanding of language is the identification of key milestones of verbal behavioral development as they are influenced by environmental experiences. One key milestone is the onset of naming, which is a term in the field for the stage in which children acquire the ability to learn new words for stimuli incidentally.

Horne and Lowe (1996) introduced the term Naming (capitalized here to distinguish this special usage) as a descriptor for the language developmental change that allowed children to learn the names of things incidentally. When Naming was present children could acquire the “names” or words for stimuli as a listener and a speaker without direct instruction. Much of the original research on Naming focused on the relation of Naming on the emergence of untaught or derived stimulus relations, where the question concerned the role that language played in such emergent relations (Horne, Hughes, & Lowe, 2006; Horne, Lowe, & Randle, 2004; Horne & Lowe, 1996; Miguel, Petursdottir, Carr, & Michael, 2008). More recently, a program of research has focused on the induction of Naming as a source of incidental language learning in young children and as a derived relation itself (See Greer & Keohane, 2006; Greer & Longano, 2010; Greer & Speckman, 2009 for reviews of that research). Several experiments have reported that after Naming was induced, children could acquire novel speaker and listener responses for novel stimuli from attending to the stimuli as they heard the words for the stimuli spoken, whereas they could not do so prior to the instantiation of Naming unless they were directly instructed in each response separately (Fiorile & Greer, 2007; Greer, Stolfi, Chavez-Brown, & Rivera-Valdes, 2005; Greer, Stolfi, & Pistoljevic, 2007; Helou-Care, 2008; Longano, 2008; Pistoljevic, 2008; Speckman-Collins, Park, & Greer, 2007).

Naming is one of the several language developmental milestones and is a component of the verbal developmental theory that grew out of research in verbal behavior development (Greer & Keohane, 2006; Greer & Longano, 2010; Greer & Ross, 2008; Greer & Speckman, 2009). Naming is an important focus of interest in language development because the onset of Naming is a, or the, source of children coming to acquire language incidentally. While some theorists proposed that the incidental acquisition of language was evidence that experience played a minor role (Pinker, 1999), there is now considerable evidence that certain experiences play critical roles in the onset of the ability to acquire language incidentally as the Naming capability (Greer & Speckman). Several theories and programs of research concur that Naming is a critical step in verbal development: (a) the relational frame theory (Barnes-Holmes, Barnes-Holmes, & Cullinan, 1999), (b) the Naming theory (Horne & Lowe, 1996), and the verbal development theory (Greer & Longano, 2010; Greer & Ross, 2008; Greer & Speckman, 2009). While each of these theories has different foci, and some differences in interpretations of the existing evidence, all build on Skinner's theory and all agree that Naming is the beginning of being truly verbal because it requires the intercept of the listener and speaker.

In the last decade several studies have identified the presence and absence of Naming and affirmed that it can be induced when it is missing in children who have the necessary prerequisites (Feliciano, 2006; Fiorile & Greer, 2007; Gilic, 2005; Greer et al., 2005, 2007; Longano, 2008; Reilly-Lawson, 2008; Speckman-Collins et al., 2007). The findings from these studies show that the onset of Naming allows children to learn in ways they previously could not. That is, rather then being directly taught the names of things, children with Naming learn new names without direct instruction (i.e., without reinforcement or corrections by caretakers). These findings suggested, in turn, that school age children with Naming might profit or be able to learn from being taught differently than children without Naming. The purpose of the experiments herein was to test that possibility.

The existing evidence suggests that in order to effectively instruct, a teacher or teaching device (i.e., the teaching machine as described in Skinner, 1968 or computerized instruction as described in Emurian, Hu, Wang, & Durham, 2000) must consist of certain interaction between the teacher or teaching device and the behavior of the student. First, the learner must attend to the relevant stimuli and be entreated to emit a response, to which the teacher or device provides two kinds of feedback —reinforcement and corrections This process includes gaining the learner's attention to a potential discriminative stimulus that is (a) presented in an unambiguous way under (b) the relevant establishing operation for the (c) reinforcement operation that is used for correct responses. Next, (d) the student must have the opportunity to respond or emit a response and (e) the teacher or teaching device must provide feedback to the learner to (f) reinforce correct responding, or (g) correct an incorrect response. Effective corrections require that the response that is corrected (h) include the student emitting a correction response that is not reinforced while attending to the potential discriminative stimulus. In the research that has identified the components of effective instruction, instructional presentations that have all of these components are identified as *learn* *units*. The components of the learn unit were initially prescribed by Skinner (1968) in what he called the *frame* in programmed instruction and was later identified in research as the learn unit. The learn unit and components of the learn unit have been tested in several experiments that consistently report that it is a key measure of instructional effectiveness (Albers & Greer, 1991; Bahadorian, Tam, Greer, & Rousseau, 2006; Diamond, 1992; Emurian, et al; Greer, 1994; Greer, McCorkle, & Williams, 1989; Greer & McDonough, 1999; Hogin, 1996; Ingham & Greer, 1992; Singer & Greer, 1997). Researchers have also reported that greater numbers of learn units presented to learners result in higher numbers of correct responses and higher numbers of objectives mastered (Albers & Greer, 1991; Greer, 2002; Greer, McCorkle, & Williams, 1989; Selinske, Greer, & Lodhi, 1991).

Effective instruction provides an environment in which students receive high numbers of learn units (Goe, Bell, & Little, 2008; Greer & Keohane, 2006 Greer, Keohane, & Healy, 2002). Unfortunately, many teachers do not provide this kind of effective instruction (Greer, 1994). Nevertheless, some students learn to some degree in spite of the paucity of learn unit presentations, while others fail to do so. Moreover, secondary students and college students must learn from lecture presentations where there are few if any learn units (Bahadourian et al., 2006; Keller, 1968), although Bahadourian et al. found that college students learned significantly more when learn units were used. This disparity suggests that some learners come to the table with the prerequisite capabilities to learn, at least to some degree, from instructional presentations that do not meet all of the conditions of learn units. Some evidence suggests that there may be verbal developmental cusps and capabilities that allow students to learn from different types of contact with instructional contingencies, including those missing key components of the learn unit.

Interestingly, according to findings from the Hart and Risley (1995) longitudinal study, typically developing children learn most of their words for things without direct instruction and reinforcement beginning at about three-years of age. They also reported that the frequency of language usage by parents in interactions with their children was a predictor of vocabulary size. This suggests that children learn much of their language incidentally; that is they learn without direct instruction. How do they come to be able to do this?

Research in the effects of environmental experiences on verbal behavior development, including the onset of Naming, have identified several verbal developmental cusps and special cusps that also include the ability to learn by different contact with components of the learn units and the obvious presence of components of the elementary principles of behavior (Greer & Keohane, 2006; Greer & Longano, 2010; Greer & Ross, 2008; Greer & Speckman, 2009). Once certain behavioral developmental milestones, called verbal developmental cusps, have been attained, the learner is able to come into contact with new aspects of their environment and the contingencies of reinforcement and punishment that such contact entails that they could not prior to the attainment of the cusps (Rosales-Ruiz & Baer, 1997). In the latter types of cusps the direct contact with the elementary principles of behavior are still obvious. While most new cusps still require direct contact with contingencies of reinforcement and correction, other types of verbal developmental cusps result in new learning capabilities in that the learner can learn in ways they could not before (Greer & Keohane, 2006; Greer & Longano, 2010; Greer & Ross, 2008; Hayes, Barnes-Holmes, & Roche, 2001; Horne & Lowe, 1996).

Inquiry into the development of verbal behavior within children's lifespan suggests that effective instruction may need to take into account the cusps and capabilities that students have in repertoire (Greer & Speckman, 2009). This focus is consistent with other educational research that reports strong interactions between children's educational histories and types of instruction (Connor et al., 2009). Building on a program of research in verbal behavior, the verbal developmental theory proposes that assessment of the presence or absence of verbal developmental cusps and capabilities allow a teacher to 1) implement researched based protocols to identify and induce certain missing cusps and capabilities and 2) alter instruction based on the learner's present capabilities.

A behavioral developmental cusp is a behavior change that allows children to come into contact with aspects of their environment that they could not prior to the change: learning to walk or talk for examples (Rosales-Ruiz & Baer, 1997). Once children have a new cusp they come into contact with new components of their environment and, in turn, they contact the consequences made possible by the new behavior. For example, once a child learns to respond to the vowel consonants of others as a listener, they come into contact with new experiences from which they learn still more about their environment. Greer and Speckman (2009) also proposed, in addition, that a *verbal developmental capability* is also a cusp, but takes on an additional attribute. A capability is a type of cusp that also allows the child to learn by new ways of contacting instructional contingencies they could not before such as generalized imitation and observational learning (Greer & Ross, 2008; Greer, Singer-Dudek, & Gautreaux, 2006). In other words, upon the acquisition of a capability, an individual can learn in a way he/she could not before, such as learning from others receiving instruction as in observational learning (Pereira-Delgado & Greer, 2009) or learning new words for stimuli without direct instruction or without observing others being instructed, as is the case in Naming. It follows then that effective instruction may entail changing the way instruction is presented based on the presence, or absence, of the verbal developmental capabilities of learners.

