Nonverbal Communication Today

Contributions to the Sociology of Language

33

Joshua A. Fishman
Editor

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Preface

This book is about communication. We are living in an era when essential communications and services are suspended, interrupted, and disturbed – yet unwanted communications – the junk mail and unsolicited telephone calls – continue to pour into our lives. The focus of this book is on extra-linguistic messages – nonverbal expressions that are part of every communicative/behavioral event. It is a collection of authors who are seeking to discover the *structure of behavior in human communication and interaction* with each other and with their environment. The articles treat current research, with one exception. This is a reprint of a 1948 article that pleads for 'the unity of science' – written with the idea that only by means of a cross-disciplinary approach can we draw nearer to an understanding of human behavior.

It is my belief that major decisions are made in the world, and in the home, by protean emotions and attitudes – not by reasoning and use of factual information. It has been noted that emotions control the stock market. An economic consultant to institutional investors says:

> The stock market has always held a mirror to investor's emotions. That was true even before the late Gerald Loeb enunciated it by noting that market values are fixed by the hopes and fears of humanity – and by greed – more than they are by balance sheets and income statements. And it is as true today as it ever was. (Bernstein 1977: 23)

A consultant to the Rand Corporation puts it another way:

> One thing is certain. Economists will never solve inflation or even make a dent in it. Poring over figures instead of looking into the human soul, they may be the last people to know what it is. (Kellen 1979)

Thus, economists will never solve the problems of inflation; linguists will never solve the language problems in the schools. Specialists cannot solve the problems of the world with their particular knowledge about the environment, diseases and their cures, food supply, crowded conditions, and so on. These problems will not be solved until it is known how decisions are made –

by individuals and by nations. It is difficult not to think of human beings as evolutionary mistakes, because of their inability to balance reason and emotions. History – and the daily newspaper – announce that human beings seem unable to function without permitting destructive mechanisms to dominate. But maybe God will find a way out!

The authors represented here are from academia and scientific research centers; they are doing their part to learn something about human behavior. They come from many directions and points of view – from psychology and linguistics, and from the fields of physics, political science, geography, and zoology, and the art world. Many languages and backgrounds are represented: Chinese, Dutch, German, Spanish, and Russian, as well as English, assuring a cross-cultural perspective. Background studies include areas of animal communication, cognition, eye behavior, emotions, infant and child behavior, that of the deaf, quantum scattering theory, cerebral specialization, acquisition of language, gestural language, and judicial behavior. This all comes together by focusing on human interaction. I have not edited the authors' style or presentation; freedom of style is one of the charms of innovative research.

These studies, then, are further explorations into the matter of 'What makes people tick?'. What are those inexorable forces behind the actions of people, families, communities, and institutions? There are many different ideas and theories set forth here; some of what we say will be wrong – unwittingly, and some of what we say will be right – unwittingly!

Irvine, California
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Mary Ritchie Key

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PART VI. THEORETICAL MODELING OF COMMUNICATIVE BEHAVIOR

List of Contributors

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Charles F. Hockett, Cornell University. Since the days of apprenticeship in the 1930s with scholars like Edward Sapir, Leonard Bloomfield, and Alfred L. Kroeber, Professor Hockett's major professional concern has been with the place of our species in the universe and the role of language in making us what we are.

Mary Ritchie Key, Professor of Linguistics, University of California at Irvine, has published linguistic studies in comparative American Indian languages, sociolinguistics, phonology, and nonverbal behavior. Latest book: *The Relationship of Verbal and Nonverbal Communication*, The Hague: Mouton, 1980.

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Fernando Poyatos, Professor of Romance Languages, University of New Brunswick, Canada. His research deals with the interdisciplinary integrative study of verbal and nonverbal systems in interaction, in narrative literature, and as culture. Recent publications include: *Man Beyond Words: Theory and Methodology of Nonverbal Communication* (1976); 'The morphological and functional approach to kinesics in the context of interaction and culture' (1977); 'Forms and functions of nonverbal communication in the novel: a new perspective of the author-character-reader relationship' (1977).

