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Comparing Topography-Based Verbal Behavior With Stimulus Selection-Based Verbal Behavior

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Michael (1985) distinguished between two types of verbal behavior: *topography-based* and *stimulus selection-based* verbal behavior. The current research was designed to empirically examine these two types of verbal behavior while addressing the frequently debated question, Which augmentative communication system should be used with the nonverbal developmentally disabled person? Four mentally retarded adults served as subjects. Each subject was taught to tact an object by either pointing to its corresponding symbol (selection-based verbal behavior), or making the corresponding sign (topography-based verbal behavior). They were then taught an intraverbal relation, and were tested for the emergence of stimulus equivalence relations. The results showed that signed responses were acquired more readily than pointing responses as measured by the acquisition of tacts and intraverbals, and the formation of equivalence classes. These results support Michael's (1985) analysis, and have important implications for the design of language intervention programs for the developmentally disabled.

In recent years the area of augmentative communication has risen to prominence in the field of speech pathology (see for example the journal *Augmentative and Alternative Communication*). In earlier work with the nonvocal developmentally disabled population, the focus had been on the development of *vocal* response forms in language instruction. However, it has now been demonstrated repeatedly that many nonvocal developmentally disabled persons can acquire a rather substantial amount of verbal behavior by using any one of several alternative response forms such as sign language, symbol boards, voice synthesizers, and computers (Bonvillian & Nelson, 1978; Bricker & Bricker, 1974; Carr, 1979; Hurlbut, Iwata, & Green, 1982; McNaughton, 1976; Sundberg, 1980). Many speech professionals have specialized in these systems, and it is now becoming more common for school districts to employ an augmentative communication specialist. An important issue faced by those who design language intervention programs concerns which system to use for an individual client. However, very little basic research has been conducted on the differences between these systems.

The current trend in the field of speech pathology is to favor pointing to symbols or pictures and pressing computer keys (hereafter referred to as simply "pointing systems") over sign language. This is partly due to the general dissatisfaction with sign language programs experienced by many who have attempted to implement them. Perhaps the main problem with signs is that staff and parents must learn sign language (at least some) in order for a program to be successful. Pointing

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systems eliminate this problem because no special training is required to function as a listener (most systems have the English word printed under each individual symbol or picture). In addition, sign language requires the careful shaping of relatively complex motor skills, whereas the relatively simple pointing response is often already strong for many clients. And finally, from a listener's point of view, the verbal stimulus produced by the client, is often clearer for a pointer than it is for a signer.

However, there are some practical problems with pointing systems which may hinder the effectiveness of this language system. The first is the obvious necessity of depending on auxiliary equipment. It is not always possible to have the symbol board immediately accessible to the speaker. Also, many words are very difficult to portray with a picture or a symbol (e.g., verbs, prepositions, pronouns), and the symbols chosen may be impossible for a listener to interpret without the English word. In addition, the listener must always be in close proximity to the speaker.

There are also some conceptual differences between these two systems which are seldom considered by intervention specialists, yet, they may be more significant than the practical problems typically considered. Michael (1985), points out that sign language can be classified as *topography-based* verbal behavior, whereas pointing systems can be classified as *stimulus selection-based* verbal behavior. In topography-based verbal behavior the *form* of the response distinguishes one verbal response from another. Signing *dog* clearly involves different movements and positions of the hands than signing *cat*. Clear topographical differences also appear in speaking and writing.

In selection-based verbal behavior the response form consists of pointing, touching, looking, or in some way indicating a particular *stimulus*. The form of the response (e.g., a point) is the same for each verbal response. What is different is the stimulus which is pointed to, thus the term *stimulus selection*. Rumbaugh's (1977) chimp Lana, for example, pressed lexigrams embossed on computer keys as a form of stimulus selection-based verbal behavior. Similarly, pigeons in the study by Epstein, Lanza, and Skinner (1980) selected certain stimuli by pecking keys.

It is common in psycholinguistics to treat these two different types of verbal behavior as conceptually equal because it is believed they both are manifestations of the same underlying cognitive process. In addition, psycholinguistics has tended to focus on the effect of verbal stimuli on the listener, which deemphasizes the role of the speaker. However, from a behavioral point of view there are several differences between these two types of verbal behavior, which may be of special significance when verbal behavior is being developed for those whose verbal repertoires are seriously lacking. Michael (1985) points out that selection-based verbal behavior involves a conditional discrimination (two primary controlling variables). In tact training for example, a stimulus such as a book, alters the controlling strength of another stimulus (the symbol or picture for *book*) over a non-distinctive response such as pointing or touching. Topography-based verbal behavior involves only one primary controlling variable such as is observed when the stimulus of book directly controls the response *book*, rather than altering the strength of another stimulus.