The verbal developmental capability of interest that has been identified and researched is the Naming capability. Naming is the capacity to say the names (or the tact as Skinner proposed in 1957) of objects or stimuli after hearing someone says the word for stimuli that is jointly observed by the observer and the speaker. In addition to learning the tact, they also learn listener responses from the same exposure (Greer & Speckman, 2009; Horne & Lowe, 1996). Moreover, the child with the Naming capability can also learn a response in one repertoire by direct or indirect instruction, either as a speaker response or a listener response, and emit an untaught response without direct instruction. The bi-directionality incorporated in the Naming capability has been characterized as a higher order behavioral relation that once established, extends across responses (Catania, 2007; Hayes et al., 2001; Horne & Lowe, 1996). Once students have the higher order behavioral relation, or higher order verbal developmental capability, they are able to learn to emit responses not directly taught (Greer & Longano, 2010; Greer & Speckman, 2009). This learned developmental capability allows learning to increase exponentially from incidental exposure to information. Several studies have demonstrated success in inducing the Naming capability using multiple exemplar instruction across speaker and listener for training sets of stimuli (Fiorile & Greer, 2007; Feliciano, 2006; Gilic, 2005; Greer, Stolfi, Chavez-Brown, & Rivera-Valdes, 2005; Greer, Stolfi & Pistoljevic, 2007; Longano, 2008; Reilly-Lawson, 2008; Speckman-Collins, Park, & Greer, 2007). Recent unpublished dissertations have also reported the instantiation of Naming by intensive tact instruction (Pistoljevic, 2008) and stimulus-stimulus pairings (Longano, 2008).

While Naming for 3-dimensional objects appears to be present for typically developing three-year olds from upper middle class families (Gilic, 2005; Hart & Risley, 1995), children from low income families, children who are English language learners, and children with autism may have significant delays in the onset of Naming, particularly the speaker component. Moreover, many children are missing Naming for 2-dimensional stimuli at the onset of their first year in school (Greer & O'Sullivan, 2007). Greer and O'Sullivan found that 48 of 52 first graders were missing Naming for 2-dimensional stimuli at the beginning of first grade. Moreover, children with autism diagnoses, children who were English language learners, and children form low SES homes were still missing Naming for 2-dimensional stimuli (i.e., pictures and symbols) at the end of first grade. Thus, older children with or without native learning disabilities may be missing this capability in early elementary school. This would appear to result in a poor educational prognosis.

The multiple exemplar instruction across speaker and listener responses that instantiated Naming in the majority of studies teaches multiple response topographies to single stimuli in training sets using a response rotation procedure that results in the emergence of incidental learning of novel speaker and listener for novel stimuli without direct instruction (Greer & Longano, 2010; Greer & Ross, 2008; Greer & Speckman, 2009). That is the word and object stimulus relation is taught across both speaker and listener responses in a juxtaposed fashion for training sets of word/objects. A sample instructional set is taught across multiple topographies, so that a student can acquire the capability to learn novel listener and speaker responses to novel stimuli as a result of hearing the word for stimuli as the stimuli are observed. For example, if taught a matching response while hearing the word for the stimulus spoken an individual with Naming can emit the listener response (e.g., if asked to point to the stimulus the child can do so) and speaker response (e.g., the child says the word for the stimulus) without instruction. Children who lack Naming cannot do this and must be taught each word and object relation directly in both listener and speaker functions. Others may acquire the listener hall from such experiences but not learn the speaker half. In the latter case they lack the bi-directional relation between the listener and speaker.

Presumably, once a child has Naming, providing instructional presentations in which the child attends to what is being taught and the teacher provides verbal instruction and a demonstration of the correct response, the child should learn faster than simply providing learn units alone. Typically teachers presume that verbal instruction and demonstration alone are useful for their students. The extant research on Naming has shown the presence or absence of the capability affects incidental learning of language in significant ways. The present study seeks to further test whether or not the onset of the Naming capability allows students to learn more efficiently from teacher provided exemplars prior to receiving response opportunities that include feedback.

Experiment 1

Method

Participants and Setting

Nine participants were selected from a suburban elementary school for grades kindergarten through grade two. Six of the students were selected from a K-2 self-contained classroom (i.e., children with autism diagnoses) and three were selected from a first grade general education classroom. The self-contained classroom utilized the CABAS® (Comprehensive Application to Behavior Analysis to Schooling, www.cabasschools.org) model of schooling for special education students based solely on the use of scientific teaching procedures (Greer & Keohane, 2004). The first grade general education classroom utilized the CABAS® Accelerated Independent Learner (AIL) model of education for general education students in which all instruction is also based on scientifically tested procedures.

Five participants were selected because they had Naming, two participants were selected because they had only the listener half of Naming, and two participants were selected because they did not have either the speaker or listener components of Naming in repertoire. The participants' grade, age, diagnosis, existing verbal behavior developmental cusps and capabilities, and classroom performance are summarized in Table 1.

Materials

The materials included teacher-created worksheets for the curricular objectives (See Table 2), graphs, black pen and data sheets.

Design

The design of Experiment I was a counterbalanced reversal design across matched pairs of participants. Pre-experimental probes of the curriculum objectives were administered to determine instructional objectives that the participants did not have in repertoire. The nine participants were then matched and paired according to their levels of verbal behavior development and their instructional repertoires. Within each of the 4-pairs, one participant underwent instruction under the standard learn unit condition first, while the other member of the pair simultaneously underwent the model demonstration learn unit condition first. One group included three students from the K-1 inclusion class; one of these students had full Naming while the other two lacked the capability. The conditions were alternated such that each student in the pair received instruction for repeated sessions under different conditions. The implementation of the intervention was also time-lagged across participants to control for maturation and classroom instructional history. The participants moved through the objectives at their own pace during the intervention, therefore the numbers of curricular objectives rotated across the conditions varied based on the responses of each participant.

Table 2
Participants A-F Curriculum Objectives for Experiments 1 and 2

Description of Objective
Identify the tens and ones using pictures of base ten blocks
Write the place of the underlined digit (ones, tens, hundreds)
Write the value of the underlined digit (ones, tens, hundreds)
Write the number in standard form (ones, tens, hundreds)
Write the number in (ones, tens, hundreds) place
Identify the hundreds, tens and ones using pictures of base ten blocks
Circle the place of the underlined digit (ones, tens, hundreds, thousands)
Write the value of the underlined digit (ones, tens, hundreds, thousands)
Write the place and the value of the underlined digit (ones, tens, hundreds, thousands)
Circle the objects in groups of tens and write the number of tens and ones.

Dependent Variable

The dependent variable was rate of learning measured as the rate of mastery of learning objectives (instructional-trials-to-criteria using trials that met the learn unit criterion). The rate of learning was measured by calculating the numbers of learn units delivered in order for the participants to meet criteria for the operationally defined curriculum-based educational objectives.

For the participants in the self-contained special education classroom (Participants A-F), criterion for mastery was set at either 90% accuracy for two consecutive sessions (blocks of 20-learn unit presentations) or 100% accuracy for any one session. For the participants in the first grade AIL classroom, the criterion for mastery was set at 90% accuracy or higher for one session (with blocks of learn units determined by the curricular material). The difference in the criterion for mastery was based on the participants' prior instructional histories. The ratio of the participants' learn-units-to-criteria were calculated and compared for the standard learn unit (SLU) phases and the model demonstration learn unit (MLU) conditions respectively.

Table 1
Description of Participants at Onset of the Experiment 1

	Grade/ Age/ Diagnosis	Level of VB	Cusps/ Capabilities	Classroom Performance
A	1/6.10/ autism	emergent listener, speaker, reader, emergent writer	Generalized Imitation (GI) Full Naming Observational Learning	Above grade level in textually responding and math. Below grade level in comprehension and writing
B	K/5.8/ autism	Listener, speaker, reader, emergent writer	GI Full Naming	Above grade level in all academic areas
C	K/6.3/ autism	Listener, speaker, reader, emergent writer	GI Listener Half of Naming	On grade level in all areas except below grade level in writing
D	1/7.2/ autism	Listener, speaker, reader, emergent writer	GI Listener Half of Naming	On grade level all academic (below AGE level in all areas)
E	1/6.2/ autism	emergent listener, speaker, reader, emergent writer	GI Full Naming	On grade level in textually responding and math. Below grade level in comprehension and writing
F	K/6.10/ autism	Listener, speaker, reader, writer	GI Full Naming	Above grade level in all academic areas
G	1/ 6/ typically developin g	Listener, speaker, reader, emergent writer	GI Full Naming Observational Learning	On grade level in reading and spelling, below grade level in math
H	1 / 6/ typically develop./ ELL	Listener, speaker	GI	Below grade level in all academic areas
I	1/6/ typically develop	Listener, speaker, reader, emergent writer	GI Listener Half of Naming	On grade level in spelling, below grade level in reading, math

Independent Variable

The independent variable was the model learn unit presentations (MLU) compared with the control condition of standard learn unit conditions (SLU). Curricular objectives were individualized based on the classroom setting of the participants.

