Research

The Impact of Aided Language Stimulation on Symbol Comprehension and Production in Children With Moderate Cognitive Disabilities

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Over the past decade, aided language stimulation has emerged as a strategy to promote both symbol comprehension and symbol production among individuals who use graphic mode communication systems. During aided language stimulation, an interventionist points to a graphic symbol while simultaneously producing the corresponding spoken word during natural communicative exchanges. The purpose of this study was to determine the impact of aided language stimulation on children with moderate cognitive disabilities. Three preschool children with moderate cognitive disabilities who were functionally nonspeaking participated in the investigation. The investigator implemented a multiple-probe design across symbol sets/activities. Elicited probes were used to determine whether the children increased their comprehension and production of graphic symbols. Results indicated that all 3 children displayed increased symbol comprehension and production following the implementation of aided language stimulation.

Key Words: augmentative and alternative communication, augmented input, aided language stimulation, moderate cognitive disability

The majority of intervention strategies for persons requiring augmentative and alternative communication (AAC) have focused on elicited production. Several well-documented instructional strategies have been used to teach symbol production using direct instruction with individuals who have moderate-to-severe disabilities (Carr, Binkoff, Kologinsky, & Eddy, 1978; Carrier, 1974; Romski, Sevcik, & Pate, 1988; Sigafoos, Laurie, & Pennell, 1996). Others have used direct instruction strategies embedded within natural contexts (Reichle & Brown, 1986; Reichle & Sigafoos, 1991; Reichle & Yoder, 1985). Several investigators have reported the successful implementation of milieu teaching strategies, which might be useful for AAC users as well (Halle, 1982; Halle, Marshall, & Spradlin, 1979; Hart & Risley, 1975; Warren, McQuarter, & Rogers-Warren, 1984).

Each of these intervention strategies has focused on the feedback and reinforcement from the communicative partner as a primary mechanism accounting for the success of the procedure. However, research emerging during the past decade has suggested that speaking children learn to comprehend and produce words that are frequently spoken to them (Huttenlocher, Haight, Bryk, Seltzer, & Lyons, 1991). More recent naturalistic intervention approaches have capitalized on this knowledge and incorporated language input strategies into teaching new words (Girolametto, Weitzman, & Clements-Baartman, 1998; Tannock & Girolametto, 1992). It is quite possible that similar processes contribute to learning to comprehend and produce graphic symbols. In AAC, spoken language input may well contribute to learning the meaning associated with a graphic symbol. Spoken language input might come from a voice output communication aid (VOCA) and/or from a communicative partner (Goossens', Crain, & Elder, 1992; Schlosser, Belfiore, Nigam, Blischak, & Hetzroni, 1995). Two AAC intervention approaches, the System for Augmenting Language (SAL; Romski & Sevcik, 1992, 1996) and aided language stimulation (Elder & Goossens', 1994; Goossens', 1989; Goossens' et al., 1992), advocate augmented input as part of a comprehensive intervention package to establish augmentative communication competence.

Romski and Sevcik (1996) described the implementation of the SAL during a 2-year longitudinal study with 13 male youths with moderate or severe mental retardation.

The authors described four basic components of the SAL that included (a) a VOCA, (b) symbols and the lexicon, (c) teaching through natural communicative exchanges, and (d) the communicative partner's use of the VOCA. The teaching method consisted of loosely structured natural communicative experiences that were embedded into the participants' regularly occurring routines. The investigators taught communicative partners to use the VOCA as a supplement to their own spoken communication as a form of augmented input. Although all participants acquired symbols, a post-hoc analysis of participant performance revealed two achievement patterns. Four participants displayed what the authors termed a beginning achievement pattern. Beginning achievers were slow in acquiring symbols and learned fewer than 20 symbols during the 2-year period. The other 9 participants displayed an advanced achievement pattern. Advanced achievers rapidly acquired at least 35 symbols during the 2-year period.

Goossens' et al. (1992) described aided language stimulation as pointing to "key symbols on the learner's communication display in conjunction with all ongoing verbal language stimulation being directed toward that [learner]" (p. 11). Aided language stimulation has been implemented with and without the use of VOCAs (Elder & Goossens', 1994; Goossens' et al., 1992). Goossens' (1989) reported on the implementation of aided language stimulation with a 6-year-old, functionally nonspeaking female with severe spastic-athetoid cerebral palsy who was learning English as a second language. Before intervention, the child spoke 5 Korean words and 10 English word approximations. Her developmental level was estimated to be at least 16–20 months. During a 7-month period, interventionists implemented a multicomponent experientially based augmentative communication stimulation program that included concurrently implemented selection techniques, direct selection eye gaze, and switch access. During intervention, the interventionist pointed to key graphic symbols on the child's communication display in conjunction with ongoing spoken language stimulation. In addition to clinician-delivered intervention, the learner's parents were provided with hands-on training. Results indicated the emergence of both graphic symbol communication and functional speech.

Schlosser et al. (1995) compared VOCA and non-VOCA augmented input conditions while teaching lexigrams to 3 individuals with severe to profound mental retardation. In the VOCA condition, the experimenter told the participant to "point to _________" and immediately modeled the correct symbol-selecting response. During this condition, the participant received augmented input in the form of synthetic speech. During the non-VOCA condition, the experimenter told the participant to "point to _________" and immediately modeled the correct response but did not actually touch the key on the VOCA (consequently, no synthesized message was produced). The investigators reported that the 3 participants reached criterion during the VOCA condition. Two participants also reached criterion during the non-VOCA condition. However, implementing augmented input resulted in fewer teaching sessions to reach criterion.

Although recent studies have supported the use of augmented input (Goossens', 1989; Romski & Sevcik, 1996; Schlosser et al., 1995), several authors have indicated the need for further empirical support for aided language stimulation (Beukelman & Mirenda, 1998; Sevcik & Romski, 2002). Sevcik and Romski indicated that "evaluating augmented input or aided language stimulation as an AAC intervention is sorely needed" (p. 470). The purpose of this study involving children with moderate cognitive disability was twofold: (a) to determine whether aided language stimulation (non-VOCA) increased symbol comprehension, and (b) to determine whether aided language stimulation (non-VOCA) increased symbol production (object labeling).

Method

Three preschool children participated in aided language stimulation activities with each of 12 new object vocabulary items. Experimenters scrutinized the effect of aided language stimulation on participants' symbol comprehension and symbol production through a series of probes completed during baseline, intervention, and maintenance phases of the study.

Participants

Three preschool children with moderate cognitive disabilities who were functionally nonspeaking (spoken vocabulary of no more than 30 words) participated. None of the children's individualized education plans contained objectives for learning graphic or gestural symbols.