Glendon Schubert is University Professor of Political Science at the University of Hawaii, Manoa. His contribution was written when he was a Fellow of the Netherlands Institute for Advanced Study in the Humanities and Social Sciences, where he studied the relationship between animal behavior and human ethology, especially political ethology. He is best known for his work in the field of judicial behavior, such as his *The Constitutional Polity* (1970) and *The Judicial Mind Revisited* (1974).

Joseph Sonnenfeld is a geographer at Texas A & M University with interests in environmental perception and behavior. He is currently involved in research on the relationship between cerebral specialization and environmental skills, which will include fieldwork in Alaska and Mexico as well as in Texas; see *Man-Environment Systems* 7: 188–193 (1977); and 8: 241–251 (1978).

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PART I

Overall Considerations of Human Beings Interacting in Their World

MARY RITCHIE KEY

Overall Considerations of Human Beings Interacting in Their World

A. INTERACTION, BEHAVIOR, AND COMMUNICATION

In studies of human communication the discussions often start with language. This book starts with the human being in an environment. Any human being, in any language or culture, is a thinking, feeling, and willing organism, who is distinguished from others and from objects in his or her environment or ambience. Human beings experience relationships, and they create responses and reactions to these relationships. Thus, we can consider human behavior/communication, in terms of *space*, *time*, and *relationships*. Human beings organize language (verbal) and extra-linguistic messages (nonverbal) in patterned ways to deal with anything and everything in the ambience.

Various definitions of 'communication' and 'language' have been set forth throughout the centuries. More recently, nonverbal considerations in the communicative event have led to new terminologies and revised definitions, in order to talk about what happens when people interact with others, and/or the environment, or when they express things to themselves. Thus we note terms such as *paralanguage*, *body language*, *nonverbal events*, *kinesic acts*, and many more. These are attempts to find a way to treat phenomena that have not been dealt with systematically heretofore.

At times the attempts are awkward and clumsy, as is some of the terminology. At times the terms are misleading; at times they are wrong. But the 'naming' ability of human beings is not clearly understood by either philosophers or linguists. Thus, we have awkward terminology occurring throughout the activities and interactions of human beings. Our daily lives are full of misnomers. One can find them in any area of life: 'private enterprise' is not private; 'joint tenants' are not tenants; 'community property' is not owned by the community. Some terms are even detrimental to eliciting proper behavior, such as 'inflammable'. So dangerous was this term that legal action was taken that resulted in a change to 'flammable'. It is one of the few cases in history where change in language usage was brought about by a decision of the court. Even when a term is carefully devised and intended for a certain usage, it may end up with another meaning, as did the term 'psychobiology'. Further, when translations into other languages are made, definitions lose their preciseness – thus, in Spanish, 'Brazil nuts' are *almendras* 'almonds'. Even though a term may be inappropriate or even wrong, it is difficult or impossible to change it; public schools in England will no doubt remain 'public', even though they are private.

It must be admitted, that in our studies of nonverbal communication/behavior, new terms are being devised and explored and old terms are being redefined. I suggest that we not get bogged down in terminological harangues. To concentrate on terminology at this point would stunt our growth and weaken our attacks on the real problems of rule-governed behavior in human interaction. There is enough general agreement on what is meant by 'language', 'sentence', 'intonation', 'nonverbal', 'communication', and we use the terms in those generally agreed upon senses.

Though current research has not yet clarified our definitions and terminologies, it has indicated new ways of looking at language and communication. I have suggested, for example, that verbal and nonverbal acts may be approached from the point of view that they are 'organizers of social systems' (Key 1980: 1–33). Further, I have suggested that language could also be observed as a system of accommodation, to get from one point in time to another point in time, and to get from one relationship or situation to another. As walking is a system to get from one place to another – in *space*, so language is a system to get from one place to another – in *time* (Key 1977: 21). In the evolution of human interactions, then, transportation systems are extensions of *walking*; various media are extensions of *talking*, with their numerous elaborations as seen in rhetoric, the debate, oratory, and books.

