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A SEGMENTATION OF BEHAVIOR*

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CONFRONTATION with a sound motion picture of human behavior overwhelms the observer with a rapidly flowing and shifting scene of sound and motion. There seem to be no clear boundary points dividing the flow of events into discrete segments. This paper seeks to present a statement of method and findings relevant to the analysis of such ongoing behavior. An attempt is made to interweave statements of method and statements of findings during the narration, with emphasis given to method.

Language, in its natural occurrence as speech, is never disembodied but is always manifested through behavior. For example: what does the lowering of the voice, 'while' the eyes widen, 'while' the brows raise, 'while' an arm and fingers move, 'while' the head lowers, 'while' a leg and foot shift, 'while' the face flushes, have to do with what was said or left unsaid? How is this modified by the equally complex configurations of change which immediately precede and follow? And how are all of the above changes, in turn, related to the similarly involved behavior of the other person or persons in the interaction?

We are quite often very clear about what a person said and meant but cannot tell precisely how he accomplished it or how we are able to accomplish our understanding of it.

The search for the units of behavior, their organization and their empirical validation, thus constitutes *the* central problem of behavioral analysis. A *method* of segmenting the stream of behavior, of discovering where information about its order is located, also emerges as a concomitant consideration. The need to control the variables in experimental method tends to modify the process under investigation. In human behavior, it is quite often not even clear what the variables are, such that they could be controlled. What is required to some extent is a method which could investigate and make relatively rigorous, predictable statements about a process without disrupting the process too severely. At a more general level this also involves some concern about how seemingly discrete elements become 'organized' into continuous processes.

Naturally occurring processes are, theoretically, as determined as the events in a controlled experimental situation. The methodological difficulty resides in discovering criteria which

* The following work is dependent upon the approach in the forthcoming book *The Natural History of an Interview*, authored by BATESON, G., BIRDWHISTELL, R., BROSIN, H., HOCKETT, C. and MCQUOWN, N. (Ed.). We are also indebted to the work of Albert E. Scheflen.

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are as rigorous as those of experimental method in providing trustworthy decisions concerning units and unit relationships. Modern descriptive linguistics, which may have the most advanced methods logic in the Behavioral Sciences, offers help in the analysis of such natural processes. The methodological principles illustrated below also have application in the analysis of processes other than speech and may have value in psychiatric research. In essence, the fundamental problem involves finding an empirical, decisional basis for the analysis of an ongoing process across the multiple and interlocking levels of that process as it occurs naturally.

There are, initially, preliminary procedures utilized to achieve a phonetic segmentation of the speech stream, including an indication of phonetic syllables and higher level units. This involves an etic analysis of the domain under investigation in order to determine the parameters which carry information about that system. In the study of language this is achieved by an analysis of the structure and patterns of usage of the physical articulatory apparatus. The term 'etic' has been defined by STETSON[1] in the following fashion.

> "Motor phonetics is the study of the skilled movements involved in the process of handling articulatory signals. Motor phonetics deals with the organized series of actual syllables or nonsense syllables shaped by the language mechanism. 'Phonetic' refers to such physiological processes in the study of the signals of a language independent of the meanings of the signals. The signals are physiological; they are uttered and perceived by kinesthetic and visual cues in the case of the deaf; the 'sounds' are not essentially auditory. A phonetic change is a mechanical change which occurs in the syllable due to context and to change of rate and stress in the utterance. Since these coordinated movements of articulation are the medium for the signals of an articulate language, the mechanical, physiological changes are important and affect the phonemes."

PIKE[2] deals extensively with the etic and emic standpoints for the description of behavior, indicating that the term 'etic' is derived from the last part of the word phonetic. He feels that the two standpoints must be distinguished and characterizes the etic standpoint as relatively prestructural in relation to the structural, functional derivation of emic analyses. In oversimplified terms, an etic approach might involve an analysis of the physical elements which cooperate in the articulation of sounds as against an analysis of which sounds will be functioning in a given language and in what ways. The two views are, however, intimately related in ongoing inquiry.

After this has been accomplished, the data is then searched for the different kinds of segments, which essentially resolves itself into an analysis of the classes of sounds which, to some extent, form the minimal 'units' of the language. Nonsuspicious sounds are listed first. These are the recurring sound types which are considerably dissimilar and clearly separate, hence not likely to be submembers of the same class. The suspicious pairs of sounds are then listed. These are considered suspicious because being phonetically similar, they might prove to be submembers (variants) of a single phoneme (class of sounds).

Methodologically, that which serves to distinguish similar sound segments from each other is their contrast in analogous environments.* When this occurs the two sounds can be distinguished into separate classes (separate phonemes) since *their* difference in this instance

* An identical environment is a form of analogous environment.

is what makes *the* difference. Quite often minimally differing pairs can be discovered: where no smaller difference in the language can make a difference in the meaning of the words. An example of this is the traditional contrast between /pit/ and /bit/. Part of the task involves an analysis of the environmental variations (around the sounds) in order to discover situations in the system where such variations are relatively identical, in order to determine if one of the similar sounds does make a difference. You seek within the system that which the control of variables accomplishes in experimental method—a decisional situation.

