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SIGN LANGUAGE: A BEHAVIORAL ANALYSIS AND APPLICATIONS

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Language as Behavior

What is language? How does language differ from non-language behavior? Are there different types of language behaviors and is there a useful way to classify them? How do more complex patterns arise? It will be easier to appreciate the common and the distinctive features of sign language if we first consider language in this more general context.

The Speaker-Listener Distinction

In traditional treatments of language it is common to minimize differences between the behavior of speaker and listener (or for sign language, "signer" and "observer"). It is said that the essential feature of both is the understanding of the meanings of words. The two different behaviors are then characterized as simply the expressive or receptive manifestation of this understanding. From a behavioral point of view, however, this is quite unsatisfactory. It is true that the roles change rapidly in conversation, and it is also true that in some especially interesting cases a speaker is behaving primarily for himself as the listener. Still, for most purposes the distinction is an important one, and especially when one's goal is to teach language behavior to someone in whom it is absent or defective. To be able to say "Open the door" under conditions where an open door would be a form of reinforcement is quite different from being able to open one when asked, and in the area of developmental disabilities it is not at all uncommon to find individuals who have one but not both of these repertoires, as well as those who have neither.

For several reasons we will concentrate on the behavior of the speaker or the signer rather than the listener or observer. It is primarily by speaking or signing that the individual benefits most directly from his language repertoire. Also, listening when the language stimuli are simple seems little different from reacting to non-language stimuli. And on the other hand, reacting to more complex language stimuli seems to depend considerably upon behaving in part as a speaker.

The Definition of Verbal Behavior (from the point of view of the speaker)

B. F. Skinner defined "verbal behavior" as behavior which achieves it's effect on the environment through the behavior of some other person. One can close a door by the appropriate hand and arm movements, which thus achieve their effects directly; or one can say "Close the door" and in the presence of an appropriate listener achieve the same effect indirectly. It is this indirect reinforcement that characterises verbal behavior and which is responsible for many of the important features that distinguish verbal from nonverbal behavior. (Try to avoid confusing this use of "verbal" with "verbal" as synonymous with "vocal", or with "verbal" as contrasted with "quantitative" or "mathematical".) This identification of language behavior with behavior which is indirectly reinforced will include some topics which are not ordinarily considered linguistic, and will exclude a few things we might wish to include, but coincides pretty well with the areas dealt with conventionally (for speakers) and has the advantage that it does not make use of any terms (such as "meaning" or "communication") that are themselves, just as difficult to define behaviorally.

The Elementary Types of Verbal Behavior

There are a number of different ways of classifying the elementary types of verbal behavior (VB), but the one that will serve our purposes best - and I am assuming throughout that one of our main purposes is the teaching of VB to those in whom it is absent or defective - is that of B. F. Skinner.

This system distinguishes different types in terms of the variables determining the form of the response - that is, what specifically is said or signed.

Mand

The first type of elementary VB to be considered is called the "mand" by Skinner. The mand is a relationship where the form of the response is determined by what has characteristically reinforced the response in the past. We use the common sense term "want" in identifying the objects or events which are effective reinforcements for an indivicual at a particular time. Thus we say that a person "wants" water, or "wants" someone to tell him what time it is. The mand can be understood in these terms as a type of verbal behavior where what is said is determined by what the speaker wants. Thus if someone says "water" because he wants a drink of water this is a mand. Mands are the kinds of responses that induce others to give us objects or substances (Give me the candy, food, water, money, book, pencil, etc.); to perform actions for us (Open the window, close the door, stand up, sit down, come here, go away, etc.) and to behave verbally in various ways for us (Tell me what time it is, where George has gone, why you did that, who is there, etc.).

The reinforcement for the mand is the event which is "manded", and it is this history which is responsible for the tendency to mand in the future. Thus, on once being given a drink when he has said "water" (usually as a result of a type of VB described below) a child's tendency to say "water" when he is next thirsty is increased.

For the mand relationship, unlike all the remaining types, the stimulus situation immediately prior to the occurrence of the response is not a major factor determining the response form (what is said or signed).

The response form is, instead, determined by whatever is responsible for the thing being manded becoming an effective reinforcement at that time. Stimuli are not irrelevant, but they don't control the response form. As an example, we may ask a stranger what time it is. The response would not occur in the absence of a person to ask - its occurrence may even wait upon the appearance of a person who is wearing a wrist watch, but we do not ask strangers what time it is, even if they are wearing a watch, unless we "want to know what time it is"; that is, unless knowledge of the time of day is an effective form of reinforcement.

Copying Behavior

There are several types of verbal behavior where the behaver (speaker, writer or signer) reacts to a stimulus by producing one which resembles it. Perhpas the most common is echoic behavior, where a speaker "says the same thing" that he just heard. This plays a major role in early language learning, where an adult induces a child to emit some particular vocal response by saying for example, "Say 'dog', See the nice dog. Say 'dog'". Here the adult is trying to induce the child to say "dog" in the presence of a dog as a way of teaching him the name for that kind of animal. The echoic response consists in saying "dog" as a result of the auditory stimulus that occurred when the adult said "dog". Another form of copying behavior is to copy a written text - for example to write "dog" on a piece of paper as a result of seeing it written on a chalk board, or another piece of paper, or printed in a book, etc. Still another is to make the same sign that you see someone else make. There is no convenient term for this last type of copying behavior. "Echoic" has too close a link with auditory stimulation; "transcriptive behavior" too strongly suggests writing. "Imitation" includes too much. Perhaps "imitative signing" will do for now. In any case, this type of behavior plays an important role in educational

settings, such as this one, where sign language is being taught as a second language, but also in work with the deaf child or with the nonvocal hearing.

The reinforcement for the various forms of copying behavior in educational settings is usually some form of social approval. When the child behaves appropriately in response to the adult's "Say dog" the adult is likely to smile, or in some other way show his approval. Copying behavior continues to occur as an important form of adult language, but is reinforced in other ways, as when we repeat a set of instructions to be sure that we have correctly understood them.

In contrast to the mand, echoic, transcriptive, and imitative signing behavior are all relationships where the response form (what is said, written, signed) is determined by a prior stimulus; auditory for echoic behavior and visual for the other two. To say "dog" because you hear that word said by someone else is echoic behavior. One could, of course, say "dog" as a way of asking for one, in which case the response would be a mand. Note that we cannot classify verbal behavior in terms of the response form alone; to distinguish mands from echoic responses or imitative signing we need to know the controlling variables, as will be emphasized as we go along.

The Tact Relationship

Skinner suggested the term "tact" for the type of verbal relationship where the form of the response (what is said or signed) is controlled by a prior nonverbal stimulus. The common nonverbal stimuli in a child's environment are objects, (Monnie, table, dog, pencil); properties of objects (red, hot, sweet, curved); actions (run, sit, talk, go); and relationships (above, in, large, open) and others. Notice that the controlling stimulus for the tact need not be visual, although probably visual stimuli are the most numerous. To say "dog" on seeing one is an example of the tact, as is saying

"dog" on hearing a dog barking even though it cannot be seen. To say "smoke" as a result of smelling smoke is a tact, as well as saying "smoke" on seeing it. Saying "rough" on feeling a piece of sandpaper is a tact as is saying "hurt" as a result of painful stimulation.

As with the various types of copying behavior, the tact is typically reinforced with some form of social approval in educational settings, and later by whatever action the listener takes with respect to one's tacting. Again, in contrast to the mand, the response form is controlled by a prior stimulus rather than the reinforcement that is usually received. Thus a child is taught to say "dog" as a tact when one can be seen, heard, felt, or smelled; but not because one wants a dog. We ask others what they see or hear, and the information is useful to us if the response is in fact controlled as a tact. We also prompt mands by asking others what they want, but we expect the two types of behavior to be clearly distinguished.