For the participants in the self-contained classroom, curricular objectives in mathematics associated with place value were chosen because the students had no prior exposure to these topics. Curricular objectives were alternated across four phases, which involved repeated sessions under SLU conditions and repeated sessions under MLU conditions. We created instructional material or worksheets to teach the curricular objectives as described in Table 2. Multiple exemplars of problems for each objective were created so that each session, including probe sessions, utilized different exemplars of the content of instruction. Each lesson or session in the special education classroom within a condition consisted of blocks of 20-learn unit presentations. Numbers of lean units per lesson or session varied in the first grade class consistent with the curriculum. Criterion for mastery during the intervention was 90% accuracy for two consecutive sessions or 100% accuracy for one session. Criterion for the post probe during the intervention was 90% accuracy. Pre and post intervention probes were administered for each curricular objective to first determine the skill was not in the participant's repertoire, and then to confirm that the participant achieved mastery of the objective. During all probe conditions a worksheet (problems in mathematics) with twenty opportunities to respond in written form was presented to the participant for each objective. The experimenter read the directions aloud to the participants. No reinforcement or corrections were provided during the probe conditions.

Standard Learn Unit and Model Demonstration Learn Unit Procedures

Standard Learn Unit Presentations. The procedures followed during the standard learn unit condition was consistent across all participants, regardless of classroom setting. The experimenter read the directions to the participant, and told him/her "Start with number one". The instructions were delivered vocally, based on the objective (See Tables 2 and 3). An example of a direction for an objective was "Circle the place of the underlined digit" or "Make tally marks for the number". The direction, and subsequent response, varied based on the objective. Learn units were delivered after each response opportunity. The experimenter recorded a plus and delivered reinforcement in the form of praise for a correct response. A minus was recorded and a correction was given for an incorrect response. The correction for inaccurate responses consisted of the experimenter saying, "Watch me", and completing the problem while the participant observed. The experimenter completed the problem correctly, taking the student through the steps vocally and in written form. The correction procedure varied based on the objective and the response required. An example of a correction procedure included the experimenter providing the following instructions and demonstrations. "Watch me.

The direction is to circle the place of the underlined digit. The 2 is in the ones place, the 4 is in the tens place and the 5 is in the hundreds place. The 4 is underlined, so I am going to circle the word *tens* because the digit is in the tens place (experimenter circles the word tens from a list of *ones*, *tens*, *hundreds*).” The participant then repeated the correct response either by circling it, writing the correct answer, or saying the correct answer. No reinforcement was delivered for incorrect responses. These procedures (reinforcements or corrections) were repeated after every response opportunity.

Model Demonstration Learn Units. The procedures followed during the model demonstration learn unit condition was consistent across all participants, regardless of classroom setting. The model-demonstration-learn unit condition began with the experimenter modeling the response while the participant observed. A model demonstration consisted of the experimenter modeling the operations for doing the math problems for the participant twice. Thus, in this condition the students were provided with an exemplar of the correct response with the antecedent problem. For example, if the objective was to write the place of the underlined digit, the experimenter modeled identifying the ones, tens and hundreds place two times prior to presenting the worksheet for the participant to complete. After the experimenter modeled a correct response twice, the worksheet was presented and the procedure conducted in the learn unit condition was replicated. The experimenter delivered learn unit feedback after each of the twenty opportunities to respond, and did not model the response again. Reinforcement was delivered for correct responses and a correction procedure was given for an incorrect response. The model demonstration was conducted at the beginning of each session in the MLU condition until the objective was met. One of the worksheet exemplars was used during the model demonstration. A worksheet with novel problems was then used when it was the participant’s turn to respond, and the model demonstration worksheet was removed. The single difference between the two procedures was the presentation of the model demonstration presentations for that condition with all other procedures in each condition remained the same.

Interobserver Agreement

For the participants in the self-contained setting (Participants A-F), interscorer agreement (ISA) was obtained for 47% of all sessions conducted with 100% agreement. For the participants in the AIL classroom, interscorer agreement was conducted for 26% of intervention sessions with a mean of 99.4% ISA, ranging from 90 to 100%.

Results

The results of Experiment 1 are shown in Figures 1, 2, and 3. Figures 1 and 2 show the numbers of learn units required for Participants A - F to meet criterion for each curricular objective, under alternating standard and model demonstration learn unit conditions. Figure 1 shows the numbers of learn units delivered to met the curricular objectives (learn units-to-criteria) for Participants A, B, E, F, and G. These five participants had the full Naming capability prior to the onset of the study. For Participant A, the mean numbers of standard learn-units-to-criteria was 100, with no range. The mean number of model demonstration learn units-to-criteria was 30, ranging from 20 to 40. For Participant B, the mean number of standard learn-units-to-criteria was 90, ranging from 60 to 120. The mean number of model demonstration learn units-to-criteria was 30, ranging from 20 to 40. For Participant E, the mean number of standard learn units-to-criteria was 90, ranging from 60 to 120. The mean number of model demonstration-learn-units-to-criteria was 40, ranging from 20 to 60. For Participant F, the mean numbers of standard-learn-units to criteria was 80, with no range. The mean numbers of model demonstration learn-units-to-criteria was 60 with no range. For Participant G, the mean number of standard-learn-units to criteria was 46, ranging from 24 to 76. The mean number of model demonstration learn-units-to-criteria was 42, ranging from 10 to 80. The results show that the participant's learn units-to-criteria were lower, overall during the model learn unit conditions. Only one exception occurred with these four participants. Participant E required the same numbers of learn units to meet an objective for a model learn unit condition and a standard learn unit condition. However, the subsequent model demonstration and standard learn unit conditions showed a dramatic difference in learn units-to-criteria as shown in Figure 1. In those subsequent conditions, Participant E required significantly fewer learn units to meet criterion during the model demonstration learn unit condition. The results for Participants A and B showed a clear and dramatic difference in learn units-to-criteria when comparing treatments, while the results were clear, but not as dramatic for Participants E, F, and G.

Figure 2 shows learn-units-to criteria for Participants C and D, the two participants who did not have the full Naming capability. For Participant C, the mean number of standard learn units-to-criteria were 90, ranging from 40 to 140. The mean number of model demonstration learn units-to-criteria was 80, ranging from 40 to 120. For Participant D, the mean number of standard learn units-to-criteria was 50, ranging from 40 to 60. The mean number of model demonstration learn units-to-criteria was 140, ranging from 120-160. The results show that the Participant C's learn units-to-criterion were similar under each of the conditions. Therefore the model demonstration learn unit did not decrease learn units-to-criteria for Participants C. Participant D's results showed that he learned faster during the learn unit conditions than the model learn unit conditions. Thus for these participants, model learn units either resulted in slower acquisition or did not improve the rate of learning.

Figure 3 shows the *mean* learn units-to-criteria for standard and model demonstration learn units for Participants H and I. These participants did not have the Naming capability in repertoire prior to the onset of the study. A mean was used for Participants H, and I, due to the large numbers of objectives presented and achieved during duration of the study. Figure 3 shows the mean learn units-to-criterion for Participants H and I during the standard learn unit conditions and model demonstration learn unit conditions. For Participant H, the mean number of standard learn units to meet an objective was 45, ranging from 18 to 102. The mean number of model demonstration learn units to meet an objective was 64, ranging from 16 to 99. For Participant I, the mean number of standard learn units to meet an objective was 23, ranging from 7 to 40. The mean number of model demonstration learn units was 39, ranging from 20 to 67. The results showed that the mean learn units-to-criterion was lower during the model demonstration learn unit conditions for both participants. The results showed that there was no major difference between mean learn units-to-criterion between the conditions. Therefore the model-demonstration-learn units did not accelerate rate of learning for these two participants.

The results of Experiment 1 suggest a correlation between accelerated rates of learning during model demonstration learn unit conditions and the presence of the Naming capability for all four of the participants. Experiment 2 was conducted to experimentally test the effect of instantiating Naming, for the children who lacked Naming, on rate of learning under the two learn unit conditions before and after the induction of Naming for two typically developing first graders, one first grader diagnosed with autism, and one kindergartener diagnosed with autism.