A lawyer is an example of one who is highly proficient in the use of language, and it is probably no coincidence that attorneys have relatively dominant status nowadays. No one could become a politician without extensive verbalizing. I repeat Bolinger's succinct observation (1975: 295): 'Gabby people get ahead in a gabby world'.

One can use metaphor as another way of trying to understand meaning in interaction, behavior, communication, and language – another way of observing the interplay of attractions and rejections in human interaction. (See, for example, Ricœur 1977; Sapir and Crocker 1977; Bolinger 1979.)

Comparisons are also useful in discovering new insights into the complexities of human behavior. Compare, for example, a debate and a prize fight – the setting up of two significant public figures, the promotion, the raising of the emotional level of the audience, the tactics employed, the surprise moves, the roar of the crowd, the announcement of the winner, the subsequent adulation of the winner (not always the 'best' one), and the mortification of the 'loser'. Another exercise that 'says' a great deal about movement behavior is the comparison of a star baseball player and a star ballet dancer –

the rigorous training and dedication, the rhythm and balance displayed, the timing, the execution of action in a seemingly effortless way, the disciplined form, the grace of movement. We can learn more about communicative behavior by looking at *all* behavior.

Without doubt, language is more ritualized than we have previously thought. Feed a computer a few stock phrases, program it properly, and it can come up with some pretty good government documents, sermons, political speeches, and university lectures. This is both comforting – and frightening. But it needn't be either. A more scholarly response is simply the observation that stereotypical language is a description of human interaction which is probably a reflection of the combination of *nature* and *nurture*. This will be discussed further in Part III.

What I am saying in this, and in recent writings, is that we must look for new and startlingly different ways to look at language and/or communication if we are to understand *meaning*. Asking different kinds of questions produces different kinds of answers, as Midgley (1978: 99) reminds us: 'Slicing the world in different directions reveals different patterns. Jelly rolls, sliced downward, have a spiral structure. Sliced across, they have stripes'.

B. ECOLOGICAL AND ARTIFACTUAL PATTERNING

The first article in this collection is titled 'The communication of environmental meaning'. Professor Sonnenfeld is a geographer who is studying the processes by means of which human beings accommodate to and communicate in their particular ecological arrangements. As I noted above, I arranged this collection to start with focusing on the *situation* of the communicators rather than the language of the communicators. Human beings are linked together in their relationships in time and space in an inextricable interdependence. It is impossible to understand language or nonverbal messages without first observing the situations in which those messages or responses are articulated.

Human beings find themselves – at a certain point in time, in a certain particular place, in connection with certain relationships. These relationships, physical location, and the temporal aspect all have their influence in the kind of communicative behavior in which people participate. Though these ecological arrangements are inseparable, for purposes of discussion, they may be dealt with separately. We must constantly remind ourselves that a linguistic item or nonverbal act that is articulated must be interpreted in terms of its Context of Situation. People may struggle with their environment; they may be in conflict with it; they may be in harmony with it; they may improve it, or make it worse, but they cannot ignore the reality of their relationships, or their spatial situation, or their temporal aspects. The WH questions are their inescapable context: who, when, where.

All languages of the world have a way of saying: I, you (singular), the other one (he/she/it), we, you (plural), and they. Human interactions are based on these *relationships*, and out of these pronoun relationships are constructed the kinship systems of the social world. The kind and degree of the relationships between the interactants determine what kind of communicative behavior people are permitted to use, such as intimate, formal, honorific, and so forth. Terms of address, joking, and avoidance relationships are culturally learned artifacts of the kinship relationships. The place in the kinship chart determines marriageable possibilities, how people are named, where people live, what kind of house they construct, what kind of work they do, and how they may express their emotions.