In addition to more complicated controlling variables, stimulus selection-based verbal behavior involves a two-component response form as opposed to the single component response form of topography-based verbal behavior. This two-component response form consists of a *scan* of the visual options, then a point to indicate the selection of a particular stimulus. Effectively scanning an array of potential verbal stimuli may be somewhat more complicated than it appears. The various visual stimuli are usually not all visible at the same time, and it may require some special training in order to become a successful scanner. Most normal adults have usually developed a systematic way of

scanning possible selections, for example, from left to right, or from top to bottom (as in looking for a certain brand of ointment in the personal care isle of a store). For those who do not have a systematic scan repertoire it would be easy to overlook the correct stimulus. Also, if the scanning takes a long time, the effectiveness of the original controlling variable could be lost. Difficulty may also result from the fact that the response topography is the same for each word, no specific muscle movement gets linked with a specific controlling variable (as in topography-based languages).

Another difference between the two language systems identified by Michael (1985) is that topography-based verbal behavior always involves point-to-point correspondence between the response form and the response product. This is not the case with stimulus selection-based verbal behavior. Michael (1985) elaborates on this issue by stating:

> When one speaks there is a correspondence between the details of the vocal muscle action and the relevant details of the auditory stimulus that results, and likewise with writing and the use of signs and their respective visual response products. When one points at a word, picture, or symbol, however, the muscle action of the pointing response has no correspondence with the important features of the selected stimulus. Again, this difference would not seem to be irrelevant to such factors as ease of acquisition, precision of control, susceptibility to interference, etc. (p. 3)

In spite of the potential differences between these two types of verbal behavior, the current movement in the field of speech pathology is toward selection-based verbal behavior. In an effort to provide an empirical basis for decision making, the current research was designed to examine the difference between these two systems with regard to speed of acquisition, accuracy of responses, generality, maintenance, spontaneous usage, and the formation of equivalence classes.

METHOD

Subjects

Four subjects were selected from a group of mildly or moderately mentally retarded individuals residing in a group home operated by Residential Opportunities Inc. (ROI) of Kalamazoo Michigan. The selection criteria were a moderate to severe language deficit, the exhibition of manual dexterity allowing for the formation of signs, the ability to imitate, and the ability to follow instructions. Guardian and official ROI consent were obtained prior to each subject's participation in the study. Subject characteristics are presented in Table 1. None of the subjects had any prior experience with sign language or a symbol board.

Table 1
Subject characteristics.

	Age	Diagnosis	Mand	Tact	Intra-verbal	Mand Compliance
Mary	50	Moderately Retarded	Moderate	Weak	Weak	Good
Gary	46	Moderate Down's	Good	Moderate	Moderate	Moderate
Dan	33	Moderate Down's	Moderate	Moderate	Weak	Weak
Eric	40	Mild Down's	Good	Good	Moderate	Good

Setting

The study was conducted in a 5 m x 7 m room in the subjects' home. This room was normally used as an office and was empty except for a desk, a bookshelf, two folding chairs, and a card table where the subject and the experimenter sat. A third chair was brought in on the days that reliability data were taken.

The experimental sessions were conducted five days a week. Monday though Thursday, sessions were at 7:00 p.m. after dinner. Friday, because of scheduled social activities, the sessions were at 4:00 p.m. Each session consisted of 60 trials and lasted approximately 20 minutes.

Apparatus and Materials

All subjects were taught relations between nonsense objects and symbols, nonsense names and symbols, nonsense objects and signs, and nonsense names and signs. Nonsense names, symbols, and signs were used to guard against the possible

influence of any verbal history, and to guard against any potential contact with verbal stimuli outside of the experimental sessions. The objects, symbols, and signs were also chosen so as to control for the differential ease of acquisition due to iconicity factors. One and two syllable words that could be easily discriminated from each other, and which did not sound like anything that the subjects could have been exposed to in their daily environment were used.

For three of the subjects, six objects made of wood, plastic, metal, foam rubber, and cardboard were used. For the fourth subject, the same six plus an additional three objects were used. The objects were of various shapes and had no obvious function. Each object was assigned an arbitrary geometric symbol drawn in black ink on a 4" x 4" piece of white poster board (for the selection-based paradigm), and assigned an arbitrary sign (for the topography-based paradigm). Each object, sign, or symbol set was randomly assigned a nonsense name (see Table 2). The fourth subject, Eric, finished far ahead of the others so Eric was trained and tested with an additional selection-based paradigm.

Table 2
The verbal relations.