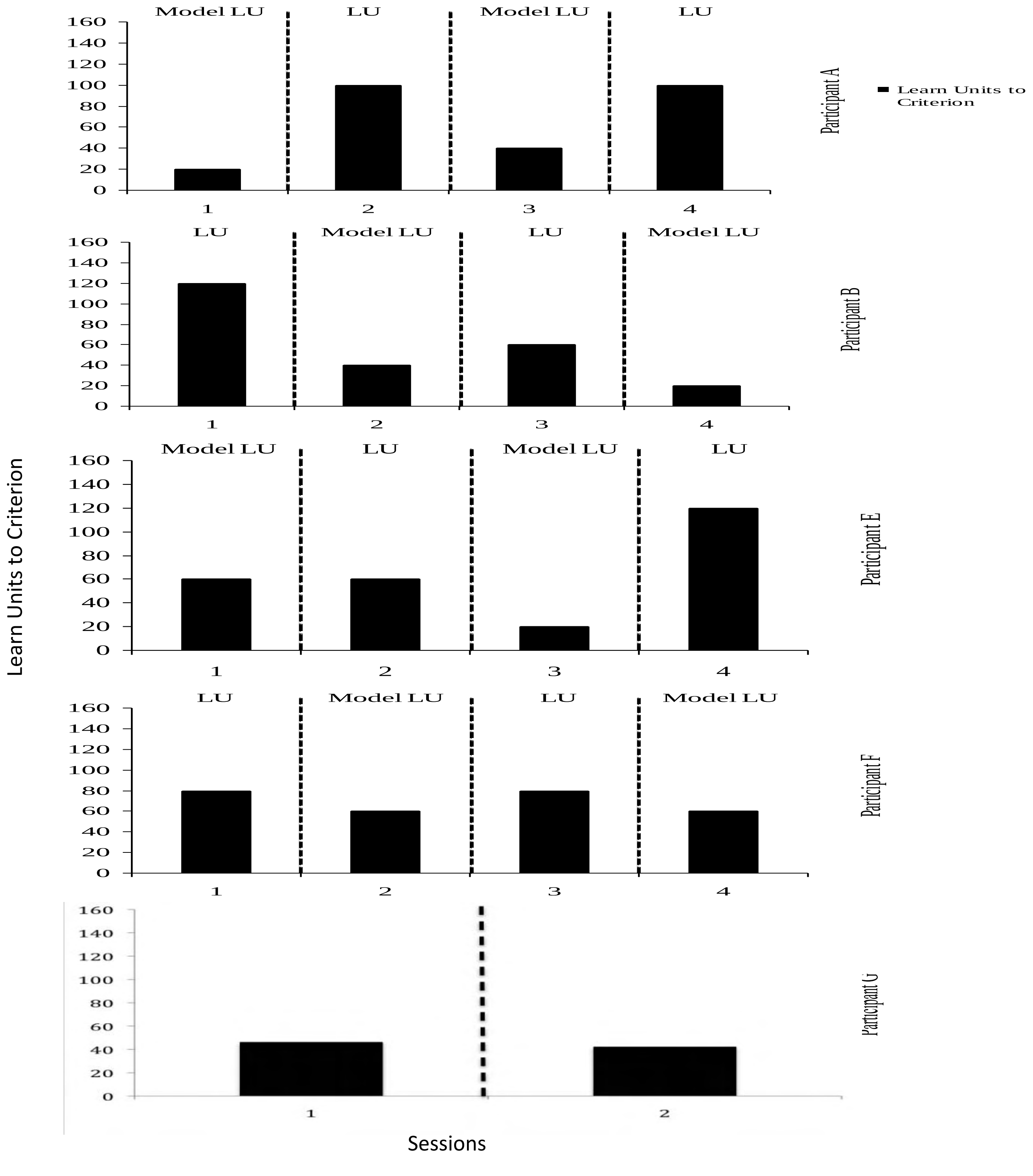

Figure 1. Experiment 1: Learn units to criterion for standard learn unit and model learn unit conditions for Participants with full Naming (A, B, E, F, G).

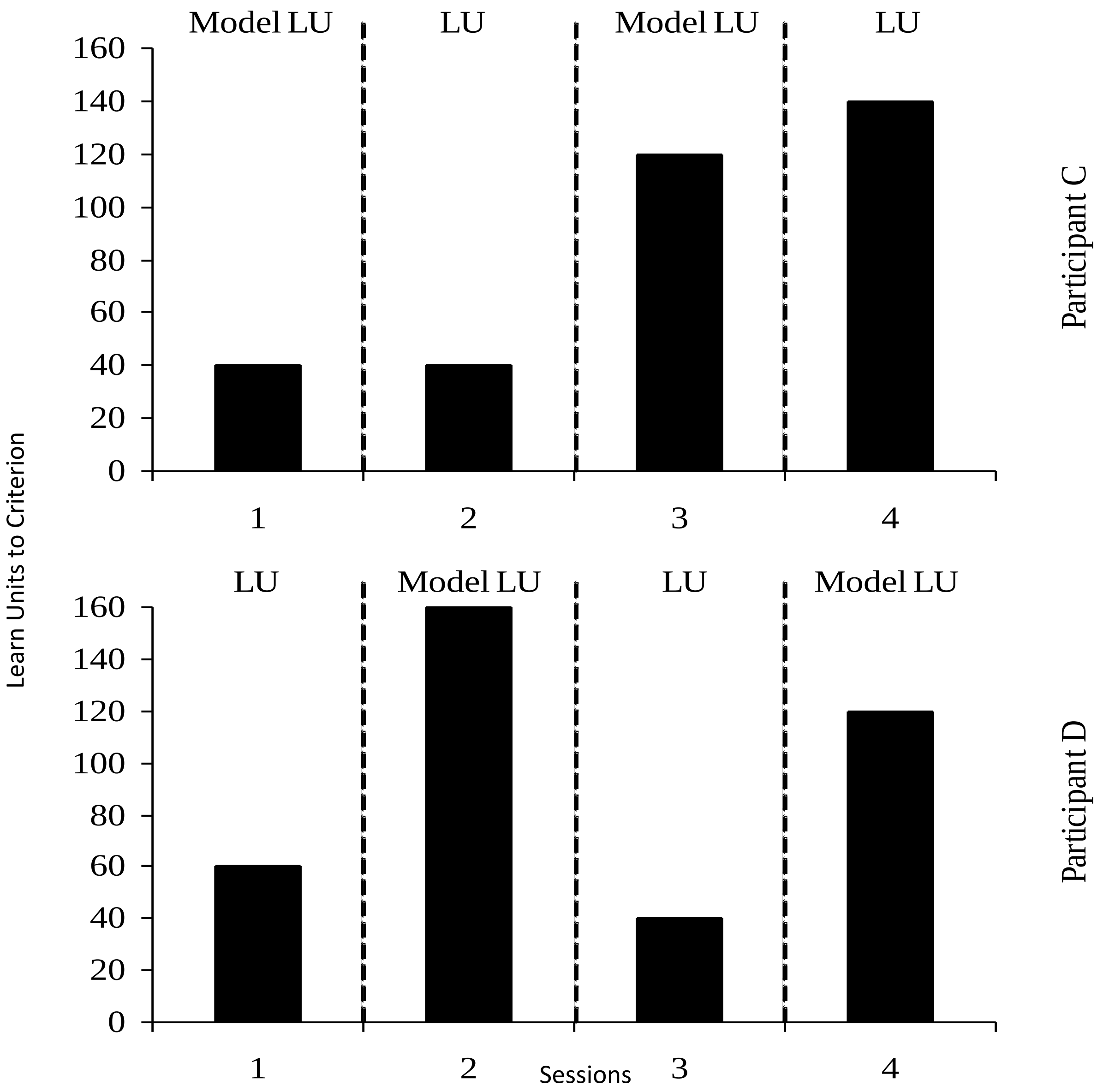

Figure 2. Experiment 1: Learn units to criterion for standard learn unit and model learn unit conditions for Participant without Full Naming (C and D).

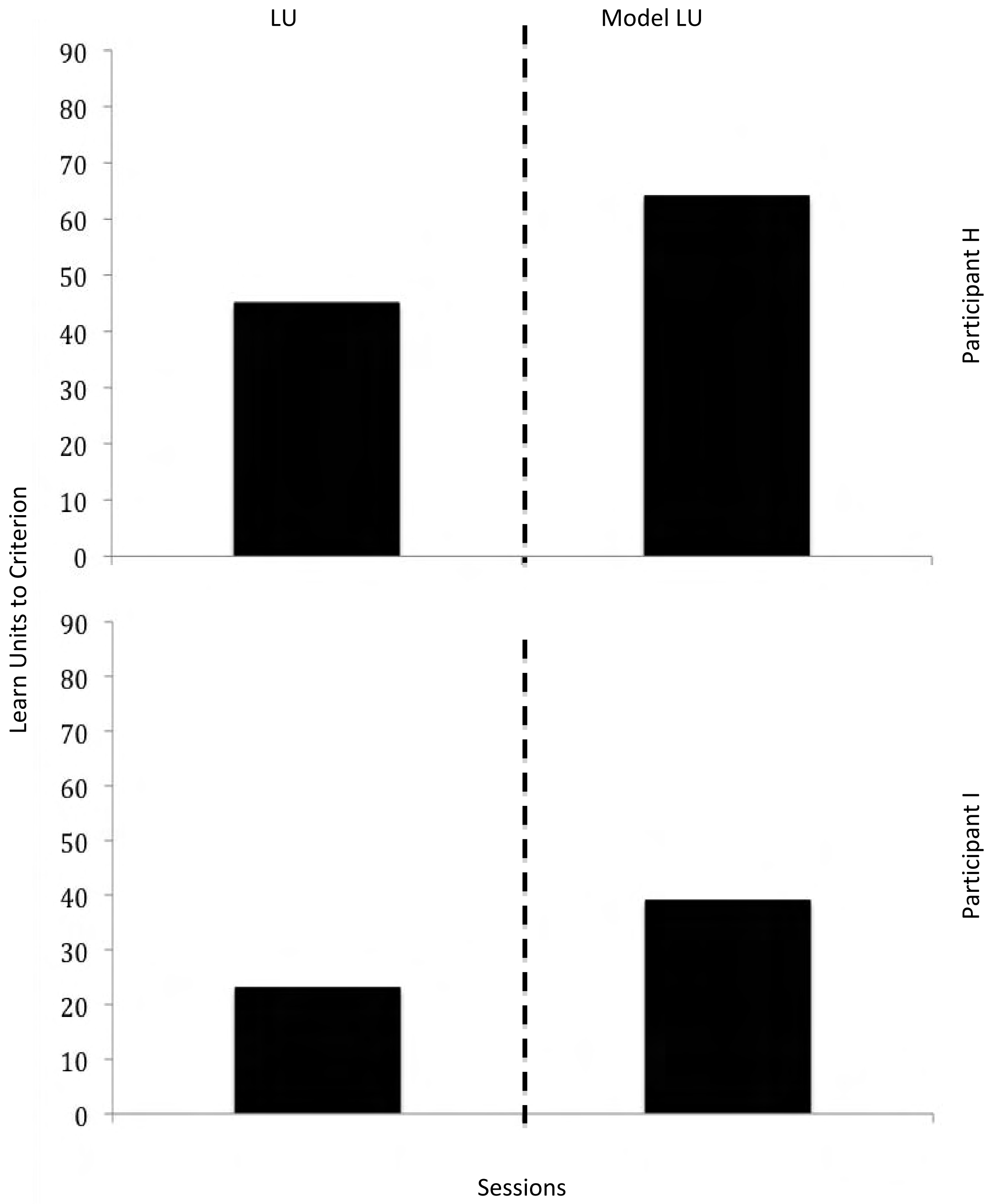

Figure 3. Mean learn units to criterion for direct and model demonstration learn units for participants without Full Naming (H and I).