All of this is rudimentary to the linguist. It is presented here in order to suggest a similarity between the decisional logic of experimental method and that used by the linguist. John Stuart Mill (1806–1873) presented guides for a decisional logic of inductive inference. His following definition of the 'Method of Difference' is strikingly like the linguists use of contrast in analogous environments.* "If an instance in which the phenomenon under investigation occurs, and an instance in which it does not occur, have every circumstance in common save one, that one occurring only in the former; the circumstance in which alone the two instances differ, is the effect, or the cause, or an indispensable part of the cause, of the phenomena".[3] One can paraphrase the above decisional situation with respect to the /pit/: /bit/ contrast. An instance in which the phenomenon occurs is the *referential meaning* of /bit/ to an informant(s). An instance in which the phenomenon does not occur is the *referential meaning* of /pit/ to the informant(s). The circumstance alone in which the two instances differ is the difference of /p/ and /b/ and this methodologically provides the decisional basis for regarding them as separate phonemes. The preceding comparison only deals with a limited aspect of both inductive inference and linguistic method. It is presented here in order to provide some indication of the logic of linguistic method.

The present research attempts to analyze wider aspects of behavior utilizing, with modification, the search-check approach developed by the linguists. A linguist uses an informant who speaks the language to be analyzed. This informant has a knowledge of the meaningful units (words) of the language and can make the judgment of whether or not a similar sound in an analogous environment does make a difference in the meaning. Many aspects of behavior, however, present a relatively unknown process both for the subject and for the investigator. The use of sound motion pictures to record the flow of human interaction provides a way of storing the visual and verbal aspects of that behavior and permits a re-viewing as often as desired. These re-viewings permit a search for the natural usages and regularities within that process. The discovery of patterns leads, in time, to the clarification of unit identities within the process. The system itself, instead of an informant, provides the contrasts which permit decisions. Analysis proceeds over time and is cumulative, with each bit of new evidence supporting previous findings and providing clues about further patterns.

Initial exploration of the structure of communicational behavior consisted of an intensive viewing of a film of a psychotherapeutic interview. This literally involved hundreds of hours of viewing the film over and over. It was, retrospectively, a training period in learning to see and describe behavioral changes. Each viewing involved a review of what had been noticed

* We are not seeking for a causal connection here, but for an empirical decision of class inclusion or exclusion, i.e. of unit status in the system.

previously and permitted regularities which had remained unnoticed to be seen, which often resulted in a transformed perspective of both. While we could not predict when a re-seeing would lead to the recognition of regularities, after a time one became assured that this would occur. In this fashion predictable patterns from various levels emerged out of the background of the seemingly continuous behavior.

Prolonged viewing of film using a time–motion analyzer, which permits a variable scanning of the sequences of body motion, indicated that the changing and sustaining of direction, including changes of velocity of the parts of the body might provide a basis for an *etic* description. This was an attempt to find patterns or forms of change of body motion which might provide a descriptive basis for the analysis of body motion. Later analyses could then seek for classes of such patterns which might have communicational import; be elements in specific cultural communication systems. Many of these changes can only be seen clearly by using the time-motion analyzer. (This is the familiar slow motion projector used by football coaches to analyze films of games.) In time this led to the observation of regularities in the way the body parts change in relation to each other.

Directionality within the context of the study of body motion (kinesics)* refers to such factors as maintenance or change in flexion/extension, pronation/supination, abduction/adduction of joints, as well as the forms of movement characteristic of the head, eyes, mouth, etc. These diverse body parts—eyes, mouth, trunk, head, arms, fingers, etc.—tend to change and sustain direction of movement together. If one body part moves or changes direction of movement, it does so concomitantly and in concert with the other body parts moving at that time. Behavior occurs as a flowing and emergent pattern of configurations of change—a configuration where the body parts are sustaining their directions of change together will be succeeded by another configuration which is in its turn followed by still another. There is no point at which there is non-change. What is being described is an on-going flow of 'moments-of-sustaining-together' of the body parts. This seemingly basic form of 'unit-in-change' has been called a 'process unit' to avoid the connotation of discrete bits of behavior. The 'process unit' is observationally defined as the initiation and sustaining of directionality of change of the body parts with each other (the *specific* directions being sustained by the individual parts may differ) across a given moment of time as contrasted with the preceding and succeeding sets of similarly sustained configurations of movement of the body parts.

We are dealing with ordered patterns of change during change, which exhibit rhythmic and varying patterns in the temporal sequencing of such changes. Metaphorically, there are waves within waves within waves, with complex yet determinable relationships between the peaks and the troughs of the levels of waves, which serve to express organized processes with continually changing relationships. Thus a 'unit' of behavior is defined by the occurring and sustaining together of a variety of changes through a given moment. This is not precisely the same as the synchrony exhibited, for example, when a person's arms and legs move together during walking, although it is not unrelated. What is being described here are the minimally observed 'units' of behavior itself. Behavior occurs as a flow of such units, but the units are not discrete in the sense of a recurring identity which is the same at each occur-

* Kinesics refers here to the developing field and methods utilized to gain an understanding of the body as it functions culturally. Ray L. Birdwhistell has been the pioneering figure in this endeavor.

rence. That which recurs is a pattern or form of change and it is this 'order-in-the-change' which constitutes the unit of behavior. Behavior, to reemphasize, occurs as patterns of 'whiles'; a person speaks connecting segments of sound, 'while' eyes and brows move, 'while' arms, hands and fingers move, 'while' the other person or persons move. Behavior *is* what they all are 'while' they occur. We are seeking to illustrate that the components of behavior are not discrete and isolated events which are then combined to form behavior, but are regular and predictable patterns of change within an ongoing process.