Topography-based	Selection-based
Zug, Oblong Wood Piece, Pat on Head	Zug, Oblong Wood Piece, Triangle Symbol
Sigpie, Metal Piece, Nose Pinch	Sigpie, Metal Piece, Circle Symbol
Cabbie, Plastic Piece, Palm Covering Hand	Cabbie, Plastic Piece, Square Symbol
Poe, Circular Wood Piece, Open/Close Hands	Poe, Circular Wood Piece, W Symbol
Wiglet, Foam Rubber Piece, Circling Fists	Wiglet, Foam Rubber Piece, X Symbol
Krepola, Cylinder Cardboard Piece, Finger to Palm	Krepola, Cylinder Cardboard Piece, U Symbol
Eric's Additional Set	Mojam, Triangular Rubber Piece, Abstract Line Drawing
	Kad, Rectangular Metal Piece, Abstract Line Drawing
	Bogad, Square Wood Piece, Abstract Line Drawing

The name of each set was written on a 5 cm x 3 cm cardboard card and randomly drawn out of a bag before each trial to determine which set would be tested or trained for that particular trial.

Reinforcer Selection

All of the subjects demonstrated appreciation for the value of money. Therefore, pennies and praise were used as reinforcers. These pennies could be exchanged at the end of each session for quarters, nickels, and dimes. Subjects could, and did, spend their money on extra food and beverage items at their day programs. Weekly, non-contingent, outings to a local restaurant were also given to help insure that subjects remained interested in the study.

Measurement

Responses were recorded by the experimenter as correct or incorrect by marking the appropriate column under one of three sets. For example, if a subject was being trained in the selection-based tact relations the three sets could be *poe*, *wiglet*, and *krepola*. If s/he failed to select the *W* symbol when shown the circular wooden piece, then a mark was made in the right side of the poe column (the "wrong" side).

The first symbol pointed to, or the first sign made, was the one recorded. Mastery criterion was defined as a sequence of ten responses, with nine correct.

Response Definitions

Topography-based tact. When shown a certain object and asked "What's this?" the subject emits the correct sign within ten seconds of its presentation (e.g., when shown the oblong wood piece and asked "What's this?" the subject pats his head with his right hand within ten seconds).

Topography-based intraverbal. When the vocal name of an object is spoken by the

experimenter the subject makes the correct sign within ten seconds of its presentation (e.g., when the experimenter says "What's zug?" the subject pats his head with his right hand within ten seconds).

Selection-based tact. When shown a certain object and asked "What's this?" the subject points to the correct symbol (out of an array of three) within ten seconds of its presentation (e.g., when shown the oblong wood piece and asked "What's this?" the subject points to the triangle symbol within ten seconds).

Selection-based intraverbal. When the vocal name of an object is spoken by the experimenter the subject points to the corresponding symbol (out of an array of three) within ten seconds of its presentation (e.g., when the experimenter says "What's zug?" the subject points to the triangle symbol within ten seconds).

Mand-compliance/test for transfer. When asked to pick out an object, the subject correctly points to the object within ten seconds of the request (e.g., when asked "Which one is zug?" the subject points to the oblong wood piece within ten seconds).

Dependent Variables

Two relations for both the topography-based and the selection-based paradigm were directly taught, and one was tested without being taught. Relations that were explicitly taught were the tact (i.e., pointing to a symbol or making a sign when shown an object), and the intraverbal (i.e., pointing to a symbol or making a sign when an object name was spoken). Testing was done for the emergence of mand-compliance, or *receptive language* (i.e., pointing to the object when the object's name was mentioned).

For a response to have been recorded as correct it must have been a close enough approximation to the desired targeted response that it could be easily distinguishable from the other responses taught to the subject.

The two paradigms were compared by looking at the number of training trials until the tact and intraverbal relations were mastered, and the number of testing trials before the subject met criterion for the mand-compliance relation. In addition, the percent correct (until mastery criterion was met) during test and training trials were recorded.

During the testing sessions (after the tact and intraverbal relations were mastered), unreinforced mand-compliance probe trials occurred once in every three trials. These probe trials were interspersed with tact and intraverbal trials. Subjects were told at the beginning of each test session that they would not be given feedback for the mand-compliance probes. Each subject was told: "When I ask you to point to one of these objects, I'm not going to tell you if you are right or wrong, but when we are all finished I will give you a penny for each one you got right."

Procedure

In general, the procedure consisted of (a) training the topography-based and selection-based tacts and intraverbals, and (b) a series of probe trials to test for transfer effects.

Pretraining. Pretraining for the topography-based tact consisted of the experimenter holding up an object and making the corresponding sign and saying, "This (holding up the object) equals this (making the sign)." The subjects were then asked to imitate the sign. All subjects demonstrated imitation on the first pretraining trial. This procedure was then repeated for the other two objects. The three signs were demonstrated approximately five times at the beginning of each new phase, and repeated only twice at the start of each session.

Pretraining for the topography-based intraverbal consisted of the experimenter saying the name that related to a sign and an object, and making that corresponding sign. Then, the procedure was the same as that described above after the tact was first demonstrated.