The children met the following inclusionary criteria: (a) moderate cognitive disability as determined by a licensed school psychologist, (b) an expressive vocabulary of less than 30 words as determined by administration of the MacArthur Communicative Development Inventories (Fenson et al., 1993), (c) the ability to directly select pictures and objects using a finger or thumb, (d) normal vision as determined through examination of school records, and (e) normal hearing as determined through examination of school records.

During an identity matching assessment, 10 black and white Picture Communication Symbols (Mayer-Johnson, 1992) were used with each child. The experimenter randomized the position of the symbol choices and the presentation of symbol samples across opportunities. The experimenter placed an array of four symbol choices centered approximately 8–10 in. in front of the child. He held up a symbol sample and said, "Find this." The experimenter recorded the child's first selection of a symbol choice. No corrective feedback was offered. Each symbol was probed twice.

The experimenter implemented a fast-mapping task adapted from Mervis and Bertrand (1994) with each child. Four sets of objects were used. Each set contained five objects: four common objects for which the child already comprehended the names and one object for which the child was not expected to know the name. Examples of known objects included book, ball, and shoe. Examples of unknown objects included garlic press and turkey baster (a novel, one-syllable nonsense label was assigned to the unknown object). Four exposure opportunities were followed by comprehension opportunities. During the exposure opportunities, the experimenter arranged the five objects in a row and encouraged the child to manipulate them. The experimenter asked the child for one of the known objects (e.g., "May I have the ball?") and for the unknown object (e.g., "May I have the lep?"). If the child responded incorrectly to the nonsense label or did not respond at all, the experimenter showed the child the correct object and allowed the child to manipulate the object. During this time, the experimenter labeled the object three times. During opportunities in which the child responded correctly, he or she was allowed to play with the object while the experimenter labeled it three times. This input was provided to reinforce the child's correct mapping as per the Mervis and Bertrand protocol. After the exposure opportunities were completed for two sets of objects, the comprehension opportunities were implemented for those two sets. During these opportunities, the experimenter placed the same five objects, along with an unknown distractor, in front of the child. Again, the child was asked for either a known object or the original unknown object. The order of requesting the known and unknown objects was counterbalanced. Following comprehension opportunities for the first two sets of objects, the procedure was repeated for the remaining two sets of objects. Percentage correct was calculated based on comprehension opportunities for unknown objects separately.

Jennie.

Jennie, age 3;10 (years;months), was a Caucasian female with Down syndrome. She was enrolled in an early childhood special education classroom. Her composite score on the Vineland Adaptive Behavior Scales (Sparrow, Balla, & Cicchetti, 1984) was 55. A licensed school psychologist administered this instrument and indicated that the scores were consistent with a diagnosis of moderate cognitive disability. Her age equivalent on the Peabody Picture Vocabulary Test (Dunn & Dunn, 1997) was less than 1;9. The MacArthur Communicative Development Inventories (Fenson et al., 1993) indicated that Jennie comprehended 143 words and produced 3 spoken words. Jennie scored 100% on the identity matching task. She met criterion with 75% correct on the fast-mapping task.

Niles.

Niles, age 5;4, was a Caucasian male with Down syndrome. He was enrolled in an early childhood special education classroom. A licensed school psychologist evaluated Niles' cognition. He scored 3 standard deviations below the mean on the cognition section of the Mullen Scales of Early Learning (Mullen, 1985). This score was consistent with a diagnosis of moderate cognitive disability. His composite score on the Vineland Adaptive Behavior Scales (Sparrow et al., 1984) was 61. Niles' age equivalent on the Peabody Picture Vocabulary Test (Dunn & Dunn, 1997) was less than 1;9. The MacArthur Communicative Development Inventories (Fenson et al., 1993) indicated that Niles comprehended 87 words and produced 11 spoken words. Niles scored 100% on the identity matching task. He met criterion with 75% correct on the fast-mapping task.

Edie.

Edie, age 4;2, was a Caucasian female with no specified diagnosis. She was enrolled in an early childhood special education classroom. A licensed school psychologist implemented several standardized assessments with Edie. Edie's composite score on the Bayley Scales of Infant Development (Bayley, 1993) was more than 3 standard deviations below the mean. She scored below the first percentile on the Mental Development Index (Bayley, 1993). Edie's performance on these assessments was consistent with a diagnosis of moderate cognitive disability. Her age equivalent on the Peabody Picture Vocabulary Test (Dunn & Dunn, 1997) was less than 1;9. The MacArthur Communicative Development Inventories (Fenson et al., 1993) indicated that Edie comprehended 121 words and produced 14 spoken words. Edie scored 100% on the identity matching task. She scored 100% on the fast-mapping task.

Materials

Individual symbols used during elicited probes consisted of laminated 3 × 3 in. black and white Picture Communication Symbols (Mayer-Johnson, 1992). The symbol arrays consisted of 3 × 3 in. black and white Picture Communication Symbols that were affixed to 10 × 7 in. laminated cards. The experimenter arranged the symbols in two rows, with three symbols in the top row and three symbols in the bottom row. The symbols were spaced .125 in. apart from one another. The communication boards used during scripted routines consisted of 3 × 3 in. black and white Picture Communication Symbols affixed to a laminated $8^1/_2 \times 8^1/_2$ in. card. Symbols were arranged in two rows, with two symbols in the top row and two symbols in the bottom row. Symbols were positioned .125 in. apart. The objects used during elicited probes and scripted routines included life-sized plastic fruit, metal miniature vehicles, wooden miniature furniture, an 18-in. tall plastic doll (body parts), and actual cloth cleaning items (see Table 1).

Participant Preassessment and Stimuli Development.

Preassessment probes were conducted to develop a pool of 12 objects and 12 corresponding graphic symbols that the children did not comprehend or produce. Comprehension probes required the children to match a line-drawn symbol choice to an object sample named by the experimenter. Production probes required the children to match an object sample to a line-drawn symbol choice (Brady, 2001).

Four opportunities per stimulus were presented in comprehension probes and four opportunities per stimulus were presented in production probes. If the child comprehended or produced a symbol with 0% or 25% accuracy, that symbol and its corresponding object were used during the baseline, intervention, and maintenance phases of the study. Table 1 lists the symbol and object sets that were identified for each child.

Line-Drawn Symbol to Object Matching (Comprehension). During comprehension probes, the experimenter placed an array of six objects, approximately 2 in. apart, in

TABLE 1. Object and symbol sets for Jennie, Niles, and Edie.