An intensive, linguistic–kinesic analysis was undertaken on a film of a three-person interaction; a mother, father and their four-year-old son at dinner. The film was taken at the standard rate of 24 frames per second (f.p.s.). At the time of filming the mother was in therapy and the son was felt to be a behavior problem.* Figure 1 presents a section of the linguistic–kinesic transcription of their interaction.

Figure 1 constitutes a behavioral flow description of the patterns of change of the bodies of the three interactants in relation to syllable and word length speech segments. The shaft of the arrow indicates the sustained direction of movement while the point of the arrow indicates change of direction of movement. The mother turns toward someone off camera saying, "I think that you . . . I think you all should come around every night, we never have had a dinner time like this in months". Because of space limitations only the phrase 'should come around' is presented in Fig. 1.

The findings from the micro analysis of this and several other films of behavior are as follows.

(1) *Self-synchrony.* The organization of change of a speaker's body motion occurs synchronously with the articulated segmental organization of his speech. The body dances in time with speech. In Fig. 1, the sustaining and change of direction of the mother's body parts coincide precisely with the articulation of the 'syllables' and word length segments of her speech. There are, however, different forms of sustaining movement across phrase and utterance length segments. This will be dealt with in a forthcoming paper dealing primarily with the wider *organization* of behavior.

In Fig. 1, to illustrate using the word 'around', the mother moves in precise harmony with the tripartite segmentation of the word as she articulates it.

Etic syllabic pulses tend to coincide with this tripartite segmentation, suggesting that at this level self-synchrony may be primarily etic, i.e. physiological.

a	·	rou	·	nd
Head up slight	)	back+up slight	)	down)
Eyes left slight	)	widen	)	right slight)
Mouth forward+purse	)	open+widen	)	close+back+narrow)
Trunk forward	)	bend+back slight	)	back)
R. Sho. lck.	)	forward slight	)	forward)
R. El. extend slight	)	extend	)	extend slight)
L. Sho. forward slight	)	abduct slight	)	back slight)

* This was one of the family films obtained by Gregory Bateson which became the basic material for much of the early work in this field.

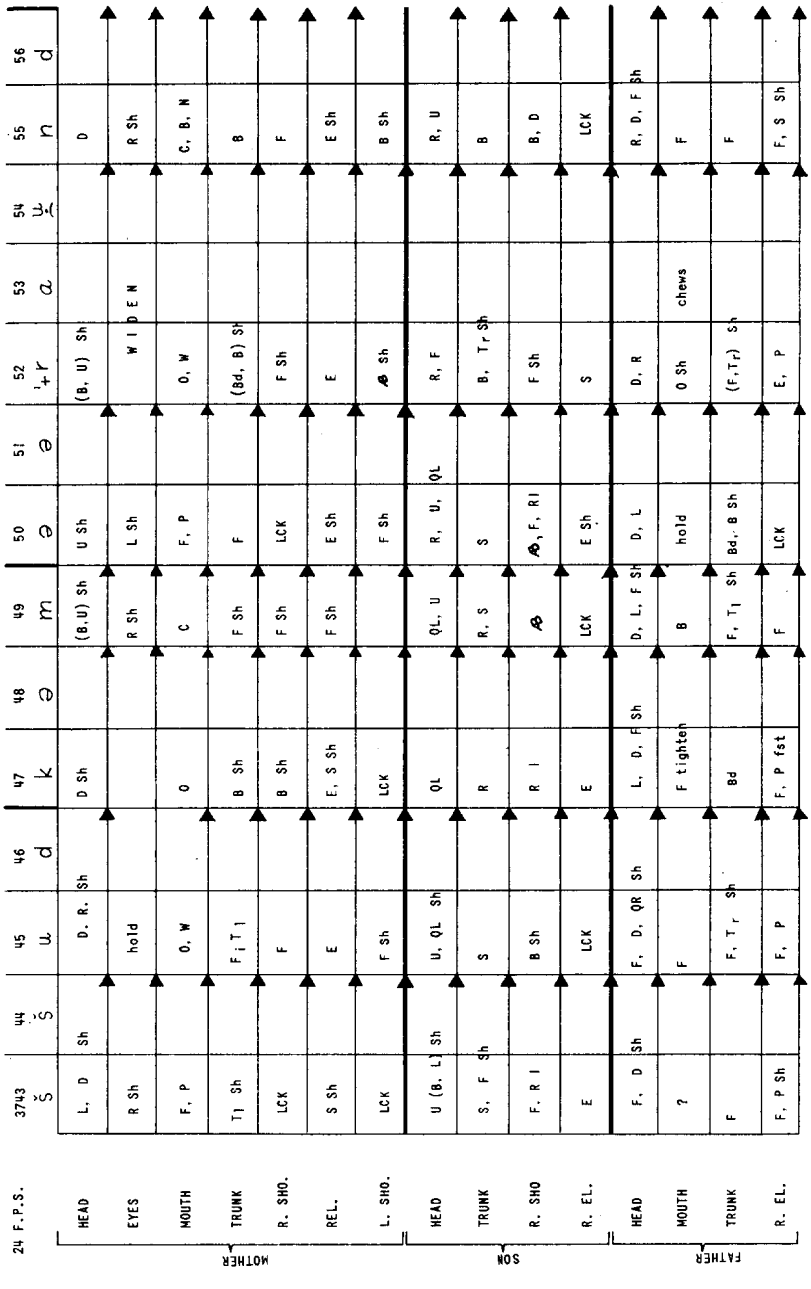
24 F.P.S.
3743 š
44 s
45 w
46 d
47 k
48 ə
49 m
50 ə
51 ə
52 ɹ+r
53 a
54 ɹ
55 n
56 d
HEAD
EYES
MOUTH
TRUNK
R. SHO.
REL.
L. SHO.
MOTHER
HEAD
TRUNK
R. SHO
R. EL.
SON
HEAD
MOUTH
TRUNK
R. EL.
FATHER
L. D Sh D. R. Sh D Sh (B.U) Sh U Sh (B, U) Sh D
R Sh hold R Sh L Sh W I D E N R Sh
F, P O, W O F, P O, W C, B, N
T] Sh F; T] B Sh F Sh F (Bd, B) Sh B
LCK F B Sh F Sh LCK F Sh F
S Sh E E, S Sh F Sh E Sh E Sh F
LCK F Sh LCK F Sh E Sh B Sh
U (B. L) Sh U, QL Sh QL QL, U R, U, QL R, F R, U
S, F Sh S R R, S S B, Tr Sh B
F. R I B Sh R I Ø Ø, F, RI F Sh B, D
E LCK E LCK E Sh S LCK
F, D Sh F, D, QR Sh L, D, F Sh D, L, F Sh D, L D, R R, D, F Sh
? F F tighten B hold O Sh chews F
F F, Tr Sh Bd F, T] Sh Bd, B Sh (F,Tr) Sh F
F, P Sh F, P F, P fst F LCK E, P F, S Sh