Pretraining for the selection-based tact consisted of the experimenter holding up an object and pointing to the corresponding symbol out of an array of three and saying "This (holding up the object) equals this (pointing to the corresponding sym-

bol)." Then, the procedure described above was followed.

Pretraining for the selection-based intraverbal consisted of the experimenter saying the name that related to a symbol and an object, and pointing to the corresponding symbol. Then, the procedure described above was followed.

Training verbal relations. Each subject was taught two-thirds of three stimulus-set relations for one paradigm (e.g., topography-based tacts and intraverbals). Then the subjects were tested for the emergence of mand-compliance (the untrained relation). The subjects were then taught two-thirds of three stimulus-set relations for the other paradigm (e.g., selection-based tacts and intraverbals). For example, Gary was taught the oblong piece of wood, pat on the head, *zug* stimulus set; the metal piece, pinch of the nose, *sigpie* stimulus set; and the plastic piece, palm covering fist, *cabbie* stimulus set for the topography-based stimulus set. He was then tested for transfer. For the selection-based paradigm he was taught the circular wood piece, M symbol, *poe* stimulus set; the foam rubber piece, X symbol, *wiglet* stimulus set; and the cylinder cardboard piece, U symbol, and *krepola* stimulus set. He was then tested for transfer (see Table 2).

Mary was taught the same relations in the same order as Gary. Dan and Eric were trained and tested using the selection-based paradigm first and then the topography-based paradigm. Since Eric was the first subject finished he was trained and tested using another selection-based paradigm with three new symbols, objects, and names.

Tact and intraverbal training. After a brief pretraining session (five demonstrations for each set) tact training started. Training began with the experimenter pulling a written name out of a bag and holding up the corresponding object and saying "What is this?" If the subject emitted the correct sign or selected the correct symbol s/he would be given verbal praise and a penny. If the subject did not respond, the proper response would be demonstrated along with the verbal prompt: "This (pointing to the object), is this (making the sign or selecting the symbol)." If the subject made the wrong response s/he would be informed of the error while being shown the object that goes with the sign that was emitted or the symbol selected. This was followed by a demonstration of the correct sign or symbol selection along with the verbal prompt. This sequence was repeated 60 times (ending the session for that day) or until criterion was met.

Intraverbal training was the same as tact training except when pulling the written name out of the bag the experimenter would ask the subject to make the corresponding sign or select the corresponding symbol (e.g., "Show me *zug*").

When criterion (nine out of ten correct for all three relations) was met the subject moved on to the next phase. The order of phases were: tact-intraverbal-test (with one paradigm); tact-intraverbal-test (with the other paradigm). For all the verbal relations, a brief remedial pretraining period took place at the beginning of each session (two demonstrations for each set).

Test for transfer. When mastery criterion was met for the intraverbal relation, testing for the emergence of mand-compliance (the untrained relation) began. An unreinforced mand-compliance probe occurred after every two consecutive baseline trials. A baseline trial consisted of randomly choosing a tact or intraverbal relation and proceeding with the same operation as described for the training. For the probe trial the experimenter would simply call attention to the three objects and ask the subject to point to the one requested. For example, after calling attention to the objects, the experimenter might say "Which one is *cabbie*?" The subject had previously only learned to make the corresponding sign or select the corresponding symbol in the presence of the plastic piece, and to make the same response when asked to sign or select the symbol for cabbie. Being able to identify which object was cabbie was a new relation, and making this identification nine out of ten times for all three sets would demonstrate partial equivalence.

Data Collection and Reliability Checks

Each trial was scored as correct or incorrect. The percentage of correct responses was calculated for each of the relations studied. Also, the average percentage of correct responses for each relation under each paradigm was calculated. In addition, the number of trials needed to reach the nine out of ten criterion was recorded.

Reliability data on subjects' responses were collected by a trained observer who was a graduate student in psychology. The observer used the same type of data sheet as the experimenter and was seated at a nearby desk so that she could see the subject's responses but not the experimenter's data. Reliability was calculated for each observed session using the following formula: [trials scored in agreement divided by (trials scored in agreement + trials scored in disagreement)] X 100. Reliability data were taken for six sessions for Dan (208 trials); eight sessions for Mary (366 trials); four sessions for Gary (199 trials); and four sessions for Eric (164 trials). Interobserver agreement per subject ranged between 91% and 96%.

RESULTS

Figure 1 shows that the average number of trials to reach criterion was higher for selection-based verbal behavior than it was for topography-based verbal behavior. This was the case for all subjects, and for both the tact and intraverbal relations (individual data are presented in Table 3).