Experiment 2

Method

Participants and Setting

Participants C, D, H and I, from Experiment 1were the participants in Experiment 2 who lacked Naming and who did not profit from MLU instruction. The participant's ages, grade levels, diagnoses, levels verbal developmental capabilities (at the onset of Experiment 1), and classroom achievements are shown in Table 1. The settings of the study were the same as in Experiment I based on the participants' assigned classroom.

Table 3

Participants G-I Curriculum Objectives for Experiments 1 and 2

Description of Objective
Count by 1's and 5's (vocally and transcribing)
Compare numbers 1-10 (tact smaller and larger numbers)
Say numbers that come before/after a given number
Say number that is one more and one less
Make tally marks for a number/give number for tally marks
Count hops on a number line
Compare numbers 1-20
Count by 2's (vocally and transcribing)
Solve simple number stories
Find sums of 10
Write numbers 9 & 10
Order numbers
Find equivalent names for numbers (i.e. in coins, tallies, etc.)
Count on a number grid
Compare quantities
Count nickels and pennies
Create and extend patterns
Distinguish between even and odd numbers
Tell time to the hour
Tell time to the half-hour

Materials

The materials for Experiment 2 are shown in Tables 2, 3, 4 and 5. Table 1 shows the curriculum objectives used for Participants C and D, and Table 3 shows the curriculum objectives used for Participants H and I. Table 4 shows the sets of stimuli used during the probe and intervention sessions for the induction of Naming for Participants C and D, and Table 5 shows the stimuli used during the probe and intervention sessions for the induction of Naming for Participants H and I.

Table 4.
Naming Probe and Intervention Stimuli for Participants C and D

Set	Type	Stimuli
Initial 2D probe	Contrived	samekh, yodh, qoph, mem, daleth
Initial 3D probe	Contrived	bingham, prickus, cabet, girlock, wiglet
Novel 2D probe 1	Novel set- flowers	azalea, mayflower, dogwood, forget me not, poppy
Novel 2D probe 2	Novel set- contrived	perdy, loplee, kimchow, riggy, follay
3D MEI set	Contrived	cobble, nogzob, keytoe, zeewee, molop
2D MEI set Y	Contrived	nopow, flogun, blapper, truddy, weewam
2D MEI set X	Novel- Greek symbols	lambda, zeta, aleph, omega, sigma
2D MEI set W	Contrived	glippy, mongat, penlug, doknan, alyup
2D MEI set V	Novel set- trees	dogwood, evergreen, maple, willow, birch

Table 5.
Naming Probe and Intervention Stimuli for Participants H and I

Set/Type	Stimuli
A/Probe	azalea, dogwood, forget-me-not, mayflower, poppy
Z/MEI	basalt, garnet, marble, mica, quartz
Y/MEI	augite, dolomite, gneiss, pyrite, shale
X/MEI	copper, flourite, mica, opal, topaz
B/Novel Probe	calcite, perlite, ruby, sulfite, thorite
W/MEI	angelfish, clownfish. eel, seacucumber, trout
D/Novel Probe	fennec fox, gar, giant barb, harp seal, howler monkey,
C/ Probe	aleph, lambda, omega, sigma, zeta
V/MEI	basalt, garnet, marble, mica, quartz
D/Novel Probe	Blowfish, prairie dog, salamander, tapir, wildebeast

Design

The first experiment established that these participants who lacked Naming did not benefit from model demonstration learn units. Experiment 2 consisted of two parts. The first part was the induction of Naming. In order for the independent variable to be in place, the participants needed to acquire Naming. This part of the experiment constituted a replication of prior research that had resulted in the induction of Naming. In this stage of the experiment we used a delayed multiple probe design across participants (Horner & Baer, 1978) for the induction of Naming in order to control for maturation and instructional history. Participants C and D were administered a pre-Naming probe at the same time. Participant D began the intervention of multiple exemplar instruction across listener and speaker responses first. Upon meeting criterion on the first set, Participant C received a second pre-Naming probe and began the intervention. The same design procedures occurred for Participants H and I in their respective classroom setting.

Once Naming was induced, we began the second stage of Experiment 2. In the second stage of the study we used a counterbalanced reversal design (alternating phases of MLU and SLU conditions) across matched pairs, as was done in the first experiment. This allowed a comparison of the participant's rate of learning under the two instructional presentations before and after the induction of Naming.

Dependent Variable

The dependent variable for stage 2, the alternating phases of MLU and SLU conditions, was learn-units -to criteria across four novel objectives (See Tables 1 and 2 for lists of objectives). Thus, the dependent variable was the same as in Experiment 1.

Procedures for Inducing Naming: Stage 1 of Experiment 2

The independent variable during the first phase was the instantiation of Naming. To train and test for the presence of Naming, we used two-dimensional and three-dimensional stimuli for Participants C and D, and only two-dimensional stimuli for Participants H and I. The stimuli were probed prior to intervention, and the probes were replicated after the intervention. During the initial probe, the participants were taught the stimuli (See Tables 4 and 5) in the match-to-sample (MTS) response while hearing the experimenter say the "words" for the stimuli until criterion was achieved. Each session consisted of twenty learn units, and criterion was set at 90% for two sessions or 100% for one session. Two pictures were placed in front of the student, and an alternate target exemplar of one of the pictures was handed to the student with the vocal antecedent "Match ____ to ______". A correct response was followed by praise, and an incorrect response was followed by a correction procedure. The correction procedure included the experimenter providing the correct response, and the participant repeating the correct response. No praise was delivered for an incorrect response, or after the correction procedure consistent with the learn unit procedures. After the MTS responses were taught to mastery as the students heard the word for the stimuli, the probes were conducted in separate blocked sessions for the untaught point or listener response, tact and intraverbal responses (speaker responses), with the same set of stimuli. For the point response, two stimuli were placed in front of the student. The vocal antecedent was delivered, “Point to _____.” For the tact response, a stimulus was held in front of the participant with no vocal antecedent. If the students were not attending, the experimenter would say the students’ names, or said, “Look” to gain the student's attention. For the intraverbal response, a stimulus was held in front of the participant with the vocal antecedent, “What is this?”

After the participant demonstrated criterion on the post-MEI probe of the initial Naming probe set, a novel set of stimuli were probed. The novel set probe was a replication of the procedures used in the initial probe in which the stimuli were first taught in the match response while hearing the experimenter say the “words” for the stimuli and the student was probed on the untaught point to, tact, and intraverbal responses. Criterion for the emergence of Naming was set at 80% accuracy for one session consistent with prior studies.

After it was again established that the two participants still lacked Naming, we induced Naming using multiple exemplar instruction (MEI) across listener and speaker responses for training sets (i.e., different stimuli). Match, point, tact and intraverbal tact responses were rotated for twenty learn units of each response for a training set, for a total of eighty learn units per session run. Each response was presented in a rotating fashion for each of the five stimuli. Criterion for mastery was set at ninety percent for two consecutive sessions or one hundred percent for one session. Once the participant met criterion, a post-MEI probe was conducted. If the participant did not meet criterion on the post probe (Set at eighty percent accuracy for one session), MEI was repeated with a novel set of stimuli. See Tables 4 and 5 for a list of two and three-dimensional stimuli used during MEI.

For matching, two stimuli were placed in front of the student once he/she was attending to the teacher. Another object, a replication of one of the stimuli on the table, was handed to the student with the vocal statement of the word for the stimuli “Match _____ to ______”. A correct response consisted of the student placing the target stimulus on top of the identical stimulus match. A correct match was followed with vocal praise from the experimenter. An incorrect response consisted of the student placing the picture on the non-match, a response of “I do not know”, or a lack of response. An incorrect match was followed with a correction procedure, with included the experimenter repeating the vocal antecedent, and placing the picture on top of the correct stimulus, and repeating the vocal antecedent. The student placed the target stimuli on top of the correct stimulus match as a correction. No teacher praise was dispensed for an incorrect response.