FIG. 1.

Two full utterances of the mother, consisting of twenty-four words and lasting approximately 5½ s, were exhaustively analyzed. This same pattern of synchronous change between body motion and speech was observed throughout both utterances. The directions of change of the body parts were sustained while a verbal segment was emitted, and changed into a different body configuration at the same moment that a new verbal segment was emitted, to be again sustained while the next segment occurred, continuing on in this fashion. Thus, there is a precise correlation between the changes of body motion and the articulated patterns of the speech stream. This has been found to hold in all films (forty) of 'normal' behavior subsequently studied.

The discovery of this synchronous isomorphism between speech and body motion resulted, in part, from an ability to segment the sound stream at the same commensurate level as body motion.* This means that the occurrence of phone changes must be detectable down to one frame or 1/24 of a second. This can be achieved by using a sound reader coupled with a visual viewer (a film editing device) that has a manually operated and free wheeling transport mechanism. One can transport the sound film through this device at a variety of speeds, from very slow to extremely fast, effectively achieving slow motion vision *and* sound. (This ability to alter the time base of behavior also provides high-speed scanning, permitting the analysis of slow and fast behavioral variations which occur across much wider stretches.) The investigator can bypass the constraints of the standard speeds of operation of projectors and tape recorders. Commensurate segmentation has been achieved with 48 f.p.s. film and sound and is possible at even higher speeds.

Since boundary smearing had occurred at the micro level with 24 f.p.s. film, a 48 f.p.s. film was made of two 'normal' male subjects (A and B) interacting, knowing that they were being filmed. Figure 2 presents a section of the micro, linguistic–kinesic transcription of their behavior.

This 48 f.p.s. film permitted a more precise and accurate analysis of the micro pattern of body motion changes in relation to the segmental pattern of speech. The organization of body motion change was found to co-occur systematically with speech at sub-phone, phone, syllable, word, phrase and higher levels. There is, again, a strong etic synchrony at the sub-phone, phone and syllabic levels. The etic segmental breath pulse, as interpreted by the investigator, seems intimately related to these etic sound segments. There is a suggestion that breath pulses co-occur in complex relationships to the phonetically emerging transformations within the sound stream. The 'syllabic' aspect tends to be strongly demarcated where these breath pulses occur rather than at precise phone terminal positions. Paralinguistic phenomena such as laughter, crying, pause verbalizations like 'umm' and 'ahh', etc. also occur synchronously with body motion.

Self-synchrony reveals complex yet related organizations of change of the linguistic–kinesic aspects of behavior. After the word level is reached there tends to be a different form of body usage accompanying syntactic sequences (phrasal and longer segments). The precise nature and function of the transition at this point is not clear; at times it consists of a sustained sweep across the phrase, or it may consist of a change in total posture at these points. Present evidence suggests that the body is what might tentatively be called

* The attainment of a commensurate spatial–temporal basis for comparison is a most important technique for the discovery of many of the patterned relationships pervading behavior.