Participant	Set Number	Target Stimuli	Distractors
Jennie	1	Plastic apple Plastic peach Plastic pear Plastic tomato	Plastic orange Plastic pepper
	2	Toy bench Toy cupboard Toy desk Toy stove	Toy dresser Toy washer
	3	Doll back Doll chin Doll knee Doll shoulder	Doll elbow Doll wrist
Niles	1	Toy bolt Toy chisel Toy drill Toy wrench	Toy pliers Toy screwdriver
	2	Toy tractor Toy trailer Toy truck Toy van	Toy car Toy train
	3	Plastic apple Plastic peach Plastic pear Plastic tomato	Plastic orange Plastic pepper
Edie	1	Toy bolt Toy chisel Toy drill Toy level	Toy screwdriver Toy tape measure
	2	Plastic apple Plastic plum Plastic strawberry Plastic tomato	Plastic orange Plastic pepper
	3	Dishcloth Scouring pad Sponge Washcloth	Dish towel Hot pad

front of the child. The experimenter randomized the position of the six object choices and the individual presentation of symbols across opportunities. During each opportunity, the experimenter said, "Show me the _______" while simultaneously pointing to the line-drawn symbol representing an object. The child's first response was recorded during four probes per object that were implemented each session. The experimenter provided no corrective feedback.

Object to Line-Drawn Symbol Matching (Production). During production probes, the experimenter placed an array of six symbols in front of the child. The position of the six symbol choices and the presentation of objects were randomized across opportunities. Holding an object in his hand, the experimenter asked, "What is this?" He recorded the child's first response. The experimenter conducted four probes per symbol during each session.

Setting

Sessions took place in Jennie's school during the academic year and summer session. During school vacation, sessions took place in her home. Sessions for Niles' academic year and summer session occurred at school. During school vacations, sessions took place in his day care. Edie's sessions took place at her educational day care setting.

Independent Variable

Aided language stimulation was the independent variable. Aided language stimulation was defined as the experimenter pointing with his finger to a referent in the environment and sequentially pointing (within 2 s of the original point) to a graphic symbol while saying the name of the referent. The experimenter implemented the independent variable during scripted routines. In the short excerpt that follows, the words written in upper case represent examples of when the experimenter implemented aided language stimulation during a scripted routine:

> Niles, let's put the TRUCK in the garage. Nice job, you put the TRUCK in the garage. Now let's put the VAN in the garage. That's a noisy VAN.

Experimental Design

The experimenter implemented a single-subject, multiple-probe design (Horner & Baer, 1978) across symbol sets/activities. Following baseline measures for all three symbol sets associated with each of three activities, two activities (and their associated symbol sets) remained on baseline while intervention began during the first activity (and its associated symbol set). For Jennie and Niles, a criterion of 75% accuracy across five consecutive sessions for symbol comprehension performance was established to trigger the onset of intervention in the next object/symbol sets. To be consistent with other educational objective criteria being implemented in Edie's school setting, her classroom teacher requested that Edie's performance be set at 75% accuracy across three consecutive sessions for symbol comprehension.

Procedures

The study was implemented in three phases: (a) baseline, (b) intervention, and (c) maintenance. Across phases, stimuli were centered a standard 8–10 in. in front of each child. The experimenter probed each target symbol or each target object twice during each session. Noncontingent praise for participation was provided throughout all phases of the investigation.

Baseline.

Scripted Routine. The interventionist interacted with the participant during a scripted routine designed for a preferred activity. The participants' classroom teachers identified preferred activities. Before beginning the scripted routine, the experimenter placed a communication board in front of the child. The experimenter randomized the position of the symbols for each session. The experimenter did not implement the independent variable during baseline (i.e., although the communication display was in view, it was not used during the baseline phase). Target objects were referred to using personal and demonstrative pronouns (i.e., it, this, that) during the scripted routine. The experimenter referred to each object four times during each baseline session.

Comprehension of Graphic and Spoken Symbols. All stimuli were chosen during the preassessment phase of the study. Twelve objects (four different objects for each of three activities) and 12 graphic symbols (four symbols corresponding to the objects used in the same three activities) were probed during baseline. The experimenter placed an array of six objects in front of the child. Four objects served as target objects, and two objects served as distractors. Distractors were objects that belonged to the same stimulus class as the target objects (e.g., fruit, furniture, body parts, vehicles, cleaning items), but were not a focus of intervention. Distractor objects were unknown to the children. Table 1 provides a list of target objects and distractors. During each opportunity, the experimenter said, "Show me the _______" while simultaneously pointing to the line-drawn symbol representing an object. The experimenter probed each target object twice during each session and recorded the number of correct responses. No corrective feedback was provided. A correct response was scored if, within 10 s, the child independently pointed to (or manipulated) the object corresponding to the experimenter's spoken word and line-drawn symbol presentation. The percentage of objects correctly identified was calculated for each probe by dividing the number of correct responses by the total number of opportunities and multiplying by 100. The position of the object choices and the presentation of symbol samples were randomized across opportunities. Daily probes were implemented for symbol comprehension before each baseline scripted activity session.

Production of Graphic Symbols. The experimenter placed an array of six symbol choices in front of the child. Four symbols served as target symbol choices, and two symbols served as distractors. Distractors were symbols that belonged to the same stimulus class as the target symbols, but were not a focus of intervention. The experimenter randomized the position of the symbol choices and the presentation of object choices across opportunities. Holding an object sample in his hand, the experimenter asked, "What is this?" The experimenter probed each target symbol twice during each session and recorded the number of correct responses. No corrective feedback was provided. A response was scored as correct if, within 10 s, the child independently pointed to the symbol corresponding to the object presentation and query (i.e., "What is this?"). The percentage of symbols correctly identified was calculated for each probe by dividing the number of correct responses by the total number of opportunities and multiplying by 100. Daily probes were implemented for symbol production before the baseline scripted routine on the days they were conducted.

Comprehension of Exclusively Graphic Symbols. The procedures used to measure comprehension of exclusively graphic symbols were identical to those used to measure comprehension of graphic and spoken symbols; except when the objects were in place, the experimenter said "Show me" as he pointed to the line-drawn symbol representing the object. The experimenter did not present the spoken object name.

Comprehension of Exclusively Spoken Symbols. The procedures used to measure comprehension of exclusively spoken symbols were also identical to those used to measure comprehension of graphic and spoken symbols; except when the objects were in place, the experimenter said, "Show me the (spoken object name)." The experimenter did not present the line-drawn symbol representing the object.

Intervention.

Scripted Routine. The experimenter used aided language stimulation during a scripted routine designed for a preferred activity. Before beginning the scripted routine, the experimenter placed a communication board in front of the child. If the child was not directing his or her gaze toward the communication board, the experimenter placed the communication board approximately 12 in. in front of the child's face before pointing to each target graphic symbol on the communication display. The experimenter referred to each object/symbol four times during each session. The position of the symbols displayed was randomized before each session.

Comprehension of Graphic and Spoken Symbols. The experimenter conducted daily probes for symbol comprehension before each daily scripted routine. Nontarget symbol sets that remained in baseline phase (while the experimenter implemented intervention for the target symbol set) were probed every two to four sessions. The experimenter conducted probes during intervention according to the protocol described for the baseline phase.