The Intraverbal Relationship

In the copying behaviors there is close correspondence between the controlling stimulus and the stimulus that the behaver produces by responding. Thus, the echoic response sounds like the stimulus that determined the form of the response. When the child says "dog" it sounds pretty much like the same word that was spoken by the adult. But we can also react to another speaker's (signer's) verbal behavior with responses which do not produce similar stimuli. Thus, on hearing someone say "table" we may have some tendency to say "chair". Such a tendency would probably not result in over behavior under ordinary circumstances, but it could be seen quite easily if instructions were given to "Say the first thing that comes to mind when I say 'table'." as in a word association experiment. This type of verbal relationship is called "intraverbal" by Skinner, and it plays an important

role in normal language. In the educational setting much intraverbal behavior is developed, as in counting, reciting poems and singing songs, stating the properties of objects or events, listing the colors, the common shapes, "things to write with", etc. This type of training results in fairly strong tendencies for certain verbal stimuli to increase the probability of certain verbal responses other than copying responses. Some are relatively trivial in their communicative effect, such as tendencies to say "butter" on hearing or seeing the word "bread". These "word associations" are not trivial, however, in their role in facilitating effective verbal behavior by a speaker or signer. Our intraverbal repertoires are quite important for rapid and effective speaking and listening. For example, it is relatively important that the verbal responses "butter, white, whole wheat, eat, meal, toast," etc.) all be readily available in our repertoire when bread is being introduced into a conversation. Intraverbal relationships between the stimulus "color" and such responses as "red, blue, green," etc., play an important role when we are asked to talk about the colors of objects.

The reinforcement for intraverbal behavior, as with copying and tact behavior is at first educational and social, but eventually is related to its facilitative effect on one's own verbal behavior as well as the action the listener takes as a result of the speaker's behavior.

In learning a foreign language the "translations" or "vocabulary" lists are intraverbal behavior. Thus any tendency to say "mesa" as a result of seeing or hearing the English word "table" is intraverbal: the stimulus is verbal, and the response is not a copying response - that is, does not duplicate the properties of the stimulus. (Saying either "table" or "mesa" as a result of seeing or touching a table would, of course, exemplify the tact relationship, since the form of the response, either English or Spanish, is determined by the nonverbal stimulus of the table).

Textual Behavior

The last type of elementary verbal relationship that must be considered in this presentation is reading aloud, or what Skinner called "textual behavior". Here the stimulus consists of written or printed words, and the response consists of reading those words out loud. In some respects this is like copying behavior, except that the response does not produce a stimulus that matches the controlling stimulus - when you read you do not produce a written visual stimulus, but rather an auditory stimulus. In a sense this auditory stimulus "matches" the written one, but not in the strict sense of "match" since they are in different sense modes. Still, saying "dog" as a result of seeing "dog" written on the chalk board, seems more of a match than saying "cat" as a result of seeing "dog" written there - an example of intraverbal behavior. Skinner used the term "point-to-point correspondence" to refer to this "lesser" type of matching; thus in textual behavior the beginning of the stimulus is closely related to the beginning of the response, the middle of the S controls, the middle of the R, and so on. In intraverbal behavior the controlling stimulus is the result of someone's verbal behavior - that is a spoken or written word, or a manual sign, but it does not copy the stimulus, nor does it have point-to-point correspondence with it. Textual behavior doesn't copy, but does have point-to-point correspondence. Is there a form of signing behavior which is analogous to textual behavior? Finger spelling "dog" as a result of seeing "dog" written somewhere would seem to be quite similar to textual behavior. With signing, however, there is at present no well known analog. Notice that a tendency to make the sign for "dog" (slapping the thigh) as a result of seeing the word written "dog" is not textual behavior since there is no correspondence of any sort between the parts of the stimulus and the parts of the response. It is not unlike a tendency on the part of a bilingual person to say perro (the Spanish term) on seeing the

word "dog", in other words, it is intraverbal behavior. This illustrates the point that sign language is much more like a foreign language than like a special form of English - a point that will be made extensively later.

But couldn't there be a form of textual behavior for signers other than finger spelling? The answer is "yes", but the issue is quite complicated and will be dealt with later.

More Complex Verbal Behavior

What has been described so far are the elementary verbal relationships. These elements can be seen to constitute a large part of the child's VB or that of the nonverbal person who is being taught some form of verbal behavior, and they constitute a useful basis for such instruction. But VB quickly becomes more complicated, with long and rapidly emitted sequences, controlled by events and relationships of extraordinary complexity. Part of this complexity comes about as a result of the occurrence of verbal relationships under new conditions which resemble the earlier ones to some degree (extension or generalization); part is due to behavior controlled by private stimuli, stimuli which arise within the body of the speaker but which are not available to anyone else; some of it results from the fact that in most normal speaking or signing situations more than one controlling variable is present at a time and the resulting behavior is the joint product of this multiple control; and finally, a good deal of the complexity of ordinary speaking or signing arises from the development of secondary verbal behavior, mands and tacts which are controlled by other aspects of ongoing verbal behavior. Skinner called this type of VB "autoclitic" behavior.

There is no time in this workshop to consider these complications. They are described by Skinner in his book Verbal Behavior in fascinating detail, and we can do no better than to recommend this work to those of you who wish to pursue the topic of verbal behavior further.

MULTIPLE CONTROL

Skinner, in Verbal Behavior, (1957) states: "Two facts emerge from our survey of the basic functional relations in verbal behavior: (1) the strength of a single response may be and usually is a function of more than one variable and (2) a single variable usually affects more than one response."

The fact that the sign "eat" may be either a mand, a tact of food, or an intraverbal of echoic response illustrates the first fact. The second fact is illustrated by noting that food deprivation may strengthen several different response forms other than the sign for "food". Similarly, an object may strengthen several response forms. A black cat may strengthen the signs "animal", "cat", or "black". Indeed, only in echoic and textual relationships does the controlling variable only strengthen one response form.

An audience, as a controlling variable, illustrates both types of multiple control. A variable may strengthen one response from in the presence of one audience, but a different response form may be strengthened in the presence of a different audience. For example, seeing the written word "bow" may result in the vocal response "bow" (rhymes with snow) in the presence of an archer; whereas, the same stimulus, in the presence of a drama instructor, may result in the response "bow" (rhymes with cow).

Another type of multiple control occurs in literature or humor. In both cases a particular response is interesting or amusing because it derives strength from more than one source. In poetry based in a vocal language, rhyming and alliteration are important secondary sources of strength. In sign language, an attempt is made to have similar hand shapes as a form of visual rhyming or alliteration. For example, a deaf signer rendered the line from an e. e. cumming's poem - "Since feeling

is first" by signing "Because feeling itself mostest" (Klima & Bellugi, 1975). The signed version has the "a" hand shape repeated three times. In addition to this, signed poetry has other features unique to a visual rather than vocal modality. An attempt is made to obtain a balance between the two hands. Some of the signs are made with the right hand and some of the signs are made with the left hand. Also, one sign may be held while another is begun, which allows for a flow of movement with overlapping and blending of signs. Finally, somewhat analogous to e. e. cumming's poetry, an attempt is made to create a "design in space" with the hands.

Certain verbal responses in humor are amusing because of the fact that the response is a function of two or more variables. Puns are the prime example of this. A pun is said to have a "double meaning", which in behavioral terminology is translated as "a pun has more than one controlling variable for the response". Dr. Samuel Johnson boasted that he could make a pun on any subject. Someone asked him to make a pun about the king. He replied, "The king is not a subject". The response "subject" is amusing because it is controlled by more than one variable. This same phenomenon is possible in ASL where two or more variables control one form of sign or similar forms. The sign "total communication" is very similar to the combined signs for drinking and smoking marijuana. Using signs, one might invite a friend over for some real "total communication".