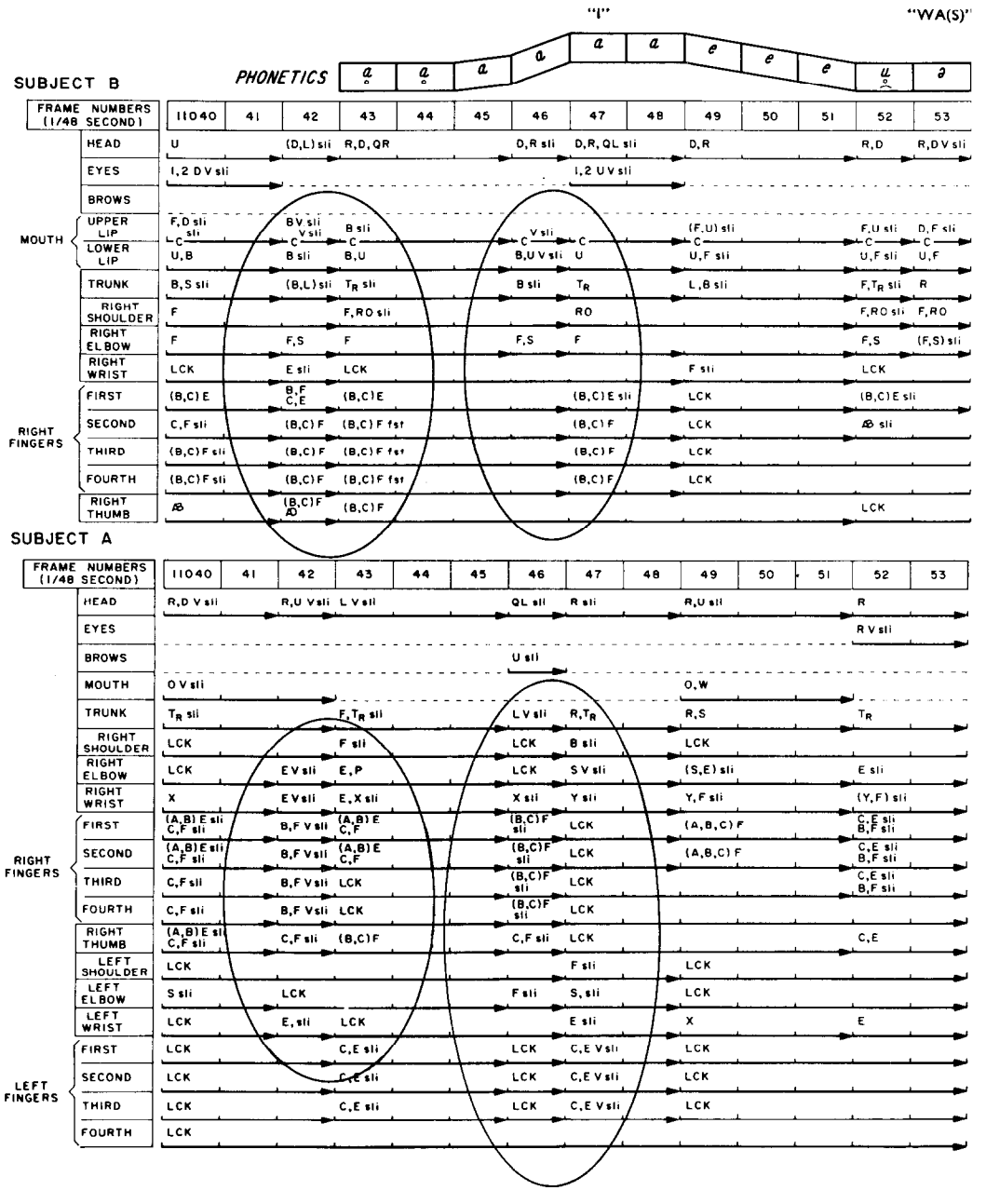
"I"
"WA(S)"
PHONETICS
SUBJECT B
SUBJECT A
FRAME NUMBERS (1/48 SECOND)
11040 41 42 43 44 45 46 47 48 49 50 51 52 53
HEAD
EYES
BROWS
MOUTH
UPPER LIP
LOWER LIP
TRUNK
RIGHT SHOULDER
RIGHT ELBOW
RIGHT WRIST
RIGHT FINGERS
FIRST
SECOND
THIRD
FOURTH
RIGHT THUMB
LEFT SHOULDER
LEFT ELBOW
LEFT WRIST
LEFT FINGERS

FIG. 2.

'word organized' and as words begin to emerge into larger syntactic sequences, a semi-isolation occurs, such that body parts tend to function somewhat more independently as they co-occur with the larger segments. There is, however, a clear distinction between the way body motion accompanies speech up to and including the word level and the way they are related beyond the word level.

We live in a familiar, cognitive world which conveys some assurance about object and event boundaries; this also provides a context in terms of which we are often led to make our investigative distinctions. One becomes less confident of these familiar modes of dividing the stream of events when one faces the task of *inductively* establishing such boundaries. In the films no points of non-behavior are discoverable. Silences, for example, are integral parts of and qualifications of the communicational interaction. They are not spaces of non-interaction, nor is one silence communicationally equivalent to another. Since the world is obviously composed of *individuals* who interact, a year and a half was arduously spent in focusing on one individual and then on the other in an attempt to detect the units of communication occurring between them.

> "We see the spatial and the temporal, but neither space nor time, for example. Yet every one of us is pretty sure to have a picture of some sort of them. It is our pictures that deceive us. Nature's perspectives are not deceptive; we live by them and rely on them. Theories of those perspectives may induce us to form pictures of perspectives which Nature never exhibits; then, letting the pictures control our thinking, we are often led to deny the reality of natural perspectives and are at our wits end to find a place where these now unreal perspectives exist."[4]

It was almost by accident that the following interactional factors were discovered.

(2) *Interactional synchrony.* During the intensive micro analysis of the three-person interaction described in Fig. 1, a startling discovery was made. The father and son were found to share patterns of bodily changes in a precise harmony with the mother as she spoke. These changes occurred in both in relationship to the mother at exactly the same frame (1/24 of a second). All three sustained directions of change across syllable and word length segments of speech and changed together at the same 1/24 of a second that these segments ended, to again sustain directions of movement together across the next ensuing segment. This occurred throughout the two utterances examined and in all other films of 'normal' interaction subsequently studied. Changes of velocity of movement were shared to some extent by all three. Pitch and stress variations are also related to the velocity variations of body motion.* Metaphorically, the three interactants looked like puppets being moved by the same set of strings. Figure 1 also provides an illustration of this interactional synchrony. No random movements, no nonshared changes, were found to occur during interactional synchrony.