Production of Graphic Symbols. These probes were implemented every 2 to 4 days throughout the intervention phase. The procedures were described in the baseline phase.

Comprehension of Exclusively Graphic Symbol. When criterion was met for comprehension of graphic and spoken stimuli, these probes were implemented to determine whether a child could respond to exclusively graphic symbols. The experimenter began these probes before the next daily session following criterion performance for the comprehension of graphic and spoken stimuli.

Comprehension of Exclusively Spoken Symbols. When criterion was met for comprehension of graphic and spoken stimuli, the experimenter implemented these probes to determine whether the child could respond to exclusively spoken symbols. The experimenter began these probes before the next daily intervention session.

Maintenance.

All maintenance probes were implemented using procedures identical to those that were used during baseline and intervention.

Comprehension of Graphic and Spoken Symbols. The experimenter conducted maintenance probes for Jennie 8, 16, 25, 58, and 91 days postacquisition criteria for Symbol Set 1; 24, 40, and 47 days postacquisition criteria for Symbol Set 2; and 13, 20, and 27 days postacquisition criteria for Symbol Set 3. He conducted maintenance probes for Niles 14, 21, and 28 days postacquisition criteria for Symbol Set 1; 21, 35, and 46 days postacquisition criteria for Symbol Set 2; and 9, 20, and 42 days postacquisition criteria for Symbol Set 3. The experimenter conducted maintenance probes for Edie 13, 25, and 33 days postacquisition criteria for Symbol Set 1; 8, 15, and 34 days postacquisition criteria for Symbol Set 2; and 11, 19, and 45 days postacquisition criteria for Symbol Set 3.

Production of Graphic Symbols. Probes were conducted on the same day as maintenance probes for comprehension of graphic and spoken symbols.

Interobserver Agreement

A graduate student in speech-language pathology served as an independent observer. The observer had extensive experience with children having cognitive disabilities. Before the study, the experimenter trained the observer to identify procedural steps, recognize child responses, and use data sheets. The observer independently recorded child responses and treatment integrity during 35% of all sessions for Jennie, 34% of all sessions for Niles, and 36% of all sessions for Edie. An agreement was scored when the experimenter and the observer both scored the same response. Interobserver agreement was calculated by dividing agreements by agreements plus disagreements and multiplying by 100 (Schlosser, 2002). Interobserver agreement for dependent measures was 100% for Niles and for Edie, and ranged from 87.5% to 100% ($M = 99.44$) for Jennie.

Interobserver agreement for treatment integrity was 100% for Niles and for Edie, and ranged from 83% to 100% ($M = 99.63$) for Jennie. Reliability was based on correct implementation of the following procedural steps for elicited probes: (a) appropriate setup of materials, (b) appropriate use of discriminative stimuli during elicited probes (e.g., graphic symbol, spoken symbol, graphic and spoken symbol), (c) randomization of symbols/objects between sessions, (d) probing in random order, and (e) no cueing or corrective feedback. Reliability was based on correct implementation of the following procedural steps for scripted routines: (a) appropriate setup of materials, (b) placing the communication board within child's view, (c) pointing to the referent in the environment before pointing to the symbol, (d) verbalizing the conventional spoken symbol while simultaneously pointing to the graphic symbol, and (e) sampling each symbol/object four times.

Results

For each child, following the establishment of a stable baseline, a gradual increase in symbol comprehension and symbol production was observed for Symbol Set 1 during the intervention phase of the study (see Figures 1, 2, and 3). The number of instructional opportunities required to meet the preestablished acquisition criterion decreased considerably for 2 of the children after the introduction of the second symbol set. Niles showed a 54% decrease in instructional opportunities required to reach criterion for Symbol Set 2, and Edie showed a 75% decrease in instructional opportunities required to reach criterion for Symbol Set 2. The number of teaching opportunities required to reach criterion for Symbol Set 3 was nearly identical to that required for Symbol Set 2 for Niles and for Edie. Although Jennie only showed a 10% decrease in instructional opportunities required to reach criterion for Symbol Set 2, she displayed a 50% decrease in instructional opportunities required to reach criterion for Symbol Set 3 (compared to Symbol Set 2).

The rate of acquisition for symbol comprehension and symbol production differed for each participant. Jennie displayed a faster rate of acquisition for symbol comprehension than she did for symbol production for two of the three symbol sets. Rate of acquisition for symbol comprehension and symbol production was relatively equal for the remaining symbol set. Niles displayed equal rates of acquisition for symbol comprehension and symbol production on two of the three symbol sets. On the remaining symbol set, he showed a faster rate of acquisition for symbol production. When he reached criterion on this symbol set, he was consistently 75% accurate on symbol comprehension probes and 100% accurate on symbol production probes. Edie displayed equal rates of acquisition for symbol comprehension and symbol production for Symbol Sets 1 and 2. She showed a faster rate of acquisition for symbol comprehension for Symbol Set 3. Postintervention probes indicated performance maintained at criterion level for all 3 children, with the exception of Jennie's first two maintenance probes for symbol comprehension on Symbol Set 1.

Jennie responded to exclusively graphic stimuli and exclusively spoken stimuli with equal performance on Symbol Set 1 (see Figure 4). She responded with nearly equal performance on Symbol Sets 2 and 3, with only a small bias toward attending to exclusively graphic stimuli. Niles responded to exclusively graphic stimuli and exclusively spoken stimuli with nearly equal performance on Symbol Set 2, but showed a slight propensity to respond to exclusively graphic stimuli on Symbol Sets 1 and 3 (see Figure 5.) Edie responded to exclusively graphic and exclusively spoken stimuli with equal performance on Symbol Set 1, while showing a tendency to respond to exclusively graphic symbols on the remaining two Symbol Sets (see Figure 6).