Another form of multiple control involves two variables, each controlling part of a new response that is a blend of the responses typically strengthened by those variables. Such a response is called a fragmentary recombination. For example, you might see both a chair and a

table at the same time and say "cable" or "chable". The recombination may also occur at the phrase level. A boisterous individual may strengthen both the mand "get out" and the mand "shut up" and the blended phrase may be "shut out".

Fragmentary recombination is somewhat different in sign language and there are three major forms of categories (Klima & Bellugi, 1975). Two signs may overlap, either by the signer making two signs at the same time or by holding one sign while beginning another. This is not possible in vocal behavior because only one response can be made at a time. What follows is an example of this. A deaf individual, when asked about leaving the place he loved and moving to a new situation and a new job, simultaneously signed "excited" and "depressed". Each hand made one of the signs.

A second form of recombination involves the blending of one sign into another to form a complex unit or it may involve the blending of the properties of two signs. A deaf interpreter for T.V. news during the watergate investigation created the following blend. The sign for Nixon is an "n" at the cheek. The sign for liar is the index finger moved across the lips horizontally. The interpreter began moving an "n" from the cheek across the lips in a horizontal motion whenever he was signing about Nixon.

A final form of recombination involves the substitution of one ASL prime for another. ASL primes are either TABS, DEZ or SIGS. The sign for New York is a "y" hand brushed across an upturned palm on the other hand. Many signs are made with the palm turned downward and most have a negative connotation. For example the sign for "kill" has the index finger of one hand slash across the downturned palm of the other hand. One form of the sign for "New York" has the "y" hand brushed across a

downturned palm to indicate that New York is a place of corruption and death.

It is clear from this analysis that a sign language has all the subleties of a language that are necessary for literature and humor and other "sophisticated" language forms. Indeed, a theatre of the deaf has grown up and the artistic achievement of that group is admired not only by the deaf, but also by hearing audiences.

AN ANALYSIS OF SIGN LANGUAGE

Before beginning an analysis of what sign language is and what the components of it are, there are two major misunderstandings which must be dealt with. Both of these misunderstandings have contributed to the difficulty sign language has had in being accepted as an actual form of language behavior.

The first misunderstanding involves the degree to which human gestural signs are universally understood. It is typically assumed that almost all signs are understood, or reacted to appropriately, by all people in all places around the world. For example, it is assumed that a German and an American Indian, even though they can't speak each other's language, could readily communicate using signs. Likewise, it is assumed that deaf people, who use a sign language, can easily communicate with other deaf people from different countries. A careful analysis of the situation indicates that, in fact, only a small subset of signs, having certain restricted properties are likely to be universally understood.

There are three general groups of signs that are likely to be universally understood. The first, and probably largest group, is composed of iconic signs. Most iconic signs are tacts in which the sign itself bears some formal resemblance to the non-verbal stimulus controlling that response form. For example, the sign which is translated into English as "stand", involves one hand "standing" on its index and middle fingers in the palm of the other hand. The sign that is translated as "flower" involves brushing a cupped hand against the nose as if you were actually smelling a flower. Iconic gestures of this sort are, of course, central to the game of charades. The probability that these signs are likely to be understood is presumably related to the degree of similarity

between the sign and the object or activity which is the controlling variable for that sign.

The second group of gestures consist of what may be called "indexes". Indexes primarily involve either pointing to or touching something which is being "talked about". Examples of this include pointing to yourself to indicate "me" and pointing to the other person to indicate "you". If you want to say something about your clothing, you might touch it to indicate that is what you are talking about. This category is pretty much restricted to very similar gestures.

The third and final category of signs or gestures which became quickly established usually involves some sign that is often repeated and is usually some kind of mand. Examples of this include gestures that come to function like the words "yes", "no", "stop", "continue", and so on.

These three groups of signs would probably permit two people to carry on some very rudimentary conversations, such as asking for and getting directions or getting someone to do something for you. Using only the signs in these categories, it would be impossible to engage in a lengthy sophisticated and even faster pace than dialogues in vocal languages. The vast majority of signs used in communication between two or more signing individuals do not fall into these three groups. These remaining signs are not universally understood. Indeed, even within the same country, signers from one region often have difficulty understanding the signs of a person from a different region.

Now we can return to the question, "What makes up a sign language, What are its components?". In vocal languages, the most basic component is a distinctive speech sound, or phoneme. In English there are about 42 phonemes, but various combinations of these phonemes permit thousands of

different words to be spoken. These phonemes do not represent all of the speech sounds that are possible, but only a restricted subset. All vocal languages do not have the same number or phonemes, nor exactly the same phonemes. Furthermore, a set of written symbols has been developed. These symbols do not provide a 1:1 correspondence with each phoneme, since there are only 26 letters. This lack of complete correspondence does cause some difficulties, as can be seen with the beginning reader. However, with sufficient training, the written stimuli comes to evoke an appropriate vocal response.

American sign language has certain features which are somewhat analogous to phonemes in a vocal language. These are called "cheremes".

A chereme is really somewhat a mixture between a phoneme and a syllable, especially of the CVC variety. In any case, however, it is a unit upon which more complex response forms are built. Cheremic elements fall into three categories: TAB, DEZ and SIG (Stokoe, 1972).

TAB is a place or location where a sign occurs. Certain locations are significant in that the same handshape and movement represents one sign in one location and a different sign in another location. The cheek is one TAB, the palm of the other hand is another. There are twelve TABs in American Sign Language. These are presented in Appendix I. DEZ is the configuration of the hand(s). There are 19 DEZ in American Sign Language (See Appendix I). Most of the DEZ are handshapes used in the manual English alphabet of fingerspelling. The SIG is the action or movement involved in making the sign. For example, the motion may be circular or away from the body. There are 24 SIGs in American Sign Language (See Appendix I).

It was mentioned above that DEZ are based upon fingerspelling, or the manual alphabet. Fingerspelling is often confused with American Sign Language, but is really a different system. In fingerspelling, for

example, the TAB and SIG are irrelevant. Furthermore, fingerspelling has a one-to-one correspondence with the English alphabet and is therefore a sort of bridge between the deaf and hearing communities. Fingerspelling would not even be a part of the deaf's repertoire if they did not live in a predominately hearing verbal community.

Returning to the analysis of the chereme, it should be noted that the order in which you describe the cheremic elements is not important in describing a sign. In describing a word in English, the order of the phonemic elements is very important indeed. "Tip" and "pit" are two very different responses. In ASL, however, you may describe the sign by giving the TAB, DEZ, SIG or by giving the DEZ, SIG, and TAB or any other order, and you will still be describing the same sign.

It is important at this time to clearly describe what ASL textual behavior would consist of. An ASL sign, controlled by a written English word is not textual behavior. It is intraverbal because there is no point-to-point correspondence between the stimulus and the response. ASL textual would require written symbols which did have a point-to-point correspondence with various elements of the sign they controlled. In other words, each element would have to correspond to the TAB, SIG and DEZ of the sign. Written symbols for the TABs, DEZ and SIGs of ASL have been developed by William Stokoe (1972). They are presented in Appendix I.

The American Sign Language And Its Relationship To English

As indicated earlier, language is distinguished from non-language behavior in that its effect on the environment is indirect - - that is, mediated through another person's behavior. Sign language, English, German, etc. are all systems by which members of specific cultures can have such indirect environmental effects. Some language systems resemble some others (e.g. the Indo-European languages share a number of common properties) but even in the case of closely related languages translating one system into another is never perfect. The Russian language, for example, makes heavy use of negation which makes translation even to another Indo-European language quite tricky. However, with a fair amount of training interpreters and translators usually encounter no major problems.