* Body motion of interactants tends to accelerate with stressed verbal segments, particularly with vowel onset and with syllabic consonants. Further study suggests that the eye blink, too, has a distributional occurrence in behavior and also functions as an accentual parakinesic phenomenon. The eye blink has been found to occur during vocalization at the beginning of words or utterances, usually with the initial vowel of the word; at word medial syllabic change points; and precisely following the termination of a word. Thus, speed variations and eye blinks do not seem to occur randomly, but are also related to other ongoing variations in the sense that *if* they occur, their point of occurrence may be relatively specifiable.

Body organization changes could systematically be predicted to occur in both speaker and listener(s) at phonetic speech change points. The father moves his fork to and from his plate in precise cadence with the syllabic segments of the mother's speech. This also holds true for the son's body movements. The syllabic segment appears to be a marked rhythm point in communicational behavior. Figure 3 presents a simplified, schematic illustration (taken from a full linguistic–kinesic transcription) of the patterns of change of the three interactants during the full $5\frac{1}{2}$ s of both utterances.

A periodic, behavioral switching of the son back and forth between the father and mother was also noted in the above passages studied. All three were sustaining interactional synchrony, but a further heightened relationship could be detected. The boy would share the same direction of change with the father or with the mother even as he changed synchronously with both. This indicates that one has no *a priori* knowledge of which specific aspects of behavior may turn out to form regularities. This shared directionality is distinguishable, as a form of regularity, from interactional synchrony, but it is not separate from it. They occupy the same behavioral space-time.

The harmonious patterns of change during interactional synchrony can be seen even more clearly in the 48 f.p.s. film. Several total utterances were analyzed in the same fashion as the word 'I' in Fig. 2 above and the interactional synchrony occurred throughout. Subjects A and B sustain the organization of change of their movements together across the same number of frames and change their configuration of movement together at the same 1/48 of a second to again sustain it across the next series of frames. This can be seen in the isomorphic vertical alignment of the arrows in Fig. 2. These changes are also isomorphic with detectable phonetic change patterns in Subject B's speech.

The areas encircled in Fig. 2 tentatively define etic 'process units'. These units differ from each other in terms of which body parts are moving together and at what velocities, so that at this level the body parts, as such, do not provide a unit basis for the description of behavior. But that which they have in common, that which gives them a possible class identity and which is interpreted to constitute 'process unit' status, is the fact that all detectable moving body parts are sustaining direction of movement together across a given interval and in precise isomorphism with an element of speech *as it is articulated.* There is, again, no point of non-change during the behavior. Changes within the total ongoing process of change occur in ordered and predictable patterns. Behavior, metaphorically, is composed of a serial emergence of such clusters of changing-together. Interactional synchrony is seen as a rhythmic sustaining and changing together of such clusters-of-change by the interactants.*

An objection had been raised that interactional synchrony might be a result of the equipment (time-motion analyzer), implying that the apparent relationships of change between the interactants was due to the nature of the manual stopping and starting of the equipment and not inherent in the behavior. It is, however, the synchronous change of direction of movement on the part of the interactants which defines interactional synchrony. Where the equipment stops or starts is not directly related to the fact that Subject B changes the

* For those interested in pathological behavior an extensive frame-by-frame comparison of normal and pathological behavior patterns revealed marked dyssynchrony at this micro level in pathological behavior as contrasted with a lack of it in normal behavior. This analysis has been published previously.[5]