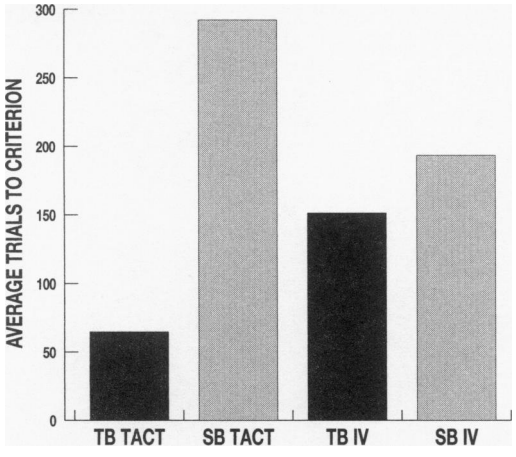

Fig. 1. The average trials it took the four subjects to reach criterion.

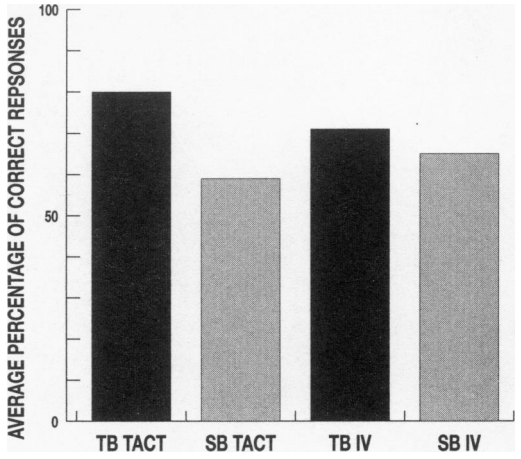

Fig. 2. The average percentage of correct responding for the four subjects.

Figure 2 shows that for both the tact and the intraverbal, the average percent of correct responses for all subjects was higher for topography-base verbal behavior (individual data are presented in Table 4). For both of these measures, the effects were greater for the tact. Three of the four subjects demonstrated faster acquisition of every relation trained with the topography-based paradigm. The fourth subject (Eric) performed well on both paradigms. However, his performance was slightly better with the topography-based paradigm.

In terms of individual performance, Gary for example, was first trained and tested using the topography-based paradigm. He was then trained and tested using the selection-based paradigm. Tables 3 and 4 show that he reached criterion for the topography-based tact and intraverbal faster than he did with the selection-based paradigm. Furthermore, his percentage of correct responses was higher with the topography-based system. Gary met criterion for the test for stimulus equivalence in

Table 3
Individual performance for selection-based (SB) versus topography based (TB) versus verbal behavior in terms of trials to criterion.

	SB TACT	TB TACT	SB IV	TB IV
Mary	841	163	—	304
Dan	234	37	426	388
Gary	34	28	120	37
Eric	60 (1st) 37 (2nd)	31	34 (1st) 28 (2nd)	29

Table 4
Individual performance for selection-based (SB) versus topography-based (TB) verbal behavior in terms of percent correct.

	SB TACT	TB TACT	SB IV	TB IV
Mary	28%	48%	—	53%
Dan	55%	86%	46%	43%
Gary	82%	96%	62%	76%
Eric	72% (1st)	90%	88% (1st)	93%
	86% (2nd)		96% (2nd)	

127 trials averaging 59% correct with the topography-based paradigm. This was clearly better than his test performance with the selection-based paradigm where he reached criterion in 332 trials averaging 39% correct (Figure 3). A serendipitous finding was that the tact was acquired faster than the intraverbal for the three subjects with the weaker verbal skills. This was true for both paradigms. One subject (Mary) never reached criterion for the selection-based tact, and was not trained on the selection-based intraverbal relation.

Dan was first trained and tested using the selection-based paradigm. He was then trained and tested using the topography-based paradigm. As can be seen in Tables 3 and 4, he performed substantially better with the topography-based tact. The difference was minimal for the intraverbal.

After 183 selection-based test trials, Dan demonstrated only partial stimulus equivalency by meeting criterion for one of the three sets only. At this point it appeared that there was no upward trend in the percentage of correct responding and that he was not going to demonstrate class formation. Because of the time constraints the conditions were changed and he was trained and tested using the topography-based paradigm. Although he did not reach testing criterion for this paradigm either, Figure 4 shows that his percentage of correct responses was clearly higher.

Mary was first trained and tested using the topography-based paradigm, and she met criterion for the tact, intraverbal, and the test for stimulus equivalency. She was then trained and tested using the selection-based paradigm. Tables 3 and 4 show that she performed better on the topography-