The American Sign Language, which is primarily used by the deaf, possesses several unique features which distinguish it from all other languages. It is a visually rather than auditorily based system. This further complicates the translation process. In addition, those who use sign language as a communication system are forced to be bilingual to the degree that they participate in the non-signing culture in which they live and this bilingualism causes more than ordinary influence by the vocal on the sign language.

The American Sign Language differs from English in several aspects. It has its own syntax and lexicon, for example, in the presence of an audience using sign language one may sign "Late you why?" as a function of seeing the other person walk through the door 10 minutes after the prearranged time. In the presence of an audience which used English one may sign "Why were you late?" as a function of seeing a person walk through the door late. These two statements are syntactically and grammati-

cally different but can have the same effect on the appropriate environment. Notice that it is possible to utilize the lexicon of sign language and the syntax of English to communicate in the visual mode, however, this is not to be considered American Sign Language. Consider the Frenchman who uses the lexicon of English and syntax of French to utter, "I myself call myself John". This double reflexive, which is required by French syntax would be considered a peculiar variety of English at best, and more likely ungrammatical (Hoemann, 1976).

Word order is less restricted for signs. For example the phrase given above "Late you why?" could also be signed "You late why?", "Why you late?" or "Why late you?" without losing any of its effect on the environment. However, the English translation is restricted to "Why were you late?". Any deviation would result in the questioning of the speaker's grammatical skills.

The semantic boundaries of sign and English lexical items overlap but are not identical. For example, the English word "fast" could mean quick, to go without food, or stuck firmly together. In sign language there is a different sign for each of these usages. On the other hand, the sign for "people who get together for one cause" has several different meanings, "group, team, organization, class, club, etc". In English there is a different word for each meaning. In both semantic examples, the context of conversation, verbal past history and the immediate environment are the controlling variables which will allow the listener to react appropriately.

Other features include the use of markers for the past, present, future and continuous verb tenses without the redundancy present in English. Sign language makes no use of articles nor does it differentiate the pronouns he, she, it, or pronouns in the nominative or accusative cases; and

the copular "to be" is accomplished via omission (Fisher, 1973). Clearly it's the case that Sign Language is a language separate from English.

Why then, don't the deaf simply adopt a signing system which uses the syntax, lexicon and grammatical aspects of the language used by the majority of the people in their environment? There are clear advantages: the deaf could learn to read English much better and the hearing could learn to communicate with them much better because they would just have to learn a word-for-sign translation.

Several attempts have been made to bridge the gap between Signs and English. The earliest attempt was by an Englishman, Richard Paget who developed what he called the Systematic Sign Language (1951). After Paget's death, Grace Paget and Pierre Gorman, a deaf man from Australia, continued the work. At the present time the system is undergoing further development by Crystal and Craig of the Department of Linguistics, University of Reading. Because the system of signing contains many arbitrary features and is quite different from that used in the United States and Canada, the elements are not readily transferable. The greatest values of Paget's work were his notions concerning the design of a "bridging" language system and the fact that he stimulated others to engage in similar efforts (Bornstein, 1973).

The first attempt at designing an artificial system in the United States was made by David Anthony beginning in 1962. Anthony was looking for a system to use with the retarded deaf at Lapeer State Home in Lapeer, Michigan. He chose sign language as the base for his system. His work, Seeing Essential English (SEE) was published as his masters thesis from Eastern Michigan University in 1966. Following graduation Anthony moved to Southern California and became involved with a group of teachers of the deaf who were deaf themselves. As a team, they continued

to develop the SEE system. However, in the late 60's and early 70's the group began to disagree on several aspects of the system and two extremes developed. Dennis Wampler felt the system should approximate English more, and split from the group to develop such a system, later called the Linguistics of a Visual English (LVE). Gerilee Gustason wanted to keep the system closer to that of sign language and also split from the group. Her system was later called Seeing Exact English (SEE_2 and as a result, Seeing Essential English became SEE_1). Simultaneously, Harry Bornstein and his colleagues at Gallaudet College in Washington D.C. were developing signs for use at the high school and college level. Those signs were useful enough to promote a similar effort by many other post-secondary programs for deaf students. The same group has also recently designed an artificial system for pre-school children called Signed English.

All of these systems, SEE_1, SEE_2, LVE and Signed English, differ in the degree to which they depart from sign language to represent English. Harry Bornstein (1973) has provided us with a detailed description of the above signing systems, the salient features of which can be seen in Table I. We will classify differences along four dimensions, syntax, lexicon, grammer and the degree to which English features are added.

Now back to our original question, why don't the deaf adopt a signing system which uses the syntax, morphology and grammatical aspects of the language used by the majority of the people in their environment? First let us consider some of the unique features of sign language. Because it is a visual system there is a greater potential for resemblance of the sign and the controlling variable. For example, the sign for food is moving the closed finger tips to the mouth as in the process of eating. English has only a few onomatopoeic words, that is, words that sound like the thing or the action such as "hiss", "buzz" or "hum". Because a large

number of signs do resemble the event that controls them as a part of the tact relationship, there is more of a correspondance between the response and the variables controlling the response, resulting in a stronger effect on the environment. For example, the sign for "around" which is one finger going around the hand in a vertical position can be done a number of different ways depending on the controlling variables. You can go around fast or slow, wide or narrow, forward or backward, steady or choppy, or any variation of these. You can do this with vocal responses, to some extent, but not as much.

Another feature is the fact that sign language is almost exclusively face-to-face communication. Practices have evolved which take advantage of this feature and in the face-to-face situation are superior to corresponding English practices. As mentioned previously, sign language does not differentiate between "he", "she" and "it". That is because they have a system which is completely unambiguous. In the English language we use "he" and "she" after they have been identified. For example, "Jim likes to go sailing. He purchased a boat about three years ago". Now if we introduce a second male, we have some problems, "Jim likes to sail, so does Jerry. He bought a boat about three years ago". Who bought the boat? Sign language uses a much less ambiguous system, that of spatial location, accomplished by way of pointing. Like English the person must first be identified and from that point on a pointing response, say to the right, is Jim, then when Jerry is identified a pointing response to the left is used. Thus, there is never any doubt as to who is being mentioned. Pointing also plays a very important role in identifying objects, places and things. You can get by without "that", "this", "here", "it", etc. in conversation and avoid a good deal of ambiguity.

Because the users of sign language have adapted to these unique features and take maximum advantage of them; and because it is a face-to-face

language, it is highly unlikely that it is ever going to be replaced by Signed English. If the deaf were to use Signed English, then as mentioned previously, they could learn to read English better and the hearing could learn to communicate with them much better because they would just have to learn a word for sign translation. The problem is, of course, that the hearing people would be forcing the deaf to use a form of language that is less efficient and takes no advantage of the unique features of sign language.

The First Language of Man

There is active support for the notion that speech is a late development in human evolution, and that the first manifestations of language were in systems of gesture (Hewes, 1973). The work of Lieberman (1973) suggests that the vocal tract of Neanderthal man was not suitable for the production of fully articulated speech. Yet the evidence of burial practices, tool manufacture, and hunting among these people indicate they had some form of verbal behavior.

Probably early man used a combination of vocal and visual modes to communicate. Fully developed vocal musculature would not be a requirement for verbal behavior, so gestures would supplement quite nicely. It's unlikely that early man survived using gestures, alone due to inherent inadequacies which would be quite dangerous to the species. One cannot gesture at night or in obstructed areas, and due to the nature of the activity of early man some vocal warning system would have been necessary. However, after man had developed the necessary vocal, musculature gestures probably faded out.

The work of the Gardeners (1969) and others with non-human primates certainly indicate that the pre-linguistic humanoid had the ability to develop repertoires appropriate for complex verbal behavior.