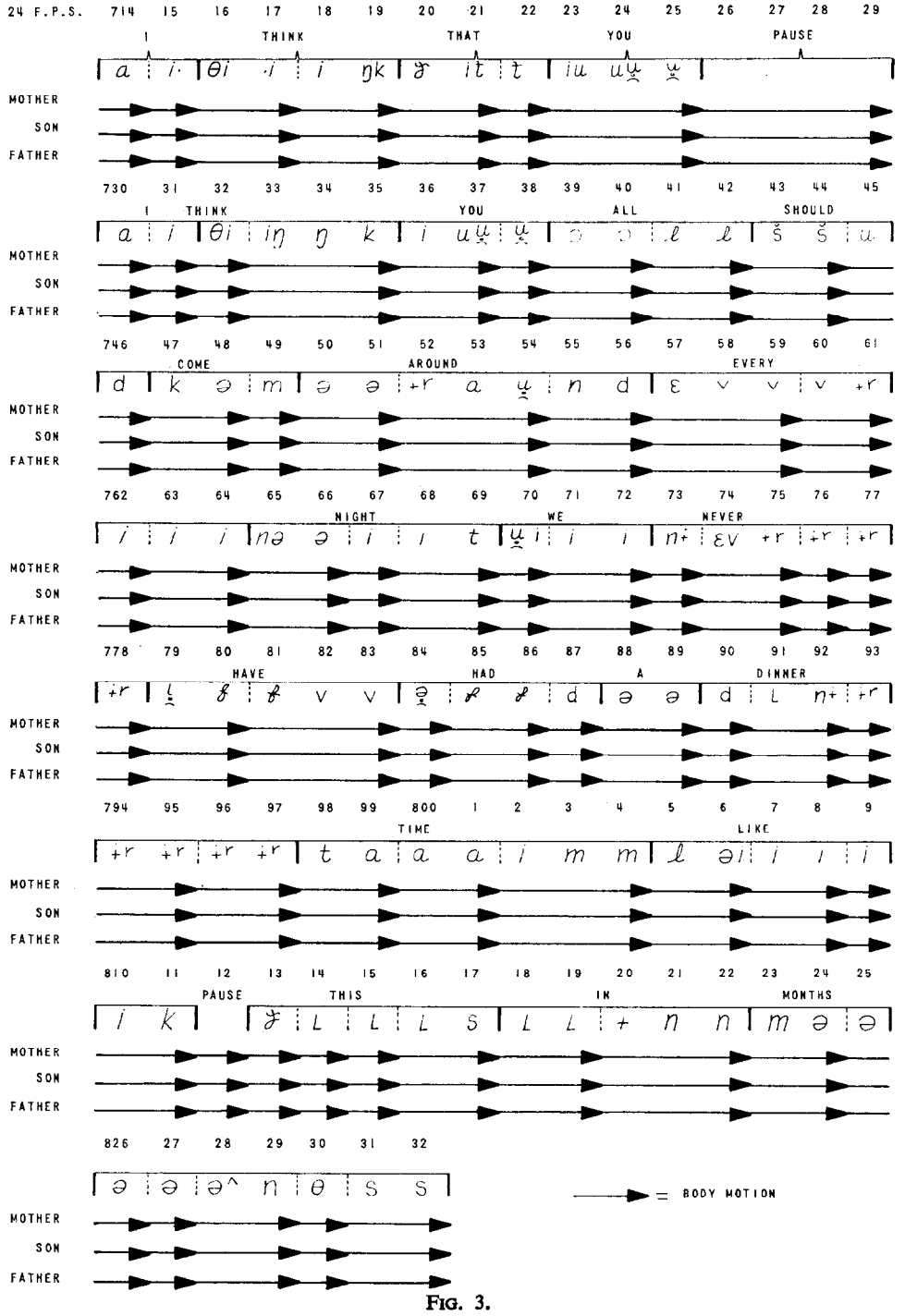
24 F.P.S.
I
THINK
THAT
YOU
PAUSE
MOTHER
SON
FATHER
I
THINK
YOU
ALL
SHOULD
COME
AROUND
EVERY
NIGHT
WE
NEVER
HAVE
HAD
A
DINNER
TIME
LIKE
PAUSE
THIS
IN
MONTHS
= BODY MOTION

FIG. 3.

direction of movement of his head from right to left at the same 1/48 of a second that Subject A changes the direction of movement of his head from up to down and that both sustain this new direction for three frames and then change directions precisely together again to sustain it across the next series of frames. These changes are also, again, occurring at distinguishable points of phonetic change.

A section of the 48 f.p.s. film was designed to test interactional synchrony; to determine whether or not it was an artifact produced by the equipment. Interactional synchrony was observed to occur consistently when the two subjects conversed with each other. When the two subjects were pulled out of their interaction to interact independently with two other widely separated persons off camera, no synchrony was observable.

(3) *Bioelectric investigations.* A further attempt to apply the above segmental method was undertaken through an examination of films of behavior and simultaneous polygraph recordings. The rationale for such an undertaking and for a brief inclusion of some of the tentative findings in the present paper, are indicated by the following considerations.

Since there were relatively no detectable behavioral changes within the minimally occurring clusters-of-change and since behavior seemed to be composed of a serial flow of such clusters, it was hypothesized that bioelectric activity might also reveal a related synchrony of some order. In essence, an attempt was made to compare the speech, body motion and bioelectric activity patterns within the speaker as well as the bioelectric patterns between speaker and listener. The history of the present research indicates that what may be random from one perspective is often not random from a different perspective. What is involved to some extent is an attempt to apply the above approach in a search for pattern in artifact at the micro level—a search to see if the artifact accompanying behavior displayed possible segmental orderings.

Two 16-mm cameras, one on the interacting subjects and the other on a standard 12-channel EEG machine, utilized as a polygraph, were operated simultaneously at 24 f.p.s. from a voltage-regulated, synchronous motor. The sound system, a 16 mm Amega sprocketed tape recorder was operated from the same regulated supply source as the camera. This equipment linkage was utilized to provide comparable data across systems. An optical sound track was subsequently recorded on both subject and polygraph films. Two 'normal' subjects were filmed in interaction with five scalp electrodes from the polygraph attached to each. The subjects had not met prior to filming. The sixth pen of each recorded a separate EMG from the wrist. A section of the film, in which Subject X (a male graduate student) is talking to Subject Y (a female speech therapist) was analyzed. Much repeated viewing of the film of the polygraph pens and graph paper was required in order to gain some idea of the location of the parameters of change which might provide information. For purposes of analysis, we assumed that the pattern of change of the pens as seen on the film formed an unknown system. We sought to detect some ordered relationship between this pen movement system and speech and body motion. Analysis focused on the organization of change of the pens, rather than the tracing, in relation to speech and body motion. The following material is tentative at the present time and a further, more precisely controlled study is being done.