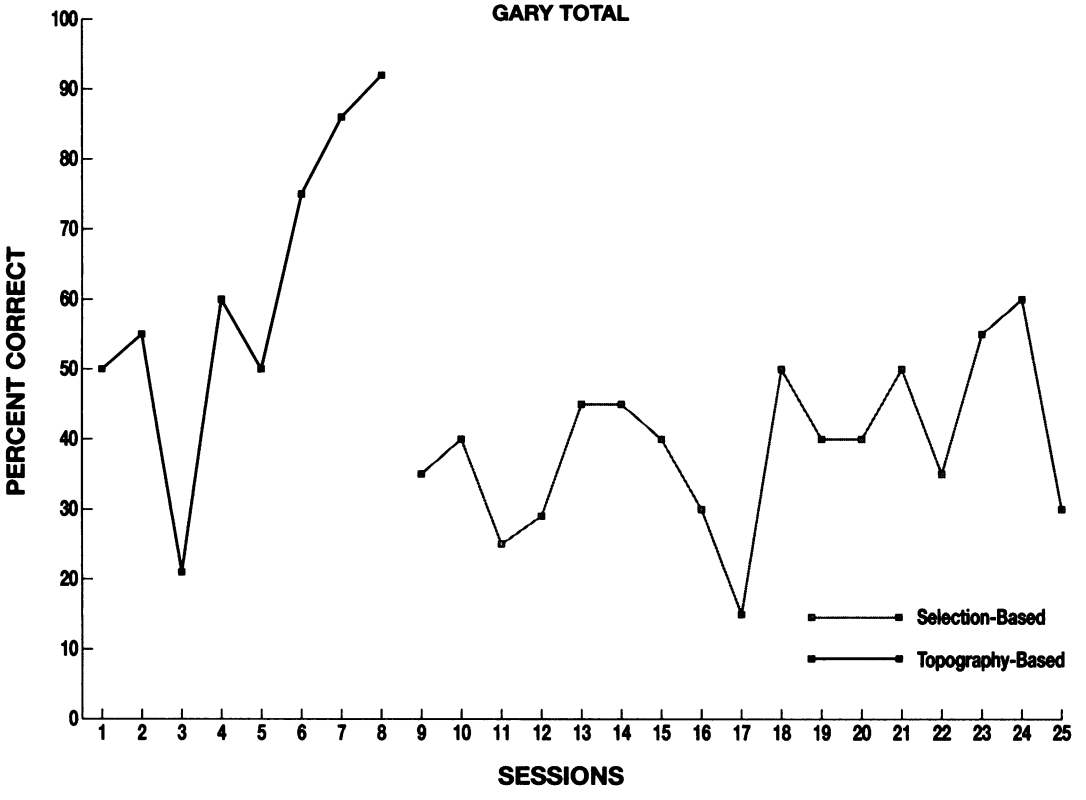

Fig. 3. Percentage of correct responses during the stimulus equivalency test for Gary.

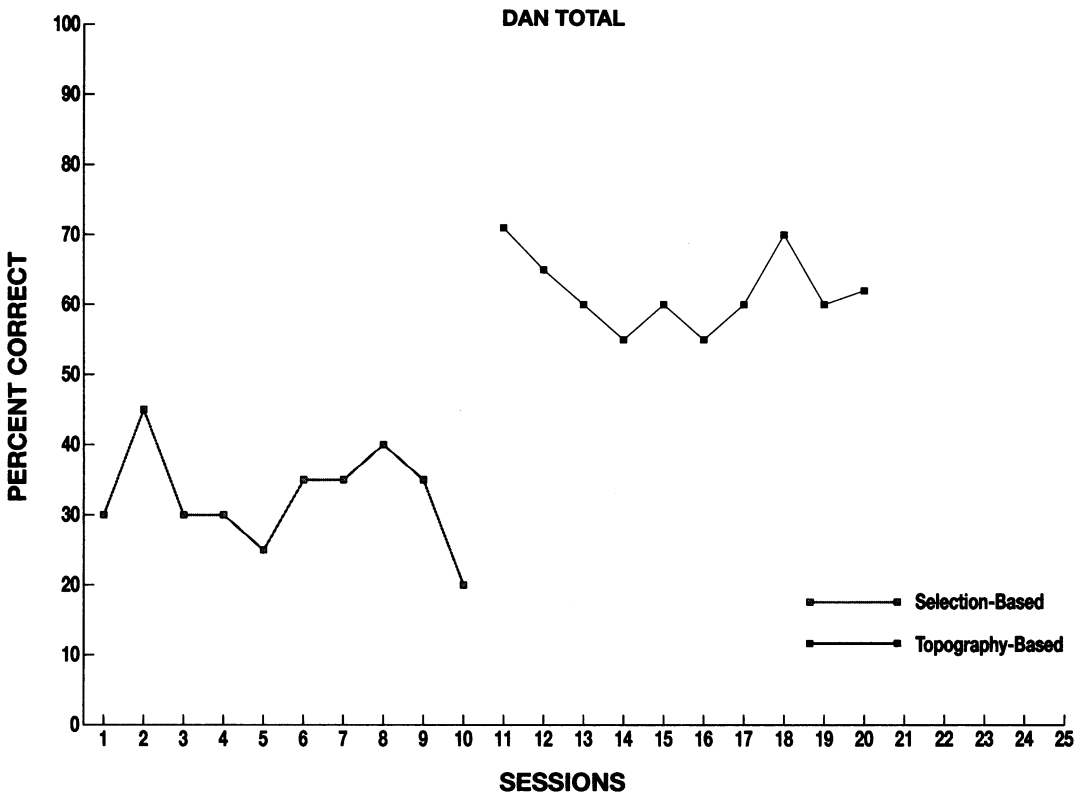

Fig. 4. Percentage of correct responses during the stimulus equivalency test for Dan.

based tact, than the selection-based tact. This, however, was the only comparison that could be made because she never met criterion for the selection-based tact.