Had man been sophisticated enough, the elements of a gestural system could have been used to educate the deaf. Unfortunately, such education did not begin until the 16th century. Prior to that time hearing people, due to the inability to communicate, simply ignored the deaf thinking them not capable of "reasoning" or "having ideas". While others were afraid of the deaf; many had many preconceived notions, such as possession by the Devil.

An Italian physician, Girolamo Cardon (1501-1577) was the first to dispute the theory that the deaf were uneducable. He devised a code to teach the deaf, but it never gained widespread use. However, he did stimu-

late others to pursue this notion. Such as Pedro Ponce de Leon (1520-1584), a Spanish Monk who succeeded in educating the deaf children of several nobel families so they could inherit property. He was able to teach them how to read and write but his method is unknown.

Sometime later Juan Poblo Bonet (?-1629) developed the one-handed manual alphabet which is almost unchanged today. He also was responsible for the first book on the education of the deaf (1620) which included some signs. However, education for the deaf remained restricted to the wealthy.

During the middle of the 18th century in France and Germany, public education for the deaf began. Unfortunately, also began a controversy that continues today. That is, what is the best method for educating the deaf? In France, Abbe Charles de L'Epee (1712-1789) founded the country's first public school for the deaf. His method of instruction utilized the "natural gestures" of the deaf, which he later collected and published (1783). Today's American Sign Language, in part, was derived from L'Epee's system.

Simultaneously, in Leipzig, Germany, Samuel Heinicke (1729-18?) established the first country's public school for the deaf. However, his method involved the use of speech and lip reading alone (the oral method). Heinicke insisted that "words and ideas could never be placed inside the mind without speech" and "signs would be too difficult to remember". Beginning in 1780, L'Epee and Heinicke began an exchange of letters. Mostly the letters consisted of arguments as to which system was most effective. Both provided unsupported examples which demonstrated the best features of their system.

Thomas Hopkins Gallaudet (1787-1851) is credited with bringing sign language to the United States. In 1813 he was employed by Dr. Mason Cogswell, who had a deaf daughter, and had to go to Europe and learn the

methods of teaching the deaf. Gallaudet's plans were to learn several methods and then combine the best features of them. However, in England (where they were using Heinicke's method) they refused to teach him once they discovered his intent to learn other methods. Several months later Abbe Sicard, a student of L'Epee's, came to England to lecture. Gallaudet was so impressed with Sicard and his deaf pupils that he decided to return to France with them. After two years Gallaudet returned to the United States with one of Sicard's deaf students, Laurent Clerc. Together they started the first American school for the deaf, it was called The American Asylum for the Deaf and Dumb, which was later changed to the American School for the Deaf. It was located in Hartford, Connecticut.

Heinicke's oral method was piloted in the United States by Harriet B. Rogers at a small school in Chelmsford, Massachusetts. Later she moved the school to Northampton via a benefactor, John Clarke. Shortly after the New York Oral School opened on Lexington Avenue (later called the Lexington School).

Current Status

There still exists a clear dichotomy between methods of educating the deaf. The oral method utilizes lip reading, heavy speech therapy, amplification and sometimes, cued speech. The other method uses all of the above plus sign language (coined Total Communication).

Advantages and Disadvantages of Each System

Advantages for Oral

The deaf person can learn to communicate with hearing individuals. This is the major rationale for teaching the deaf person via oral method. However, the degree to which communication is successful differs for each student.

Advantages for Total Communication

A child can develop an extensive verbal repertoire at an early age without losing any speech quality (Meadow, 1968; Stuckless and Birch, 1966; Vernon and Koh, 1970).

Disadvantages for Oral

The major problem is that language development is delayed. If the child cannot produce effective speech, then the effect on the environment is quite weak. Much academic development is lost due to this delay (Vernon and Koh, 1970). Also, the form of the response is much more difficult to acquire. Therefore, a fair amount of educational time must be devoted to speech therapy.

A second problem is that the Oral deaf cannot effectively communicate with other Oral deaf persons. Many of the speech sounds are impossible to visually discriminate (e.g. K and G, P and B, T and D). Also, due to the nature of the English language, several sounds are difficult for the deaf to correctly reproduce (e.g. the different sounds for "a", the difference between M and N). A final disadvantage is that deaf persons report that lip-reading is very trying and generally frustrating.

Disadvantages for Total Communication

The oralists believe the deaf person's vocal quality will decrease if signs are used. Research sited above dispute that notion.

Summary

Most deaf persons prefer to use sign language. However, it is usually the parents and school personnel who make the decision. Many States do not allow the usage of sign language within the schools despite requests by deaf persons.

The Use of Sign Language With Hearing, Non-Vocal-Verbal Mentally Impaired Persons

For the deaf individual sign language is a functional aid and alternative to vocal-verbal behavior. The person can learn to manipulate the appropriate environment as effectively as one could with a vocal language. However, only recently has the hearing person begun to study this form of language. This delay is probably due to a complexity in sign language which is common to no other system; that is, it is a visually rather than an auditorily based system. This, along with the complexities of translating any language into another seems responsible for the delay.

Gardner and Gardner (1969) were the first persons to conduct a major study using sign language with a non-deaf organism. The organism was Washoe, a chimpanzee. Largely, it was their success that stimulated other hearing persons to study various features of a visual system and its applications to non-deaf populations.

Margaret Creedon has been credited with the first application of sign language to hearing non-vocal-verbal populations. She began her work in 1969 at the David School of the Michael Reese Medical Center. Following her success (Creedon, 1973), several others began using sign language with similar populations (Bricker, 1972; Bonivillian and Nelson, 1976; Fulwiler and Fouts, 1976; Milani and Sundberg, 1977; Miller and Miller, 1973; Richardson, 1975; Sundberg and Partington, 1977; Topper, 1975). Some researchers began investigating and developing specific features of the method and produced programs containing step-by-step instructions for the teaching of sign language. Some followed the traditional analysis of language (Creedon, 1975; Lake, 1976; Snell 1974), while one followed a Skinnerian Analysis of Language (Sundberg and Horn, 1976). The major differences

concern the issue of how one acquires a verbal repertoire.

There are several explanations why such populations can acquire sign language more readily than a vocal language. First, attempts at vocal communication are generally punished due to the degree of unintelligibility of the words. Often these same persons engage in high rates of inappropriate behavior which are intermittently reinforced with some adult and peer attention. When signs are introduced in a systematic fashion, the experimenter has direct control over the development of the language. The signs permit the students to manipulate their environment in an immediately reinforcing and consistent way, usually for the first time.

A second unique feature of a signing system is that the form of the response is easier to acquire. It is much easier to place someone else's hands in the appropriate position than it is to place their vocal musclulature in the appropriate position. This also makes the shaping process quicker, as well as allowing for more clear and unambigious models of the appropriate response.

A third feature of a signing system, which was mentioned earlier, is the greater potential for resemblance of the sign and the controlling variable (Iconic Signs). The sign for food, for example, is made by moving the closed finger tips to the mouth as in the process of eating. Because a large number of signs do resemble the event that controls them as part of the tact relationship, there is more of a correspondance between the response and the variables controlling the response, which probably facilitates learning and usage.

Preparation For The Sign Language Program

Analysis

In order to teach a person sign language as a primary means of communication one must first carefully consider several variables.

1. Is it clear that vocal behavior is ineffective in manipulating the environment?
2. Have speech therapy techniques proved to be ineffective, or too slow to produce a major impact?
3. Does the person have the physical capabilities to produce the signs?