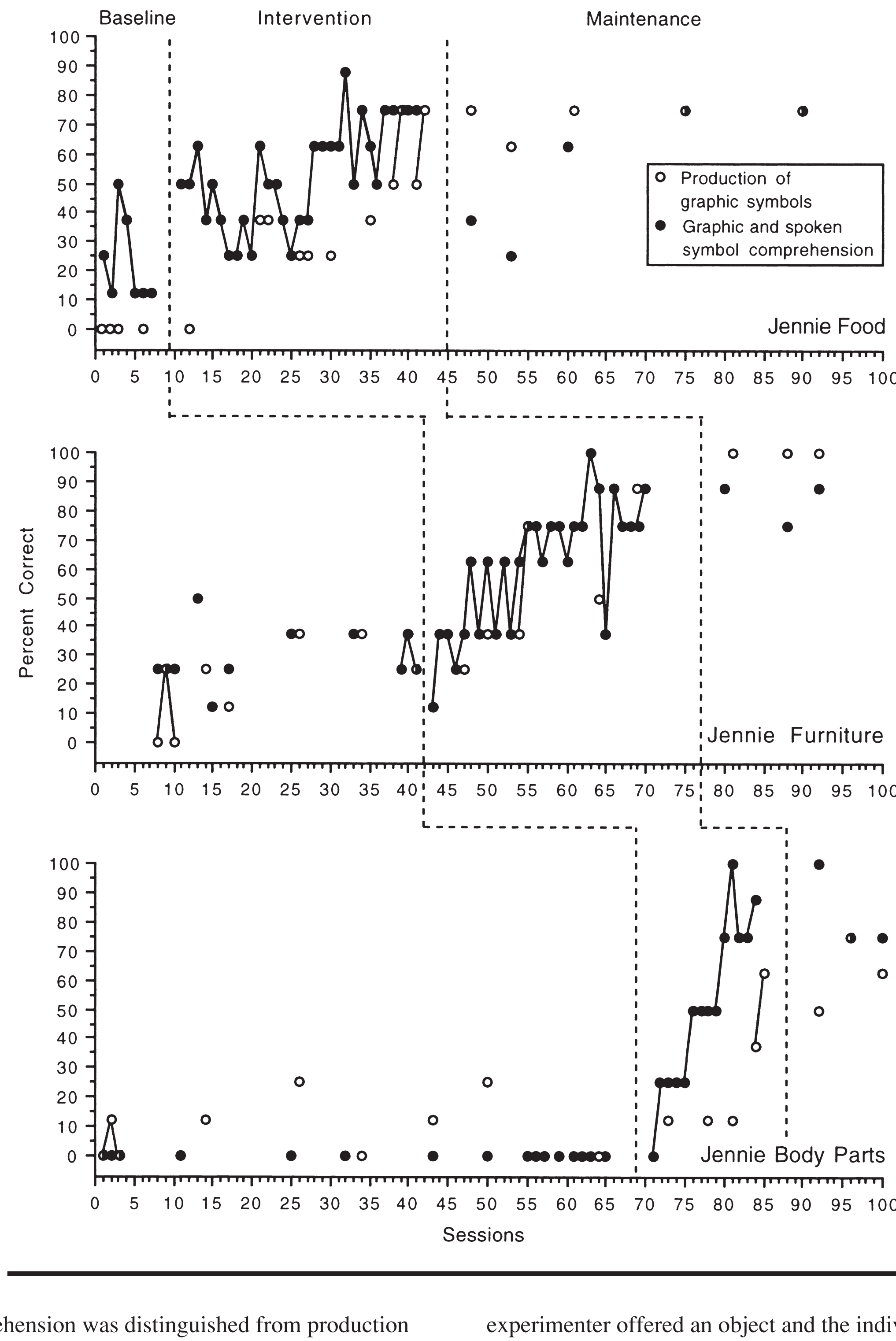
Discussion

The results of this investigation support the hypothesis that aided language stimulation facilitates symbol comprehension in individuals with moderate cognitive disability who are functionally nonspeaking. The findings also support the hypothesis that aided language stimulation facilitates symbol production (object labeling). Additionally, the findings indicate that symbol comprehension and symbol production were maintained.

During aided language stimulation, the experimenter simultaneously exposed the children to both graphic and spoken stimuli. The results shown in Figures 4–6 indicate that participants attended to both the visual and the auditory aspects of the compound stimulus.

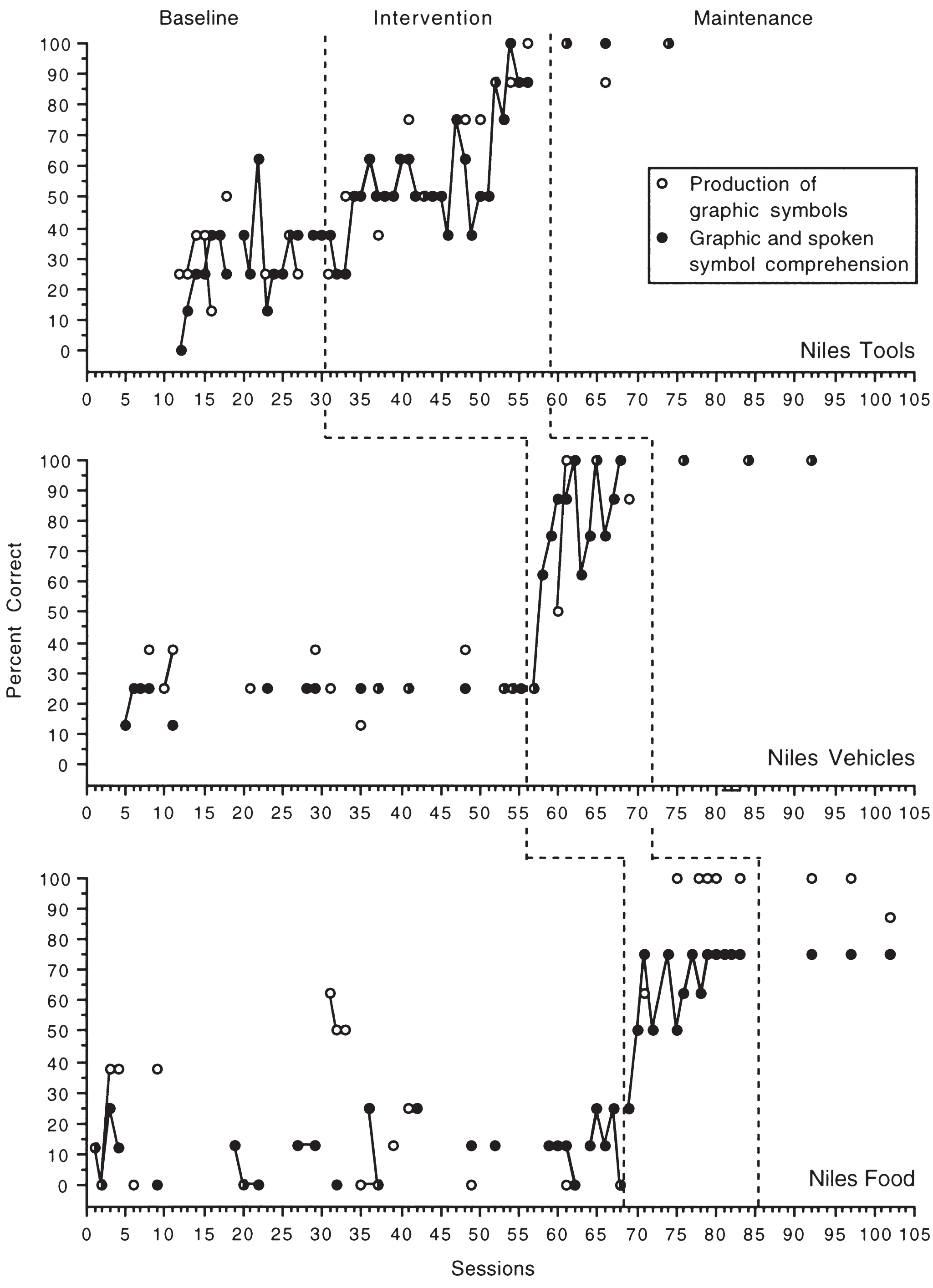
The relationship between comprehension and production is complicated in AAC (Brady, 2001). In the current

FIGURE 1. Percent correct for symbol comprehension and production for Jennie.