For the pointing response (the listener response), two of the stimuli were placed in front of the participant with the vocal antecedent “Point to _______”. A correct response consisted of the student pointing to the correct stimulus and an incorrect response consisted of the student pointing to the inaccurate stimulus, a response of “I don’t know” or a lack of response. Praise was delivered for a correct response and a correction procedure was implemented for an incorrect response. The correction procedure consisted of the experimenter pointing to the correct stimulus and repeating the vocal antecedent and the student pointing to the correct stimuli. No praise was delivered for a correction response.

Pure tact responses consisted of the experimenter holding up one of the stimuli in front of the student. If the student was not attending, his/her name was spoken, or the vocal prompt “Look” was used to get the student to attend to the stimulus. A correct response consisted of the accurate response emitted vocally by the student. An incorrect response consisted of any other vocal response, or a lack of response. Positive reinforcement was delivered for a correct response, and an incorrect response was given the correction procedure described above.

The intraverbal tact responses consisted of the experimenter holding up each stimulus with the vocal antecedent “What is this?” or “What is this called?” A correct response consisted of the accurate response emitted vocally by the student. An incorrect response consisted of any other vocal response, or a lack of response. Positive reinforcement was delivered for a correct response, and an incorrect response was given the correction procedure described above.

Once Naming was induced, the comparison of learning rates under the two different instructional conditions—standard learn units and model-demonstration learn units, was replicated in the same fashion as Experiment I.

Interobserver Agreement

For the first stage, the induction of Naming as the independent variable, interobserver agreement was conducted on 80% of probes with 100% agreement for Participant C and 100% of probes with 99% agreement for Participant D. Interobserver agreement was conducted on 50% of intervention sessions with 100% agreement for Participant C and 70% of intervention sessions with 100% agreement for Participant D.

For the dependent variable or rate of learning, interscorer agreement was conducted for 55% of sessions for Participants C and D with 100% agreement. Interobserver agreement was conducted for 55% of sessions for Participants H and I, with a mean of 99.8%, ranging from 99 to 100%.

Results

Instantiation of Naming. The results for Experiment 2 are shown in Figures 5, 6, 7, and 8. Figures 4 and 5 show Participants C and D’s correct responses to point, tact and intraverbal responses on the Naming probes for three and two-dimensional stimuli respectively demonstrating the induction of Naming; hence, the implementation of the independent variable which was the instantiation of Naming. The pre-Naming probes showed that neither participant had Full Naming in repertoire. The post-MEI probes showed both Participants acquired Full Naming for both 3-D and 2-D stimuli after the intervention of multiple exemplar instruction across listener and speaker responses. Figure 6 shows the pre and post probes for Naming Participants H and I. The figure shows Participants H and I acquired Full Naming as a function of experimenter intervention.

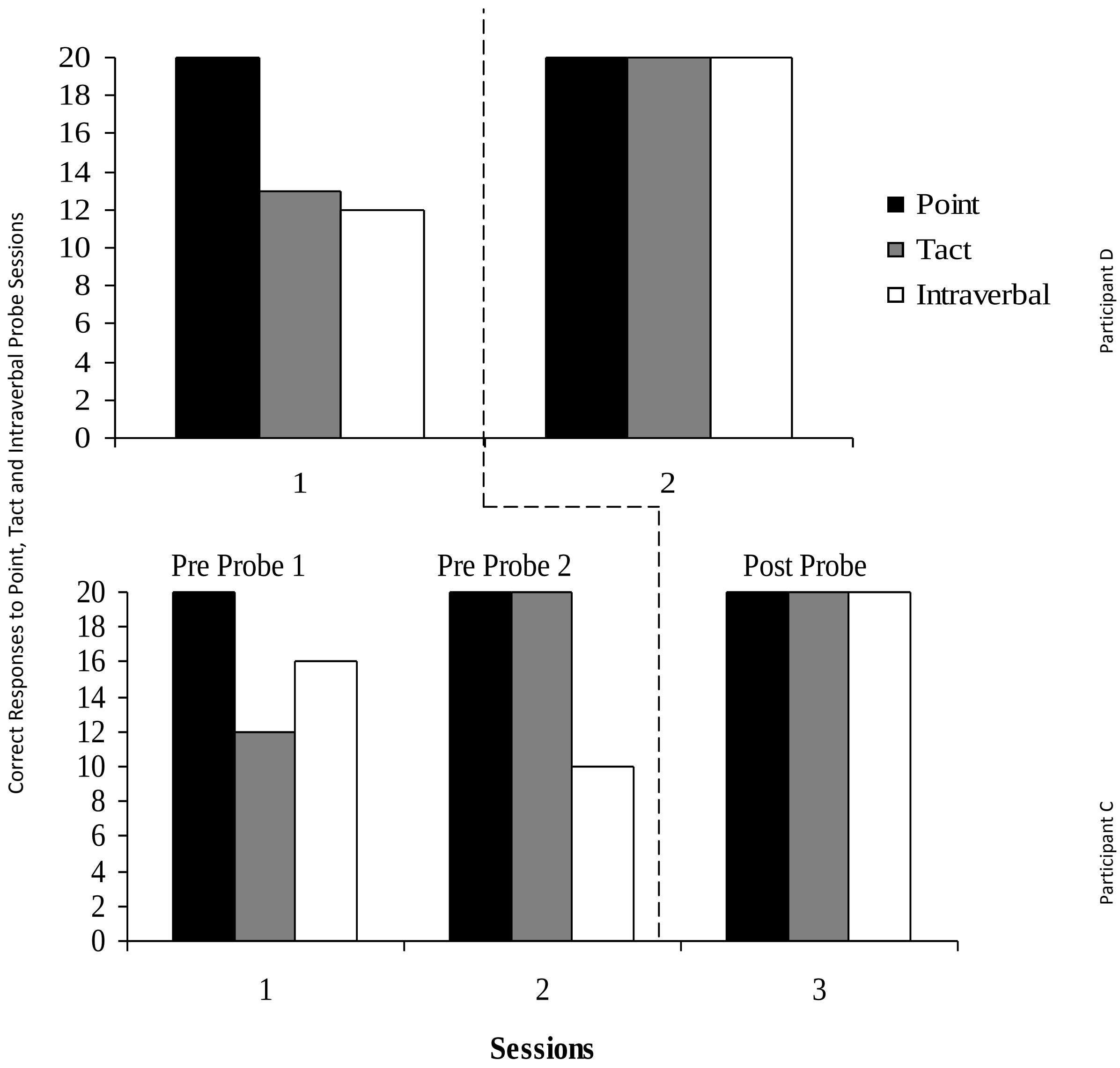

Figure 4. Experiment 2: Correct responses to 3D Naming probes for the point to, tact and intraverbal responses for Participants C and D demonstrating the induction of Naming.

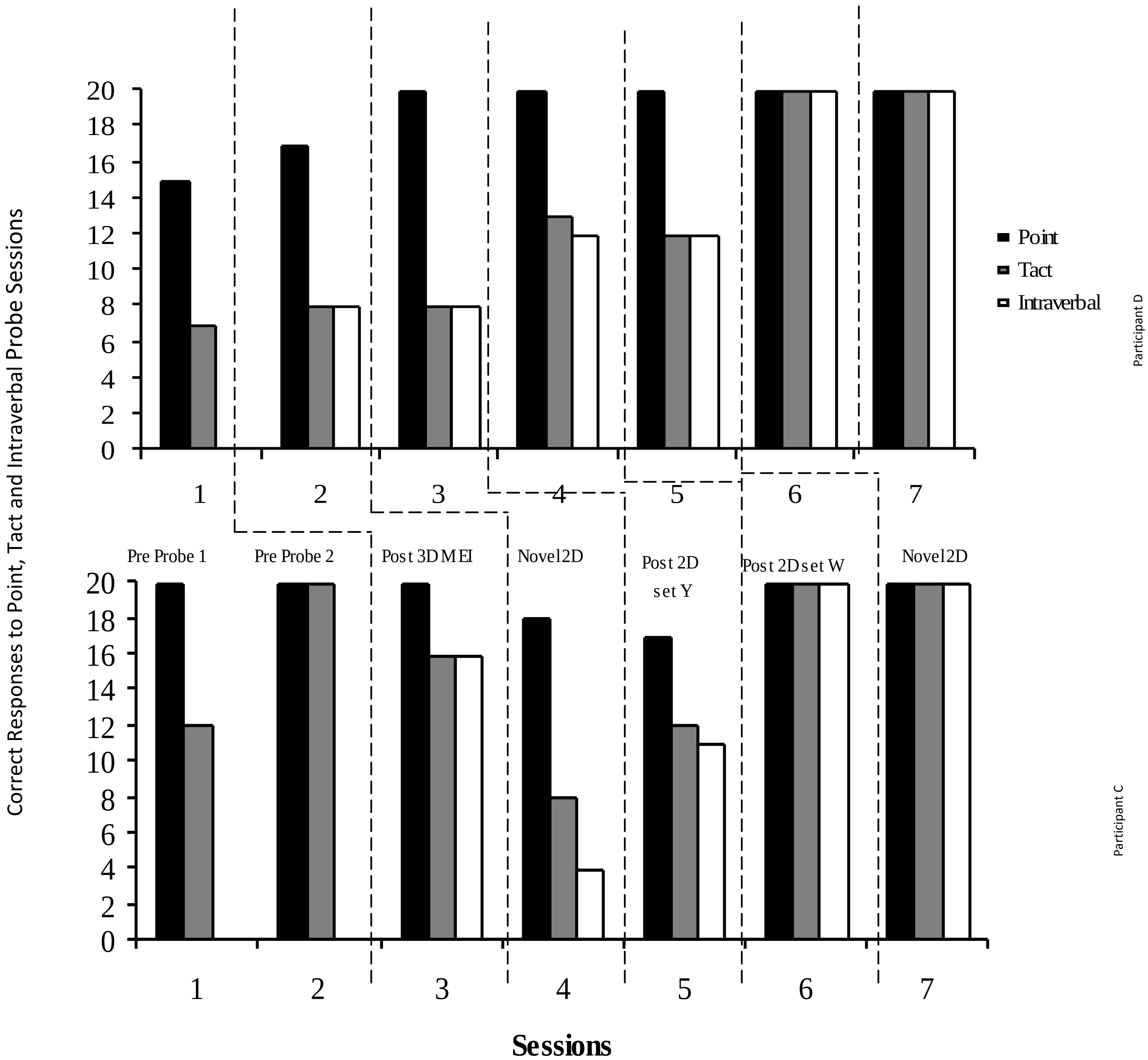

Figure 5. Experiment 2: Correct responses to 2D Naming probes for the point to, tact and intraverbal responses for Participants C and D.