If a person has some vocal capabilities, signs may facilitate its development. After vocal behavior becomes functional the signs may be faded out. On the other hand, if the person has no vocal behavior, signs permit him to manipulate his social environment much better than an arbitrary gesture system. If vocal behavior exists, require the child to use it with signs (total communication). If no vocal behavior exists, simply require the child to use signs. If the person does not have the physical capabilities to produce the signs, then other systems, such as Blissymbolics should be tried (Partington and Sundberg, 1977).

Observation

Spend several days observing the person prior to beginning the use of signs. Develop a data sheet and record items and events which appear to function as reinforcement for the person. Also, record items which the person comes in contact with within the various environments. It is often helpful to make notes of various behavior patterns and sequences of events in order to later incorporate them into the signing system.

Teaching Sign Language

Echoic (Imitative) Responses

Teaching sign language to a non-vocal-verbal person should be carried out in the same sequence as one would teach a vocal language to a normal infant. In acquiring a vocal-verbal repertoire, a child first learns to make echoic responses (e.g. da da, ba ba). These echoic responses

are then used to generate other forms of verbal behavior. A non-vocal person should, likewise, first learn echoic or imitative responses at both the gross and fine motor level. Commands such as "Do this" can be used.

Mands

Once a child is able to imitate movements, return to the list of apparent reinforcers. Pick one or two of the "most powerful" reinforcers (e.g. ball, tickle, food) whose signs are iconic in nature. During the first session, in the presence of, say, a ball, the sign for "ball" should be made by the therapist and then imitated by the student (an echoic response). Then pick up the ball, while signing and saying "ball" (this is possible due to the iconic relationship between the controlling stimulus and the response). Ask the student "what is this?" and a correct response would be producing the sign for ball (as well as a vocal approximation, depending on the individual student). If the student fails to respond appropriately, go through a correction procedure using echoic stimuli, then present a new trial. Develop data sheets and always record the nature of the response. Outside the training session the student should always be required to sign ball to have access to a ball. If he fails, go through the correction procedure. When a student meets a criterion of 100% correct responding for two consecutive sessions, put the sign on a review list, and start with the next word(s) on the list. Follow the same procedure. When the student's vocabulary reaches four or five signs, begin a separate review session, preferably early in the morning. Post information relevant to the acquisition of signs for all involved with the student. Those persons should be requested to learn the signs at the same pace as the student (preferably faster but it's not required for all persons at this point). If the student goes to a different environment

in the evening, send Sign Language Flash Cards (Hoemann 1976) to those responsible and suggest they be used. Continue working on mands until the student has five to eight signs in the repertoire. Then proceed to Tacts.

Tacts

The next group of words should also be taken from the observation list. These should include objects which the student frequently encounters, and iconic in nature (e.g. table, pencil, book). Teach these using the same procedure outlined in the Mand section, with emphasis on usage in the natural environment.

After five to ten signs (Tacts) have been acquired, begin teaching the student tacts for actions (stand, sit, go, come, etc.) and object properties (red, sweet, hot, etc.). Next teach the properties of actions (fast, slow, etc.) and relationships (in, out, above, same different, etc.) This order of tact teaching should be used flexibly considering the individual and his situation.

Mand and Tact Extensions

It is important to provide the student with opportunities to sign in the presence of stimuli other than specific training stimuli. So if a student can sign "book" in the presence of a small red book, provide an opportunity to sign "book" in the presence of a larger brown book. The strength of the response can be assessed by the student's ability to make such generic extensions. As the verbal repertoire increases, the opportunities for more complex extensions occur. For example, if a student encounters a stimulus for which the sign has not been taught, a combination of known signs frequently occur (e.g. "rock sweet" for hard candy, "dark drink" for cola). Exercises to facilitate mand and tact extensions should be conducted daily (perhaps in conjunction with the review sessions).

Intraverbals

Intraverbal training consists of teaching the student to produce a verbal response as a function of a different verbal stimulus. For example, when the therapist signs "paper and _____" the student should be able to sign pencil. To teach such behavior, begin with a small set of paired objects (e.g. cup and saucer, shoes and socks). Present the first stimulus to the student and reinforce the correct response. If the student fails, present a correction procedure, then the next trial. As with other forms of verbal behavior reinforce its occurrence in the natural environment (e.g. require the response "fine" following the stimulus "how are you"). This procedure should gradually become more complex.

A student who has come this far has a fairly effective language system. Reaching more advanced forms of verbal behavior (e.g. complex abstraction, autoclitics) simply requires the appropriate training, which is no different than that given for a vocal system.

Maintenance and Use of Sign Language

To reiterate, there are several variables that are critical for the use and maintenance of sign language. The most critical is use in the natural environment. In order for such use to occur the students must be required to sign in the presence of the appropriate variables and be reinforced for doing so. Also, those who interact with the student must use sign language (at least those which the child knows) if verbal skills are to develop.

As students are acquiring a basic vocabulary, they are able to produce a fair effect on the environment. Some specific procedures can be used to maximize this effect. For example, if the students can follow single and multiple component instructions (touch the window, pick up the

shoe and touch the paper), shape them to give the therapist similar instructions. Another technique is teaching the students to tact their own behavior (e.g. what are you doing?) Other procedures should be designed specifically for each student.

The Aged and Other Populations

There are a number of circumstances where an individual who has had normal speech becomes essentially nonvocal. In some of these cases, such as surgical removal of the vocal organs, prosthetic devices can provide acceptable substitutes, or the individual can rely extensively on writing. These are situations where the verbal repertoire seems intact, but the vocal organs are defective or essentially absent. Sign language in such cases would not seem useful unless the individual became a member of the deaf community and conducted most of his verbal interactions with deaf signers - a somewhat unlikely, but not entirely unreasonable approach to the problem.

There are other circumstances, however, where an individual whose verbal repertoire was once normal, loses more than just the ability to vocalize. Brain injury or aphasia is an example, as are the language deficits of the senile aged. Some forms of psychotic behavior seem also to be characterized by gross verbal defects, although in many such cases it is questionable whether a normal verbal repertoire was ever present.

With all of these types of verbal defects, whatever their cause, sign language instruction may very well prove useful, for the same reasons that it is of value in work with the mentally retarded. The signing can be more easily shaped than vocal behavior; much of it is "easier" to react to and to produce because of its iconic nature; the language has fewer grammatical complexities at least at an elementary level; and it is nevertheless a highly effective form of language with which the individual can achieve some form of effective interaction with his social environment.

Another useful feature is that signing can be taught while the

teacher vocalizes and if vocal behavior begins to recover, the signing can be faded out or dropped.

Not much work in this area has been done to date, but we would certainly predict a considerable increase on the basis of the success with the mentally retarded.

In general, it is probably a good general approach to begin sign training at any time when it appears that speech training is not progressing or is progressing too slowly to be of any general value to the client.

CHIMPANZEES AND LANGUAGE

There has probably always been an interest in the possibility of talking with so called lower animals. This interest is whimsically expressed in the song by Rex Harrison, "Talk to the Animals". There are frequently rumors or stories about talking dogs, and people are always wondering what their pets are thinking about and wishing they could somehow communicate. Furthermore, some animals seem to understand quite a lot of verbal behavior - although probably not as much as their owners or trainers would like to think.

There are other reasons to suspect that animals might be able to acquire some degree of verbal behavior. The general notion of the evolution of species would tend to suggest that various behavior might show quantitative rather than qualitative differences. In other words, why isn't it reasonable that animals presumed to be close to man on the evolutionary scale might have at least some rudimentary forms of verbal behavior. Bees are said to have an elaborate form of communication and some birds can certainly imitate human speech. There are an increasing number of reports suggesting that dolphins or porpoises might have a complex form of communication.

A final source of interest might be the possibility of using lower animals as experimental subjects for a more detailed analysis of the various aspects of verbal behavior that are difficult to investigate with human subjects. Of course, the question that must be answered first is which animal is the best candidate for acquiring verbal behavior.