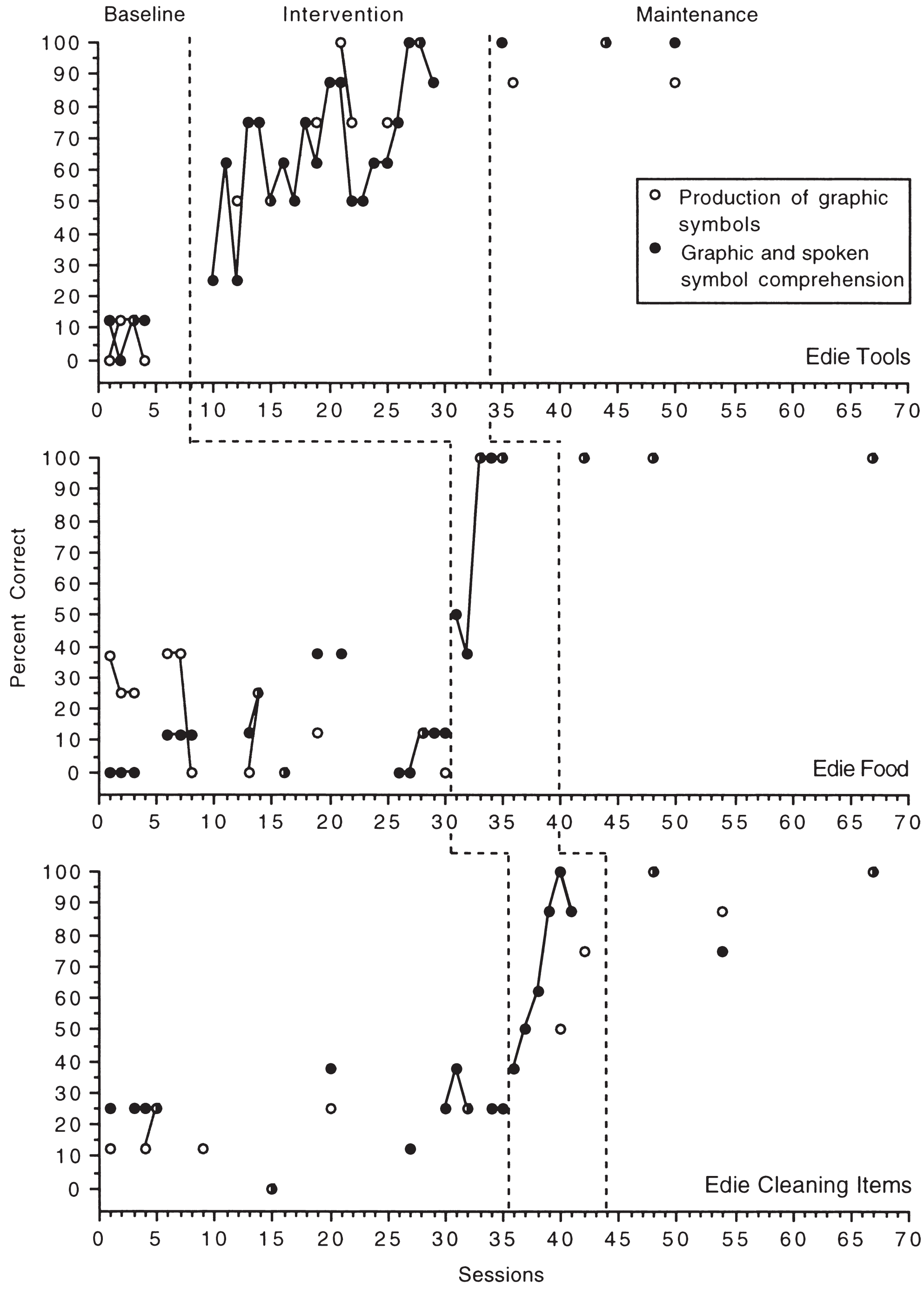
study, comprehension was distinguished from production based on whether the focus of the partner's attention was the graphic symbol or the object (Reichle, Halle, & Drasgow, 1998). A comprehension task was implemented when the experimenter offered a graphic symbol and the individual selected the corresponding object from an array of objects. A production task was implemented when the experimenter offered an object and the individual selected the corresponding symbol from an array of symbols. There is no real parallel to the production task used for individuals who speak (Brady, 2001). Traditionally, many interventionists have assumed that comprehension precedes production (Wetherby, Reichle, & Pierce, 1998). However, there is growing evidence that disputes this more traditional

FIGURE 2. Percent correct for symbol comprehension and production for Niles.



assumption for individuals who use graphic mode communication (Brady, 2000, 2001; Brady & Saunders, 1991). In the current study, Niles showed a faster rate of acquisition for symbol production than for symbol comprehension for Symbol Set 3. During the intervention and maintenance phases, he consistently failed to differentiate *tomato* and *orange*. However, it might have been that the line-drawn symbols representing these objects were more difficult to discriminate than were the plastic replicas of tomato and orange. In this task, Niles needed to discriminate between the choice stimuli (plastic tomato and plastic orange). Second, he needed to discriminate between the sample stimuli (line-drawn symbol of tomato and line-drawn symbol of orange). The investigator presented the choice

FIGURE 3. Percent correct for symbol comprehension and production for Edie.



stimuli together (simultaneous discrimination), while he presented the sample stimuli one at a time (successive discrimination). Evidence suggests that successive discriminations might be more difficult than simultaneous discriminations (Brady & Saunders, 1991; Carter & Eckerman, 1975). Consequently, if Niles found the line-drawn symbols representing tomato and orange more difficult to discriminate than the plastic replicas of tomato and orange, it might account for his slower rate of acquisition for symbol comprehension as compared to symbol production for Symbol Set 3.

The ability to fast-map may influence the effectiveness of aided language stimulation. Romski, Sevcik, Robinson, Mervis, and Bertrand (1995) suggested that individuals who do not show evidence of fast-mapping may require differing amounts and types of language input than individuals who successfully "fast-map." All of the children in the current study were able to fast-map; this may partially account for their success in learning through augmented input. Future research should explore any potential differences in the efficacy of aided language stimulation as a function of fast-mapping ability.