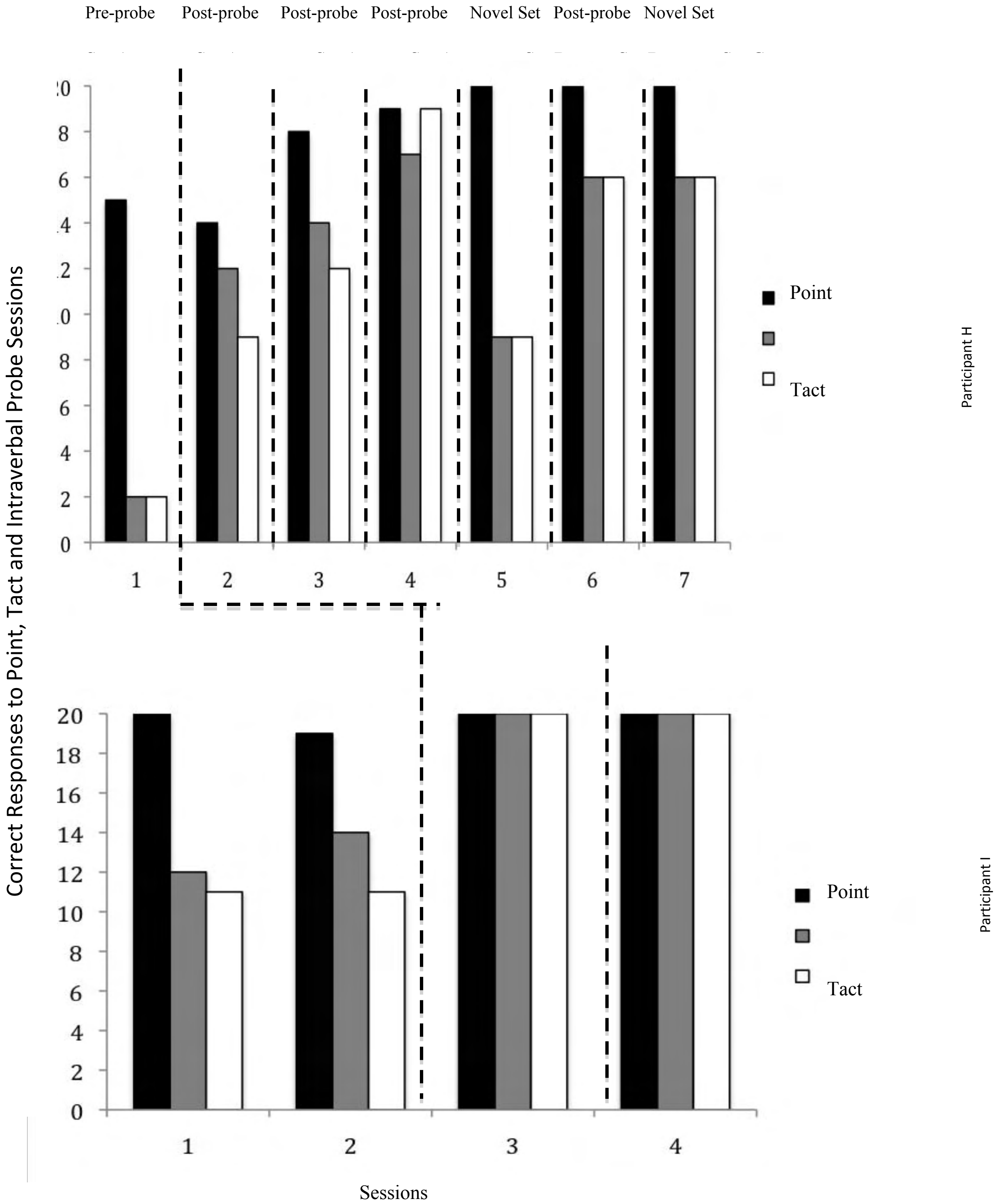

Figure 6. Experiment 2: Correct responses to 2D Naming probes for the point to, tact and intraverbal responses for Participants H and I.

Effects of Acquisition of Naming on Rate of Leaning. Figure 7 shows Participants C and D's learn units to criterion across standard learn unit and model demonstration learn unit conditions for four novel curricular objectives that was the dependent variable. Figure 7 shows the comparison of the numbers of learn units required for the participants to meet the objective for the two alternating conditions. After the induction of Naming, the mean numbers-of-learn-units –to-criteria for the standard learn unit condition was 60, with no range, for Participant C. The mean numbers of model demonstration learn units-to-criteria was 40, with no range. For Participant D, the mean numbers of standard learn units-to-criteria was 80, with no range. The mean number of model demonstration learn units to criteria was 50, ranging from 40 to 60.

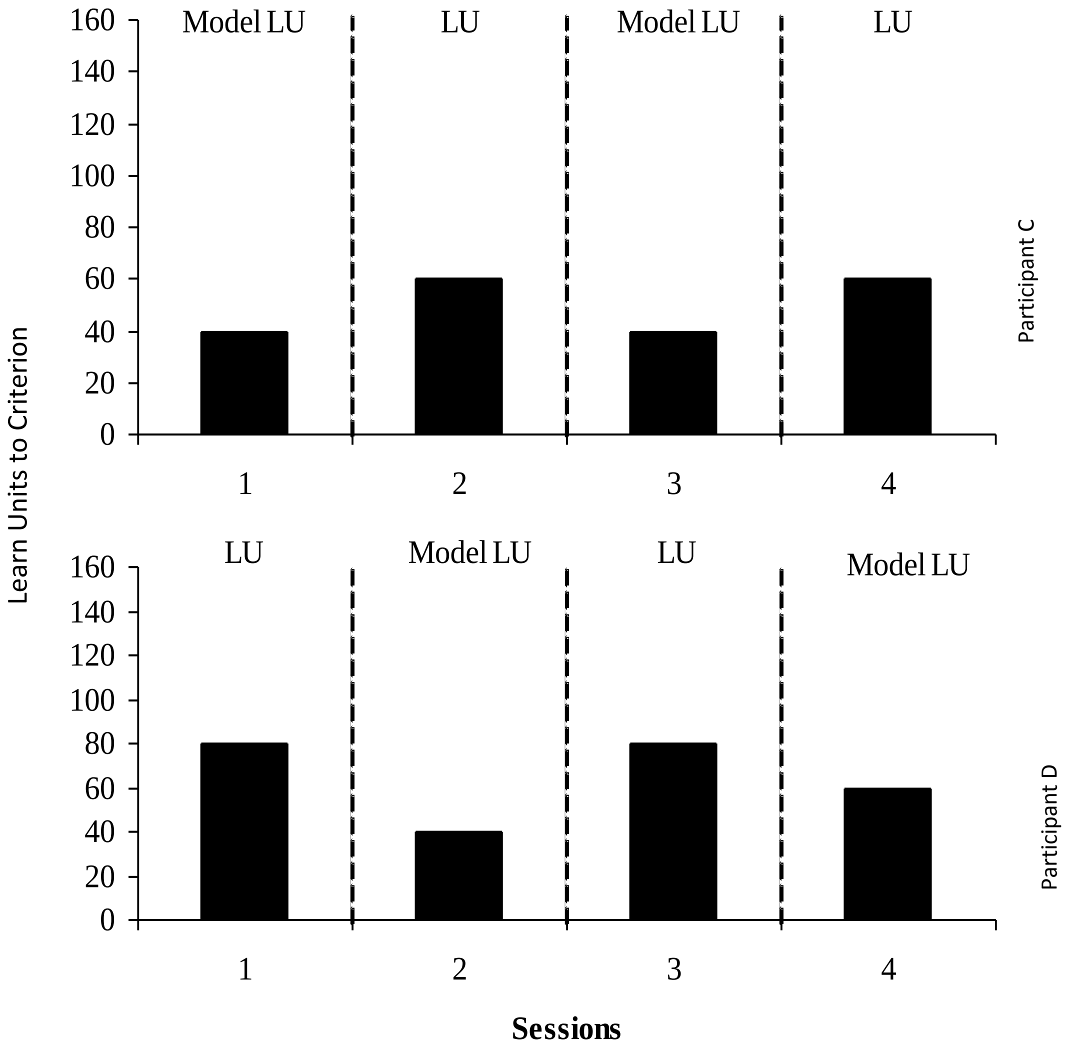

Figure 7. Experiment 2: Learn units to criterion for learn unit and model learn unit conditions for Participants C and D after the emergence of Naming.