The polygraph pen changes of Subject X appear to occur synchronously with his speech and body motion. Further, the pen change patterns of Subject Y appear to occur synchronously with those of Subject X. The pattern of change of the pens which was discovered

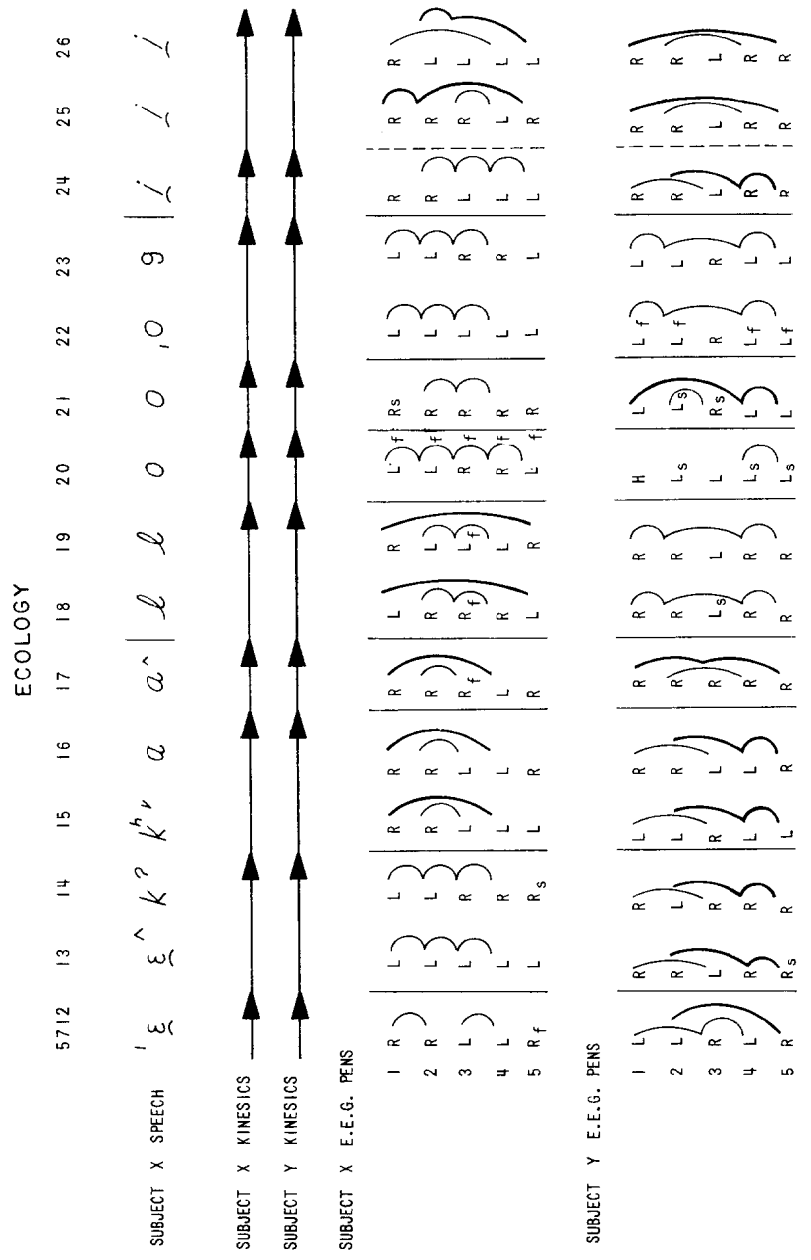
ECOLOGY
5 7 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26
SUBJECT X SPEECH
SUBJECT X KINESICS
SUBJECT Y KINESICS
SUBJECT X E.E.G. PENS
SUBJECT Y E.E.G. PENS

FIG. 4.

to be in harmony with speech and body motion involved a relational pattern which all five pens participated in forming. Figure 4 presents a segment illustrating this suspected speech, body motion and bioelectric harmony.

In the pen movement section of Fig. 4, the pattern of change was analyzed in terms of three factors; direction of pen movement, speed of pen movement and manner in which the pens moved relative to each other. Subject X is speaking about his career and remarks, "Ecology is sort of my . . . my interest". Only the word 'ecology' is presented in Fig. 4 because of space limitations. The word was articulated into three major segments with concomitant sub-segments. The symbols R and L refer to direction of pen movement. Due to camera positioning the upward deflections of the pen are seen in the film as left and the downward deflections as right. The curved lines connecting these symbols indicate which pens are moving in unison during each frame. Three tentative speed distinctions were made (later five speed variations were transcribed); 's' after a symbol indicates slow speed, the letter by itself indicates medium speed and 'f' after the letter indicates fast. The pattern of change of the five pens tends to be isomorphic with speech and body motion patterns of change as the words are articulated by the speaker. Further, the pen changes of the listener seem to be harmonious with those of a speaker. This occurred consistently throughout the film.

To briefly summarize this section; the speech, body motion and bioelectric activity in a normal speaker appeared to display synchronous patterns of change. The person listening also displays patterns of change of body motion and bioelectric activity which seem to be harmonious with those of the speaker. Artifact is highly ordered in relation to the flow of behavior and appears to be amenable to segmentation.

CONCLUSION

An approach to the segmentation of behavior has been presented, including a partial consideration of the logic of the method utilized. In the process of analysis, a preliminary approximation to a micro, 'etic' segmentation of speech and body motion emerged. The 'units' of behavior, that into which it was ultimately segmented, were ordered and predictable changes of change (clusters-of-change) rather than discrete isolates. The body of the speaker was found to 'dance' synchronously with the articulatory segmentation of his speech. Further, the body of the listener was found to 'dance' synchronously with the speaker, primarily up to and including word length segments. Verbal and kinesic behavior can be minutely described and transcribed from the micro level of 1/48 of a second (or faster) up to and including much wider behavioral sequences. The use of high speed cameras, including the appropriate analytic instrumentation, thus may provide a method for the microscopic analysis and *organizational description* of both normal and pathological behavior and permits a comparison of them across many levels.

The search for the units within an ongoing process was found to involve, simultaneously, the search for the location of the informational order or organization of that process.

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