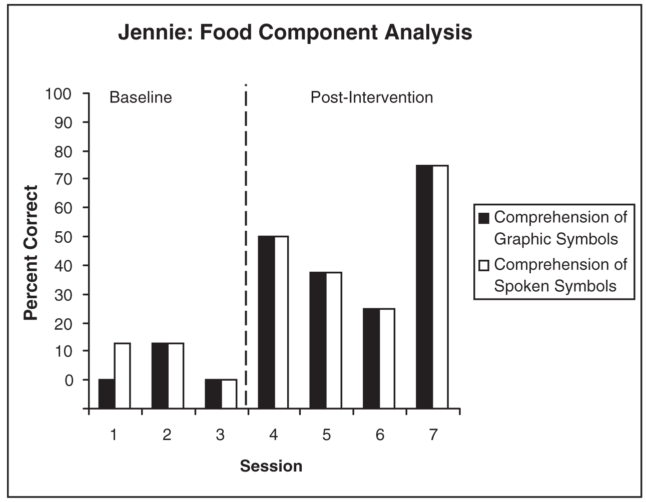
In this study, each child showed evidence of speech comprehension skills before the experiment, as measured by the MacArthur Communicative Development Inventories (Fenson et al., 1993). Individuals who comprehend speech may have knowledge about the relationship between words and their referents (Romski & Sevcik, 1993, 1996). Sevcik and Romski (2002) indicated that speech comprehension provides an essential foundation on which to build productive language competence. Consequently, individuals who do not comprehend spoken words (or who comprehend a very small number of spoken words) may be at significant risk in deriving maximal benefit from aided language stimulation. Future research should examine the effects of aided language stimulation with individuals who have a more limited speech comprehension repertoire at the outset of intervention.

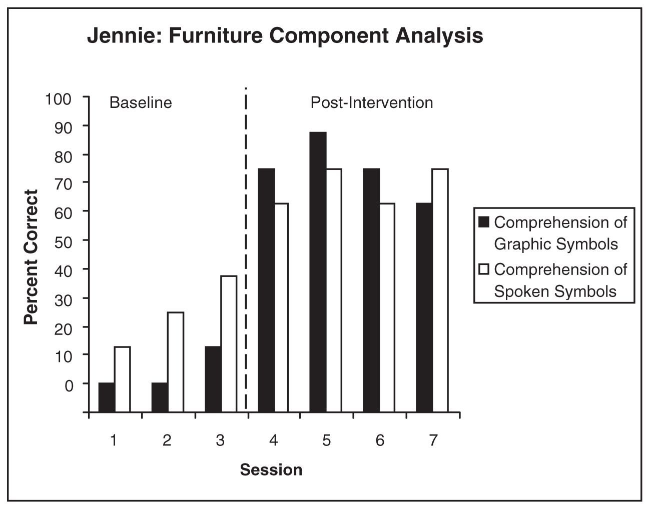
Caution should be exercised when considering the extent to which the results of this investigation can be generalized to the larger population of children with developmental disabilities. The children in this study were required to meet specific inclusionary criteria. This resulted in a fairly homogenous group of children.

During aided language stimulation, Elder and Goossens' (1994) recommended using communication displays that were language rich. These authors suggested organizing communication displays using a much broader range of grammatical categories than were used in this study. The communication displays used in the present study each contained only four black and white symbols representing nouns. Consequently, results of this study cannot be generalized to include other grammatical categories (e.g., adjectives, adverbs, verbs, pronouns). Future research should explore the effect of aided language stimulation on other aspects of semantic and syntactic language comprehension and production.

It is possible that the black and white line-drawn symbols used in this study may have influenced the rate of symbol comprehension and symbol production. Graphic symbols can take a variety of forms that include color photographs, black and white photographs, product logos, line drawings, lexigrams, Blissymbols, Premack-type symbols, and traditional orthography (Fuller, Lloyd, & Stratton, 1997; Mustonen, Locke, Reichle, Solbrack, & Lindgren, 1991). Different symbol collections may vary with regard to iconicity (Mirenda & Locke, 1989). Iconicity refers to the visual similarity between a symbol and its referent (Harrell, Bowers, & Bacal, 1973; Lloyd & Fuller, 1990; Schlosser & Sigafoos, 2002). Iconicity has been demonstrated to influence symbol acquisition (Clark, 1981; Ecklund & Reichle, 1987; Mizuko, 1987). The Picture Communication Symbols (Mayer-Johnson, 1992) used in this study have been shown to be among the most highly iconic aided

FIGURE 4. Percent correct responding to exclusively graphic and exclusively spoken stimuli for Jennie.





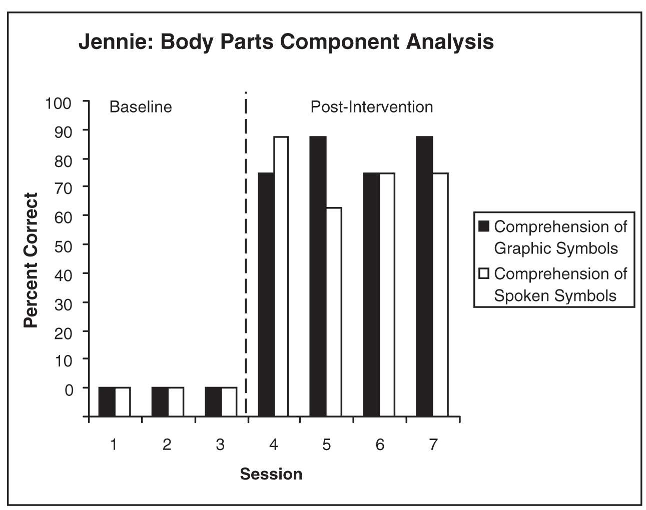


FIGURE 5. Percent correct responding to exclusively graphic and exclusively spoken stimuli for Niles.