Eric was first trained and tested using the selection-based paradigm. He was then trained and tested with the topography-based paradigm. Additional training on the selection-based paradigm was given because Eric was the first subject finished and a sequence effect was suspected.

Tables 3 and 4 show that for the tact and intraverbal, there was not much difference between the two paradigms after the tact training for the selection-based paradigm (the first phase of the experiment). Eric met criterion for the first selection-based test in 112 trials. Test criterion was met after 116 trials for the topography-based paradigm, but during testing Eric immediately confused two objects and consistently picked the *krepola* object when asked to identify *poe*, and he consistently picked the *poe* object when asked to identify *krepola*. He correctly identified *wiglet* in 100 percent of the trials. Even though his reversal of objects inflated his testing score, it was apparent by his training trials, his 100% correct responding to *wiglet*, and the invariable reversal of objects, that he was performing better on the topography-based paradigm than he was on the first selection-based paradigm. His almost perfect performance on the second selection-based paradigm, however, confirmed the existence of a sequence effect.

DISCUSSION

The results of this study indicate that there are several important differences between topography-based and selection-based verbal behavior. The data show that not only are more training trials required for mastery of selection-based responses, but performance, as measured by percentage of correct responses, is clearly lower with the selection-based system. In addition, it appears much more difficult to establish stimulus classes with selection-based verbal behavior. These findings do

not support the traditional psycholinguistic position that these two types of verbal behavior are equal. Nor do they support the current tendency in speech pathology to favor selection-based language training over topography-based language training for non-vocal populations.

What was interesting was the *extent* to which the subjects' overall performance was better with the topography-based paradigm. These findings lend support to Michael's (1985) assertion that the conceptual differences between the two language systems are relevant to such factors as "ease of acquisition, and precision of control" (p. 3). This is important for speech pathologists, parents, and teachers when making decisions about which type of augmentative communication system to use. The advantage of faster learning, which seems apparent with the topography-based system, along with the practical advantages discussed earlier (such as freedom from environmental support), should make learning sign language worthwhile, in spite of its inconveniences.

Three of the four subjects showed a substantial difference between the two systems in at least one verbal relation. Mary learned the topography-based tact with relative ease, yet showed no signs of mastering the selection-based tact by the end of the experiment. Dan had a great deal of difficulty learning the selection-based tact, yet mastered the topography-based tact in one session. Gary performed better with the topography-based intraverbal than with the selection-based intraverbal. He also demonstrated class formation with the topography-based paradigm but not with the selection-based paradigm.

The results of this study also support the original conclusion of Sidman, Cresson, and Wilson-Morris (1974), who demonstrated that oral naming was not a necessary component in the emergence of visual auditory matching. It was noted in this study, however, that some of the subjects did respond to a testing stimulus, during the topography-based phase, by naming it or making the sign before they chose one of the three objects. These subjects seemed to perform better during the testing when the mediating response was made.

For example, during topography-based testing Mary would be asked to point to an object (e.g., "Which one is *zug*?"). She would then vocally repeat the name and make the sign. As a result she was correct on 56% of her testing trials. Gary, on the other hand, made no overt mediating response at all. He was correct on 59% of his topography-based test trials. This is only a difference of 3%, yet for the topography-based tact Gary was correct 96% of the trials while Mary was correct 48% of the trials—a difference of 48%. For the topography-based intraverbal Gary was correct 76% of the time while Mary was correct 53% of the time—a difference of 23%. Gary's obvious superior performance with the tact and intraverbal relations would lead one to believe that his test percentages would similarly be higher than Mary's test percentages. This was not the case, however. Perhaps this was due to Gary's lack of a mediating response.

Dan did not make a mediating response during the selection-based testing. He was not very vocal or likely to imitate, and since the symbols were temporarily removed, he could not select one. During the topography-based testing, Dan was asked to point to an object (e.g., "Which one is *poe*") and he would make the sign for that object followed by his selection of the object. As a result, Dan was correct on 55% of the topography-based test trials (in which a mediating response was made) and 29% of the selection-based test trials (in which no mediating response was made). Almost all of the testing trials that Dan did miss involved an incorrect mediating response. For example, if Dan was asked to identify the poe object, and he signed *krepola* as a mediating response, he would then select the krepola object. This is consistent with the subject's stronger performance on the tact over the intraverbal. In fact, all the subjects, except for Eric, performed better on tact trials than they did with intraverbal trials. This differential rate of acquisition provides further support for Skinner's (1957) assertion that the tact and the intraverbal are separate verbal operants (Watkins, Pack-Teixteira, & Howard, 1989).