Figure 8 shows the mean learn units-to-criterion across standard learn unit and model demonstration learn unit conditions for Participants H and I after the induction of Naming. Subsequent to acquiring full Naming, for Participant H, the number of standard learn units required to meet an objective units was 19. The mean number of model demonstration learn units to meet an objective was 17, ranging from 13 to 19. Subsequent to acquiring full Naming, for Participant I, the mean number of standard learn units required to meet an objective was 23, ranging from 8 to 38. The mean number of model demonstration learn units required to meet an objective was 18, ranging from 9 to 23. The results shown in Figures 8 and 9 show that after Naming emerged for Participants C, D, H and I, their learn units to criterion were fewer during model demonstration learn unit conditions than during learn unit conditions. Therefore the participants met the objective faster under the model demonstration learn unit condition. Thus, prior to the induction of Naming as shown in Experiment 1, the participants required more learn units to master curricula under the model demonstration condition than the standard learn unit presentation condition. After Naming was induced, the participant's learning accelerated 2 to 3.8 times faster during the model demonstration learn unit conditions after Naming was induced than they did prior to Naming as shown in Experiment 1, showing that the acquisition of Naming allowed them to learn faster under the model demonstration learn unit condition.

General Discussion

The results of Experiment 1 showed a correlation between the presentations of model demonstration learn units and acceleration of rate of acquisition of curricular objectives, when the Naming capability was in repertoire, for five participants. Four of the participants were diagnosed with developmental delays while one participant was typically developing.

The results of Experiment 2 showed a functional relationship between the induction of the Naming capability and learning from a model demonstration learn unit. Participants C, D, H and I did not acquire objectives faster in model demonstration learn unit conditions during Experiment 1. After the full Naming emerged for Participants C, D, H and I, all acquired objectives faster during model demonstration learn unit conditions in Experiment 2. The participants learned two to four times faster during the model demonstration learn unit conditions after the acquisition of Naming. In addition, Participants D and I acquired objectives faster regardless of condition after the induction of Naming. This held true for Participants C and H for the model demonstration learn unit condition, but not for the learn unit condition. It is unclear why Participants C and H did not learn faster during the standard learn unit condition after the induction of Naming. Perhaps there are other variables that have not yet been identified and require further research.

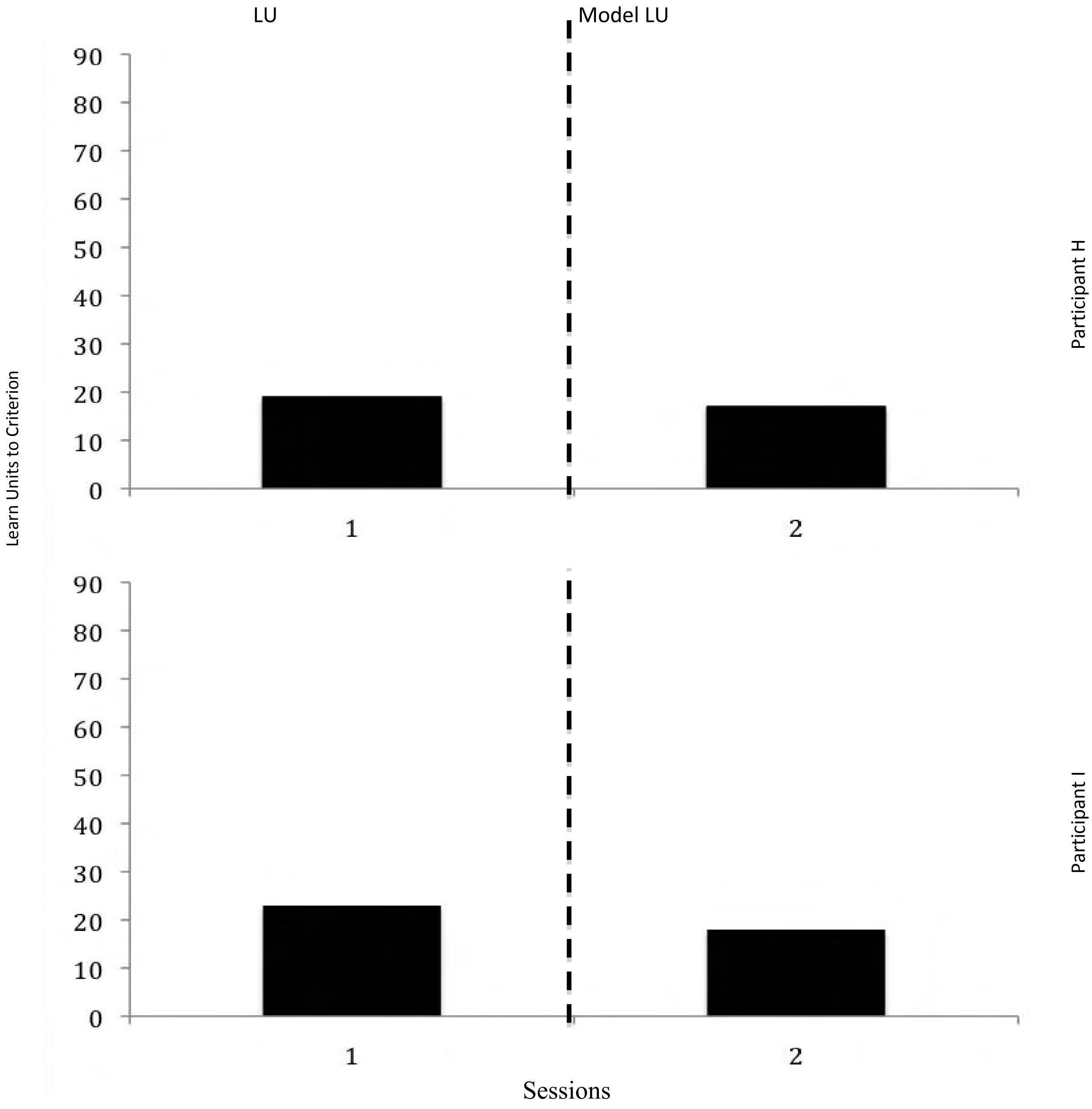

Figure 8. Experiment 2: Learn units to criterion for learn unit and model learn unit conditions for Participants I and J after the emergence of Naming

Some limitations warrant discussion. For Experiments 1 and 2, the number of curricular objectives achieved varied for the students in the K-1 inclusion general education classroom from those in the special education classroom where sessions or lessons were always 20-learn unit blocks. This was due to the differences in standards for mastery for general education students, where the criterion for mastery requires fewer numbers of correct responses. The children in the general education class acquire mastery faster than do those in the special education classroom and require fewer numbers of learn units to achieve mastery. This resulted in a wide range of objectives met (9 to 21) across the four participants from that class. Therefore, they differ from the special education in terms of the numbers of objectives achieved. On the other hand the effects were present even with these differences.

The results of the study also support prior basic and applied research that shows children acquire both the speaker and the listener responses for stimuli from hearing the word for the stimuli as a listener after they acquire the verbal developmental capability of Naming (Fiorile & Greer, 2007; Greer, Stolfi, Chavez-Brown, & Rivera-Valdes, 2005; 2005; Greer, Stolfi, & Pistoljevic, 2007; Helou-Care, 2008; Longano, 2008; Pistoljevic, 2008; Speckman-Collins, Park, & Greer, 2007). In other words, Naming is once again affirmed as a (or the) source for how children come to learn incidentally. This study suggests that the presence of Naming affects how children can be taught. Once Naming is in place, not only can children acquire language incidentally, but also the presence or absence of Naming affects how children can be taught in school settings or for those who lack Naming how they cannot be taught efficiently. Once a child has Naming, providing presentations using a model demonstration learn unit allows a child to learn faster than simply providing a standard learn unit alone. The findings of this study suggest that students, such as those in Experiments 1 and 2, can learn faster via the model demonstration learn unit if they have Naming and they cannot if they do not have Naming. These results suggest that Naming is a critical prerequisite in order for students to benefit from teacher demonstrations prior to instruction. Therefore it is critical to test for, and induce, missing capabilities such as Naming. Interestingly, most teachers provide model demonstrations as part of their presentation of instruction. These data suggest that students without Naming do not profit from this and in some cases such presentations may interfere with learning. In order for such presentations to be effective children appear to require the Naming capability.

The results also raise other issues in the basic science. The data suggest that the types of verbal developmental cusps and capabilities that are in student's repertoires affect learning. These findings identify a particular type of instruction by participant interaction one based on an empirically identified verbal behavior developmental capability. Moreover, the findings support one aspect of the verbal developmental theory (Greer & Speckman, 2009), to wit, Naming affects the way that children learn and can be taught. It is also likely that there are other cusps and capabilities that affect the way in which children learn and can be taught.

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