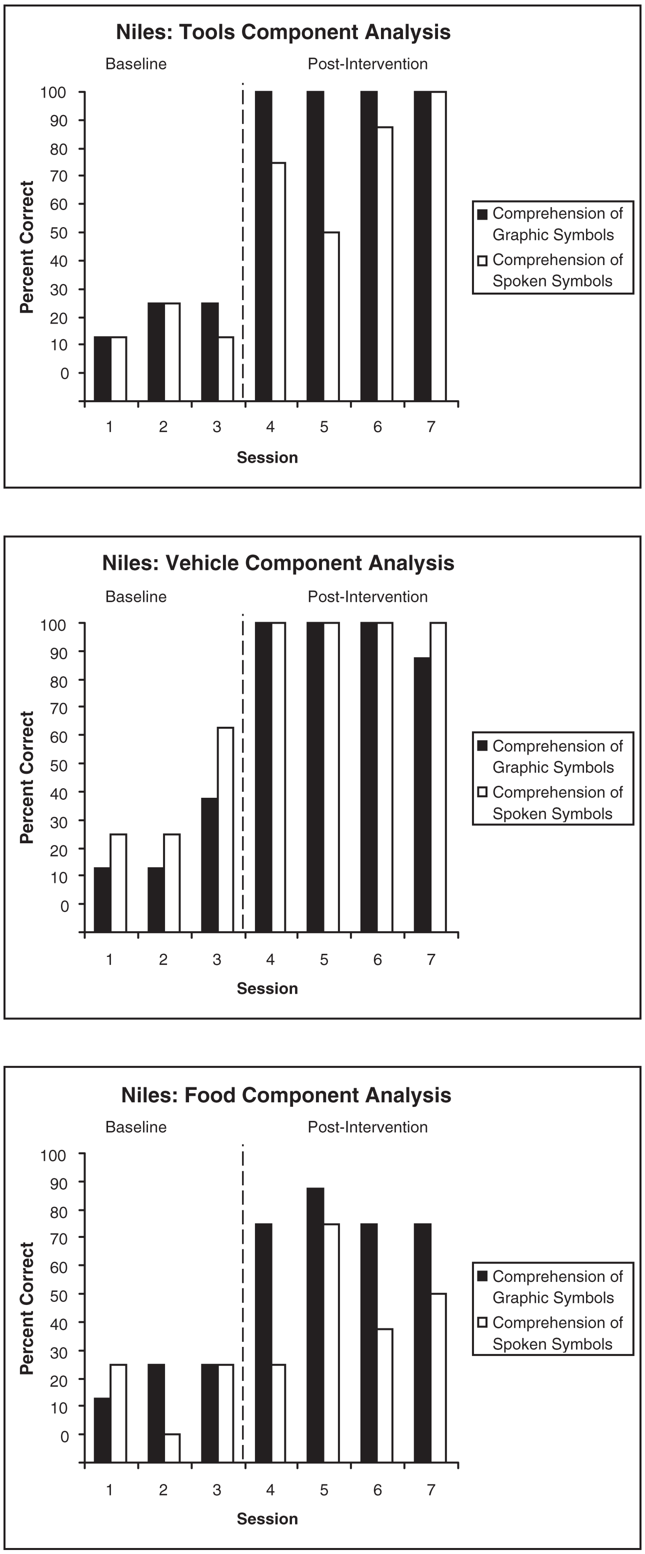
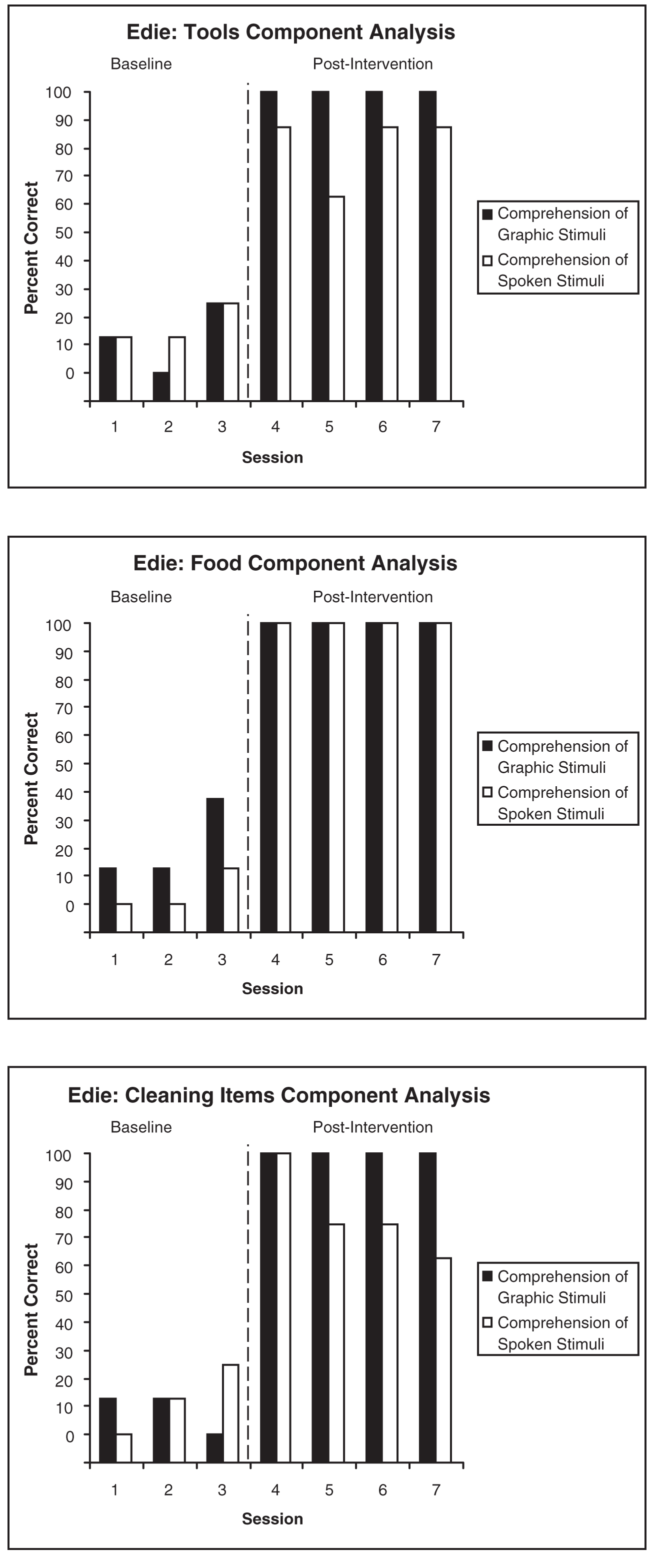


FIGURE 6. Percent correct responding to exclusively graphic and exclusively spoken stimuli for Edie.



symbols (Fuller et al., 1997). It is possible that the use of highly realistic digital photos or less iconic black and white line drawings may have altered the outcome of the current study. Replicating results of the current investigation with other symbol types would enhance the external validity of the outcomes reported in this investigation.

The current study implemented aided language stimulation using graphic symbols and natural speech. Although used in a decontextualized manner, Schlosser et al. (1995) demonstrated that augmented input in the form of synthetic speech resulted in more efficient learning than did augmented input without the use of a VOCA. Future research should determine whether there is a differential effect when using synthetic speech or natural speech during aided language stimulation.

Results of the current investigation suggest that young children with moderate cognitive disabilities can acquire, concurrently, comprehension and production skills as a result of aided language stimulation implemented in the context of scripted routines. Future augmentative communication intervention research should continue to explore the role that more naturalistic intervention procedures can play in establishing an initial communicative repertoire. The effectiveness of aided language stimulation should be compared to the effectiveness of other training programs, including direct instruction, direct instruction embedded within natural contexts, and milieu teaching strategies.

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