It should also be noted that three of the four subjects were always willing to participate. They eagerly waited for their turn in the next room, even though they were told they could wait upstairs. These three subjects never indicated that they would like a session to be terminated, and generally seemed to enjoy the whole process.

Dan, on the other hand, did not greet the experimenter with excitement during the first half of the study (the selection-based paradigm). He would wait in his room and would have to be prompted many times. He would show signs of frustration as a session would progress and he was very rarely observed smiling. In general he was behaving as if the sessions were aversive. This in itself was not out of the ordinary. According to the staff it was a chore to get Dan to participate in everyday programming (e.g., educational activities). What was noteworthy was his apparent reversal of motivation when the topography-based paradigm started. One prompt was all that was needed for Dan to proceed to the experimental room. He was observed smiling many times throughout each session and he never indicated that he did not want to participate further. In general, he was behaving as if the sessions were a game.

An interesting follow-up study might include a replication with higher functioning subjects and with more complex stimuli (e.g., three component signs, and symbols, more signs and symbols to choose from, etc.). This might help determine if there is a point at which the systems are equivalent. For example, Eric seemed to be skilled enough that he mastered both systems at the same rate. These were simple systems, however. If they were more complex, as might be found in a functional language (e.g., putting words together into a sentence, or sequencing symbols), perhaps he would have had more trouble with the selection-based system.

In conclusion, these results support the position that sign language is easier to learn than pointing systems. Even though, the proponents of pointing systems argue that it is inconvenient for the listener who is not adept in sign language, it is probably more inconvenient for the speaker to learn the symbols and to depend on an auxiliary equipment that limit the potential for verbal interactions. It seems that it would be quite beneficial, and worth the effort, for a client to be assigned to staff who know sign language. If a significantly larger vocabulary can be built using sign language, then more verbal interactions with the environment are likely. This, of course, leads to stronger verbal skills (practice). A client using a symbol board may be less likely to come in contact with a high density of verbal interactions, thus slower verbal development would be expected.

REFERENCES

Augmentative and Alternative Communication (1985 –). Baltimore, MD: Williams & Wilkens.

Bricker, W., & Bricker, D. (1974). An early language intervention strategy. In R. Schiefelbusch & L. Lloyd (Eds.), *Language Perspectives* (pp. 429-468). Baltimore: University Park Press.

Bonvillian, J. D., & Nelson, K. E., (1978). Sign language acquisition in a mute autistic boy. *Journal of Speech and Hearing Disorders, 41*, 339-347.

Carr, E. (1979). Teaching autistic children to use sign language: Some research issues. *Journal of Autism and Developmental Disorders, 9*, 345-359.

Epstein, R., Lanza, R. P., & Skinner, B. F. (1980). Symbolic communication between two pigeons (culumba livia domestica). *Science, 207*, 543-545.

Hurlbut, B. I., Iwata, B. A., & Green, J. D. (1982). Nonvocal language acquisition in adolescents with severe physical disabilities: Bliss symbol versus iconic stimulus formats. *Journal of Applied Behavior Analysis, 15*, 241-258.

McNaughton, S. (1976). Bliss symbol—an alternative symbol system for the non-vocal pre-reading child. In G. Vanderheiden & K. Gillery (Eds.), *Non-vocal communication techniques and aids for the severely physically handicapped*. Baltimore: University Park Press.

Michael, J. (1985). Two kinds of verbal behavior plus a possible third. *The Analysis of Verbal Behavior, 3*, 2-5.

Rumbaugh, D. M. (1977). *Language leaning by a chimpanzee: The Lana project*. New York: Academic Press.

Sidman, M., Cresson, O. Jr., & Wilson-Morris, M. (1974). Acquisition of matching to sample via mediated transfer. *Journal of the Experimental Analysis of Behavior, 22*, 261-273.

Skinner, B. F. (1957). *Verbal behavior*. New York: Appleton-Century-Crofts.

Sundberg, M. L. (1980). *Developing a verbal repertoire using sign language and Skinner's analysis of verbal behavior*. Unpublised doctoral dissertation, *Western Michigan University*.

Sundberg, M. L. (1987). *Teaching language to the developmentally disabled: A course manual*. Prince George, B.C.: College of New Caledonia Press.

Watkins, C. L, Pack-Teixteira, L., & Howard, J. S. (1989). Teaching intraverbal behavior to severely retarded children. *The Analysis of Verbal Behavior, 7*, 69-81.