The concept of *time* in nonverbal studies has been labeled *chronemics*, by analogy with proxemics (Poyatos 1972); additional studies have been subsequently published by Bruneau. Other scholars have researched synchrony, rhythm, and the use of timing – the components that make up the *suprasegmentals of interaction* (Key 1980: Part II). It is tempting to ponder how the interrelationships of nonverbal time and space will be discovered and outlined. Linguistic items illustrate the meshing of spatial and temporal concepts. With both we use the same prepositions: before, after, in, at; and the same adjectives: long, short, same, different, right, wrong, hard, nice, more, less; and many of the same noun phrases: stretch of time, segment of time, amount of time, length of time.

The study of *space* in human interaction is called *proxemics*. With increasing awareness of the communicative value of space, scholars note that linguistic expressions often reflect one's orientation in the environment. The importance of spatial concepts is evidenced in the large number of words referring to space. These words refer to various spatial dimensions, such as: distance (close or far); level (above or below); place (front or back); and laterality (right or left). Hall has noted that in English, some 20% of the words in the pocket Oxford Dictionary have some spatial connotation, for example, together, next to, adjacent, congruent, level, upright.

It is perhaps more common than we have heretofore realized that terms for the parts of the body are also terms for the house and artifacts in it. Thus, the bed has a head and a foot; a chair has a back, arms, and legs; a bowl has a bottom and sides; sugarbowls have ears; loaves of bread, heels; pitchers have lips; and even potatoes have eyes.

This orientation to the house and cultural artifacts is reminiscent of early memory techniques of the ancient world, before paper and pencil were invented. Memory systems enabled storytellers and orators to narrate with great detail. It is believed that they associated each thought of a speech to a particular place in a house. 'In the first place', the opening thought, would be associated with the front door, the second thought with the foyer, the third to a piece of furniture, and so on. The associations enabled them to memorize large amounts of information (Lorayne and Lucas 1974: 1–5).

The value of space is demonstrated around us constantly. A poet plans space on the page:

where
always
it's
Spring) and everyone's
in love and flowers pick themselves

e. e. cummings[1]

A high school student captured the spirit of the spacing of symbols with his contribution:

He threw the ball t
me.
o

A photographer crops a picture to bring the desired element into focus, with judicious/artistic spacing. Architects and home-builders study the use of space. Winston Churchill recognized the importance of the *built environment* in human interaction: 'We shape our buildings and they shape us' (in Forsdale 1974: 100). The 'semiotics of the built environment' is increasingly a topic of concern to scholars studying the effect of architecture on behavior (see Preziosi 1979; Heimsath 1977).

> Humans live in an extraordinarily complex world of made objects . . . . Not only do we use and make objects; objects in turn have, in a sense, made us what we have become as a species. It seems evident that we have evolved ourselves in large part to interact with this artifactual world of sign-formations – in other words, that human evolution is in part the product of our long interaction with systems of built forms.
>
> Like verbal language, the *built environment* – what will be called here the *architectonic code* – is a panhuman phenomenon. No human society exists without artifactually reordering its environment – without employing environmental formations (whether made or appropriated) as sign-tokens in a system of visual communication, representation and expression. (Preziosi 1979: 1)

To test these ideas, one might compare in our own society, for example, the size, dominance, architecture, and location of our educational buildings (schools) with financial structures (savings and loans and banks). To say that teachers are not doing their job of educating pupils these days is to avoid acknowledging shifts of values and to circumvent what are the real and important issues.

Finally, in order to study the communicative and behavioral events of the artifactual world we live in, it is necessary to devise notational systems by which the messages can be recalled. Notational systems come in all shapes and forms – alphabets, musical notes, sketches, blueprints, formulas, recipes, and so forth. Elsewhere I have discussed the notational systems of paralanguage and kinesics as they have been used in nonverbal studies (Key 1977: Ch. 4). Interestingly enough, the varied notational systems are themselves a kind of language. Notation systems can separate as well as unite. The language Hindi (formerly known as Hindustani) is written with one script in India; in Pakistan it is written with another script and is called Urdu (Trager 1972: 240–241).