The first major criterion for selecting a species to work with is probably the "intelligence" of the species. There are several species of

lower animals that have support for the claim of the most intelligent animal. Some of these species include the chimpanzee, the orangutan, the dolphin and the gorilla. Most of the early investigators assumed that sociability was another major factor. The chimpanzee, of course, scores very high on this latter factor. The gorilla and the orangutan are somewhat rare and are quite expensive to obtain. The dolphin simply requires a very different environment and the orangutan is not thought to be as social as the chimpanzee. The early investigators all had the notion that the best strategy was to try and raise the animal as much like a human child as was possible; if the animal grew up in the same environment as a child, perhaps it would acquire speech in somewhat the same manner as the child does. The chimpanzee therefore became the animal of choice. Only recently has work been done with the gorilla and dolphin (Patterson, 1976; Lilly, 1970).

There have been five reported serious attempts to try teaching vocal-verbal behavior to chimps and one attempt with an orangutan (Kellogg, 1968). Furness, in 1916 reported that an orangutan had acquired the words "papa" and "cup". Four of the studies with chimpanzees were done in the 1930's. All of them involved raising a chimpanzee in the researcher's home in an attempt to approximate the same environment in which a normal human acquires verbal behavior. In fact, in three of the four studies, there were either one or two human children living in the home at the same time. The experiments lasted from nine months to three years and all were dismal failures. There was even little or no observed babbling or vocal play and no indication of a propensity to try to imitate human speech. All of the studies did indicate, however, that the chimps did use some gestures.

It was pretty much concluded that chimps could not acquire human speech or, presumably, any form of verbal behavior. In the mid-fifties, some twenty years later, one final attempt was made. Keith and Cathy Hayes (Hayes & Hayes, 1956) obtained a three day old chimp and named it "Vicki". They had no children living with the chimp. After six and one-half years of training, Vicki had learned four words, all with a heavy "chimpanzee" accent. She could say "papa", mama", "cup", and "up". No further attempt to teach vocal-verbal behavior to chimps has been reported.

Unfortunately, these researchers probably had not been aware of the fact that the vocal musculature of the chimpanzee is somewhat different from that of the human. Even in the wild, the chimpanzee is not a highly vocal animal, usually remaining quiet except under some form of emotional arousal. In June of 1966, a different approach was taken by R. Allen and Beatrice Gardener (1969), psychologists at the University of Nevada at Reno. The Gardeners reasoned that since the use of the hands "is a prominent feature of chimpanzee behavior", a language involving the use of the hands would be more appropriate. Furthermore, all the chimps used in the vocal-verbal behavior studies had used gestures, and so do caged laboratory chimps.

There were other features of the study that were somewhat different. The chimp, whom they named Washoe, after the name of the county in which the university was located, was not kept in the Gardener's home, but in a small trailer nearby. Washoe had been captured in the wild and therfore her exact age was impossible to determine, but she was about 8 to 14 months old when training began. Unlike the earlier chimps who did not imitate speech, Washoe spontaneously began imitating gestures made with the arms and hands. The language form that the Gardeners decided to teach to Washoe was American Sign Language, a gestural form of language used in deaf

communities. No speech was used; everyone around Washoe always used signs.

The first reliable signs began to appear after 16 months of training. By the end of 22 months of training, she had 30 signs that met the criterion established by the Gardeners. The first signs Washoe learned included "food-eat, flower, dog, you, napkin, in, brush, hat, me, shoes, baby and clean". After 3 years, Washoe had about 85 signs in her repertoire. A year later the number was at 160 and the rate of acquisition was increasing. A chimp grows to be a strong and potentially dangerous animal; and in 1970, the Gardeners decided that they had to send Washoe to a chimp colony. Fortunately, one of the Gardener's best graduate students, Roger Fouts, was able to accompany Washoe to the Institute for Primate Studies in Norman, Oklahoma.

By 1972, Fouts had 4 more chimps signing in Oklahoma: Bruno, Booee, Thelma, and Cindy. By 1976 there were three more: Ally, Lucy and Salome'. This proved conclusively that Washoe's accomplishments had not been a fluke or that Washoe was somehow an exceptionally intelligent animal. Fouts also began to teach the chimps to learn signs from a trainer using English words, without the appropriate objects being present. Meanwhile, the Gardener's have since acquired two new chimps. But what are some of the specific achievements of these animals?

One of the first interesting achievements involved generalization: the occurrence of a response under novel stimulus conditions. Washoe was taught "open" in three situations, all involving doors, and then extended the sign to many other situations. She would sign "open" to get someone to open a drawer or a jar or on other similar situations. Washoe also learned the sign-tact "hurt", under the control of cuts or sores. Washoe later signed "hurt" at the sight of a bandage and also when she had all the symptoms of intestinal flu. She also made the sign the first time she saw a human navel.

Another achievement involves syntax. Without much training, all the chimps had a tendency to make three types of syntactical errors: repetition, jumbled order, and secondary topics. The following example contains all three of these errors. "Hurry, hurry, tickle, come gimmie tickle, tickle, gimmie, banana, hurry banana, tickle, hurry". However, with some training, all of these errors can be eliminated. Remember, however, that syntax is not as important in ASL as it is in English.

A third set of achievements concerns "neologisms". A neologism is a new word or response form which usually occurs when a situation involving multiple stimuli exists and there is no appropriate response in the repertoire. Washoe, when she first saw a swan, signed as a tact, "water bird". She had already acquired the response forms "water" and "bird" and now combined them to describe a novel situation. She continued using her sign even when the trainer demonstrated the correct sign. When she first saw a brazil nut, she signed "rock berry".

Another chimp, Roger Fout's Ally, tacted a tootsie roll as "banana sweet". He also signed "cry hurt food" when he first ate a radish. Another of Fout's chimps, Booee, signed "string pipe food" when he first saw chewing tobacco.

Fouts and his collegues (e.g., Fouts and Mellgren, 1976) have begun a series of more systematic experiments. The first involved the degree to which a chimpanzee would be able to comprehend, or react appropriately, to novel commands. The subject was trained to take an item from a box and place it in a specified location, e.g., "put the baby (doll) on the table". In a generalization test, 29 old commands, used in training were given, and 29 new commands were presented. The subject was correct on 31 percent of the novel commands (chance would have been 7 percent). The subject was never correct when chair was the novel location. Typically, the subject would get the object and then go and sit in the chair. When chair, as a location, was excluded from the data, the amount of correct responses rose to 50 percent.

Another experiment (Fouts and Mellgren, 1976) involved the production of verbal behavior in the presence of new sets of complex stimuli. The subject had all the appropriate tacts for each of the objects, locations and relationships (in, on, under) already in the repertoire. However, in the test situation, the relationships of objects and locations were novel. Also, objects and location were used that were not used in the training sessions, but which had already come to control responses outside the training session. One experimenter would set up the stimuli on one side of a barrier. The subject would then look around the barrier and was required to tact the set of stimuli. The second experimenter could not see the stimulus, but only wrote down what the subject signed. The prepositions "in", "on" and "under" were investigated. The subject was 80% correct on novel prepositions and 60% correct overall. In 240 trials the subject made no "grammatical" errors, only lexical errors.

Another interesting report made in an article by Fouts and Mellgren concerned the possibility that chimps had learned to lie or be deceitful. Fouts and his collegues taught the chimps possession and then gave them some picture books. Sometimes when a chimp would have someone elses book, they would sign "mine" when asked "Whose book is that?". Much of this could have been error, but perhaps not all. Another episode involved the hoses that are used to wash down the compound. In order to get the hoses away from the chimps, who love to play with them, the trainers would give an alarm cry and the chimps would drop the hoses and run up into the trees. Soon after, one of the chimps wanted to get a hose that another chimp was playing with. The chimp gave the alarm cry and the other chimp dropped the hose and ran up a tree. The first chimp then calmly went over and picked up the hose.