I suspect that the Cyrillic alphabet of the Russian language and the Roman alphabet of English contribute to the feelings of both peoples that the other is exasperatingly 'different' and unfathomable.

Contemporary linguistic theories are another example of the disparate messages subliminally given by notation systems. In the linguistic journals of the past decade or two, one finds a proliferation of formulas and symbolizations. The theories presented are not as difficult to assimilate as are the notations. One might make a case, in this and in other disciplines, that the exaggerated use of unfamiliar formulas is a device used to congregate the 'in' crowd and to reject the outsiders. There is also the possibility that the symbolization itself separates the population; right-brained scholars may be able to relate to one kind of symbolization, and left-brained scholars may better relate to another kind of notation.

These questions are of vital interest to scholars in any of the areas of nonverbal studies: paralanguage, kinesics, built environment, emotive language, interaction and dyads, tactile behavior, sensory messages, and everything else with which one organism triggers another. Research will progress only so far as the notational systems can keep up with the documentation.

C. PHYSIOLOGICAL AND SOCIAL ASPECTS OF INTERACTION

> Look into a person's pupils,
> He cannot hide himself.
>
> Confucius, 551–479 B.C.

The articles in this section have to do with what is basically biology, and what is culture, in the anthropological sense. Since both innate and learned behavior are usually *out-of-awareness*, it is an extremely difficult question to decide which is which and how they are interrelated. The first two articles treat eye and skin response and explore further the communicative aspects beyond actual physiology. Of particular interest is the study by artist Betty Edwards, that deals with the right and left hemisphere and the abilities to 'see' and draw. The next three articles focus on social perspectives and how they influence *meaning* in the interaction of working and speaking organisms.

There is no clear distinction between physiological functions and communicative behavior, an aspect I dealt with in *Paralanguage and Kinesics* (Key 1975: 91–100, 107–115). The illustrations come from many cultures all over the world; no normal physiological act is without its communicative counterpart in some part of the world, at some time, or in some relationship. Thus the kind of control exerted over the handling of body functions: urinating, vomiting, defecating, breathing, expelling flatus – all these 'say something' in the interactions of humans. Further, spontaneous physiological acts, such as coughing, spitting, belching, yawning, sighing, sneezing, clearing the throat, also are a part of *syntax*, in the grammatical sentence, embedded in the discourse at frequent intervals. These expressions are patterned in recurring ways to give meaning, as grammatical morphemes give meaning. The *rhythms* of communicative behavior are seen in physiology as well as in language. The popularization of these relationships is noted in a resurgence of the term 'sociobiology'. In the last few years this term has swept through the media as well as through scholarly publications. Probably few people (even linguists!) know that the well-known linguist, Charles Hockett, used the term in an article published in 1948. (Note that this is the only reprinted article that I am including in this collection – in the last section of the book.) The term 'sociobiology' has elicited a good deal of emotional response, as well as sound research and outstanding scholarly publications. It is not surprising, with the givens of human behavior, that it has also produced a good deal of disagreement, in the parleying of scholarly debates. Some of the important publications and references are found in: Barkow (with comments from others) 1978; Sahlins 1976; and Wilson 1975.

D. EXPRESSIVE AND LINGUISTIC ASPECTS OF NONVERBAL BEHAVIOR

This section begins with a discussion of the meanings of emotional expression, by Nico Frijda, a psychologist, and continues with two articles by linguists. Since my earliest observations on nonverbal phenomena I have stressed the indissoluble union of linguistic and extra-linguistic messages (see, for example, Key 1974). Language is accompanied, modified, reinforced, enhanced, and nullified by nonverbal concomitants.

It seems probable that nonverbal modalities carry the heavier weight of expressive and emotive messages. Thus, tone of voice and vocal quality, as seen in paralanguage, contribute to the meaning of the speech act. One of the baffling problems of investigation is that we have so little information on *emotions*, as analyzed by non-Western people. The ramifications are so complex that it seems certain that we cannot really understand universals until non-Western people of many types of cultures enter the scholarly world of research and present their points of view. There is so much that we are ignorant about, as far as basic characteristics and properties of the human being. The following incident is just one example of how differently people may view an aspect of human behavior.