From the above description of accomplishments, it certainly appears as

though the chimpanzee is capable of acquiring at least rudimentary forms of verbal behavior. Other investigators have done research of the language capacity of chimpanzees using artificial languages that allow for a greater deal of experimental control. Premack (1977) has written a book describing his work with Sarah and other chimps, in which plastic symbols were used as words. The accomplishments are impressive. Another chimp has been using a computer-based language system. Lana pushes buttons which have symbols on them to create sentences. The reader is directed to the account of this by Duane Rumbaugh (1973). Another researcher has used ASL with a gorilla named Koko. Penny Patterson has worked with Koko at Stanford and Koko has a reported repertoire of about 350 - 400 signs, but nothing has been published to date precisely describing Koko's achievements.

Summary

This paper began with a functional analysis of verbal behavior. That analysis classified verbal behavior according to its effect upon the environment, rather than upon its form alone. Five elementary verbal relationships were described: Echoic, Textual, Intraverbal, Tact and Mand. It must be emphasized that the classification does not depend upon the form of the response, but rather upon the relationship between the different types of controlling variables and the responses to which they are functionally related. Traditional classifications are typically based upon a vocal form of verbal behavior, but this analysis is made irrespective of the modality of the response. Both a vocal and gestural language are effectively described by this analysis and both have all the components of the analysis.

Partially because of some misunderstandings about the degree to which sign languages are universally understood, sign language has not readily been accepted as a "true" language. However, a careful analysis indicates that only a very resticted set of gestures are "universal" and that there are significant variations in sign languages around the world, just as there are significant variations of vocal languages. It was also pointed out that sign language is different from fingerspelling, which is essentially a bridge between the deal and hearing communities.

An analysis of signs themselves reveals that they are composed of a small set of units (cheremes) which are combined much like the phonemes of vocal languages, to generate an extensive lexicon. The units are TAB, the location of a sign; DEZ, the hand configuration; and SIG, the action or movement. American Sign Language (ASL) is

both lexically and syntactically different from English and is a separate language, just as French or German is. Several variations of ASL have been developed, all of which have elements of both ASL and English. These variations have not won much acceptance with the deaf community.

American Sign Language, as a form of verbal behavior, has several applications. Of course, it is most commonly taught as a form of verbal behavior to deaf individuals. However, it has more recently been used with the mentally retarded who have hearing, but have not developed vocal verbal behavior. It has also been used with the mentally retarded to facilitate the acquisition of vocal verbal behavior.

Literary effects and humor are possible with ASL. These occur as a result of multiple causation, just as they develop in vocal languages. There are some differences, however, as a result of ASL producing visual stimuli that are less transient than the auditory stimuli produced by a vocal language.

Other populations may also benefit from a form of ASL. The aged, or people who have suffered some kind of brain damage may be able to acquire a gestural form of verbal behavior. Of course, much work has been done lately using ASL with a non-human population, the chimpanzee. Chimpanzees had failed to acquire any significant form of vocal verbal behavior, but have acquired at least an impressive rudimentary form of verbal behavior using ASL.

When verbal behavior is analyzed from a functional point of view, it becomes clear that vocal languages are only one possible form of verbal behavior, and that other forms, such as a gestural language like ASL

can have all the same functions of vocal verbal behavior. Furthermore, ASL has some unique advantages and has proven to be a very easily acquired and very useful form of verbal behavior for many special populations.

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Table 2. Tab Symbols for Writing the Signs of American Sign Language*

1.	∅	Zero, the neutral place where the hands move, in contrast with all places below.
2.	) (	Face or whole head
3.	⌒	Forehead or brow, upper face
4.	⊔	Midface, the eye or nose region
5.	∪	Chin, lower face
6.	ʒ	Cheek, temple, ear, side-face
7.	π	Neck
8.	[ ]	Trunk, body from shoulder to hips
9.	⌒	Upper arm
10.	⌒	Elbow, forearm
11.	⌒	Wrist, arm in supine position (on its back)
12.	⌒	Wrist, arm in prone position (face down)

*From Stokoe, Croneberg, and Casterline, 1965.

Table 3. Dez Symbols for Writing the Signs of American Sign Language*

1.	A	Compact hand, fist; may be like "a," "s," or "t" of manual alphabet
2.	B	Flat hand
3.	5	Spread hand; fingers and thumb spread like "5" of manual numeration
4.	C	Curved hand; may be like "c" or more open
5.	E	Contracted hand; like "e" or more clawlike
6.	F	"Three-ring" hand; from spread hand, thumb and index finger touch or cross
7.	G	Index hand, like "g" or sometimes like "d"; index finger points from fist
8.	H	Index and second finger, side by side, extended
9.	I	"Pinkie" hand; little finger extended from compact hand
10.	K	Like except that thumb touches middle phalanx of second finger; like "k" and "p" of manual alphabet
11.	L	Angle hand; thumb, index finger in right angle, other fingers usually bent into palm

*From Stokoe, Croneberg, and Casterline, 1965.

Table 3. (continued)

12.	3	"Cock" hand; thumb and first two fingers spread, like "3" of manual numeration
13.	O	Tapered hand; fingers curved and squeezed together over thumb; may be like "o" of manual alphabet
14.	R	"Warding off" hand; second finger crossed over index finger, like "r" of manual alphabet
15.	V	"Victory" hand; index and second fingers extended and spread apart
16.	W	Three-finger hand; thumb and little finger touch, others extended spread
17.	X	Hook hand; index finger bent in hook from fist, thumb tip may touch fingertip
18.	Y	"Horns" hand; thumb and little finger spread out extended from fist; or index finger and little finger extended, parallel
19.	ʊ	(Allocheric variant of Y); second finger bent in from spread hand, thumb may touch fingertip

Table 4. Sig Symbols for Writing the Signs of American Sign Language*

1.	⌒	Upward movement
2.	⌣	Downward movement
3.	∼	Up-and-down movement
4.	>	Rightward movement
5.	<	Leftward movement
6.	Z	Side-to-side movement
7.	T	Movement toward signer
8.	⊥	Movement away from signer
9.	I	To-and-fro movement
10.	ɑ	Supinating rotation (palm up)
11.	b	Pronating rotation (palm down)
12.	ω	Twisting movement
13.	b	Nodding or bending action
14.	□	Opening action (final dez configuration shown in brackets)
15.	#	Closing action (final dez configuration shown in brackets)
16.	⁂	Wiggling action of fingers
17.	⊙	Circular action
18.	X	Convergent action, approach
19.	×	Contactual action, touch
20.	I	Linking action, grasp
21.	⋕	Crossing action, grasp
22.	⊙	Entering action
23.	÷	Divergent action, separate
24.	ʊ	Interchanging action

*From Stokoe, Croneberg, and Casterline, 1965.

	American Sign Language	Signed English	Seeing Exact English (SEE2)	Seeing Essential English (SEE1)	Linguistics of a visual English (LVE)
Order of inclusion of English lexical and grammatical items from least to most.	1	2	3	4	5
Syntax	ASL syntax	English syntax	English syntax	English syntax	English synta
Grammatical Features	Makes use of tense markers. Does not differentiate certain pronouns. Makes no use of articles.	Signs are created for pronouns and articles. Uses a limited number of tense markers	Borrows basic innovations from SEE1. Less restricted from ASL. Fewer semantic boundaries.	When semantically different from ASL, those of ASL are extended or narrowed to those of English. Each pronouns and article have a SEE equivalent.	More phonetically based than syntactally based. Signs are paired with English bounc and unbound morphemes.