Competition is taken for granted among Western people; we play to win! The Agta Negrito people of the Philippines have another way of dealing with playing and working together. Some years ago two Americans were doing field work in the Philippines, and for recreation they set up a croquet game in their front yard.

[They] began to play. Several of their Agta Negrito neighbors became interested and wanted to join the fun. Roy explained the game and started them out, each with a mallet and ball.

As the game progressed, opportunity came for one of the players to take advantage of another by knocking that person's ball out of the court. Roy explained the procedure, but his advice only puzzled his Negrito friend. 'Why would I want to knock his ball out of the court?' he asked. 'So you can get ahead and finish first', was Roy's reply. 'Why would I want to do that?' he asked again. 'So you will be the one to win!'

The short-statured man, clad only in a loin cloth, shook his head in bewilderment. Competition is generally ruled out in his hunting and gathering society, where people survive not by competing, but by sharing equally in every activity.

The game continued, but no one followed Roy's advice. When a player successfully got through all the wickets, the game was not over for him. He went back and gave aid and advice to his fellows. As the final player moved toward the last wicket, the affair was still very much a team effort. And finally, when the last wicket was played, the 'team' shouted happily, 'We won! (Taken from D. Elkins (1979), 'We won', in *In Other Words*. Used by permission of Wycliffe Bible Translators, Huntington Beach, California)

E. ORIGINS AND DEVELOPMENT OF COMMUNICATIVE BEHAVIOR

At what age do human beings start to learn and respond to communicative behavior? The first article by Thelma Weeks treats the use of intonation in infant vocalizations. She notes that while infants use intonation in 'meaningful' ways, this is not to say that they immediately acquire the adult system of intonation. Children develop their own rule-ordered intonational system for their own particular use with their own meanings. The next paper by Beatrice Beebe also deals with infant communication. It is a study of the interaction of mother-infant and presents a methodology of microanalysis. This method has revealed that mother and infant live in a 'split-second' world, where meaningful events last only one-third to one-half second.

The next two articles deal with children. Kenneth Abrams discusses facial expressions and limitations in very young children. Deaf children are the focus of the next study, which analyzes their behavior compared with the signing behavior of chimpanzees. A zoologist, Sheila White, further explores the language functioning of deaf children and proposes a model. The final paper in this section is authored by scholars who are doing research in the U.S.S.R. and thus it is important to us because it gives us another perspective on communication and cognition in human semiotic systems.

F. THEORETICAL MODELING OF COMMUNICATIVE BEHAVIOR

All of us who study human behavior have at least one goal in common – even though our approaches and perspectives come from many different directions. We are trying to understand the 'why's' behind human interaction. What are the forces that draw people together in language and nonverbal exchanges; and what are the forces that repel equally intelligent human beings, inhibiting interaction? In order to understand the powers of communication and the powers of lack of communication, we can use the concepts that physicists use to understand the forces that bind the universe. Scientists tell us nowadays that there are four basic forces that exist in nature; they are labeled: gravity, electromagnetism, strong, and weak.

It is easy to see how these concepts suggest an application to the organization of human interaction. Thus, we can look at language and nonverbal communicative acts as tools that are used in organizing social systems. For the positive interactions, certain words come to mind: attract, accept, affiliate, bond, include, contact, make connections. For negative interactions: reject, repel, repulse, exclude, withdraw. 'I don't understand you' often means 'I don't accept you'.

The magnetic attractions can be seen in ritualistic expressions, 'I love you'. The repulsions are noted in every language of the world in the way of insults and obscenities. The 'I hate you' is just as ritualistic as the 'I love you' but, interestingly enough, the negative is usually expressed nonverbally – that is, with a gesture, or a contemptuous curl of the lip, or with an ugly voice quality. See Bolinger (1979), for additional examples on how language and nonverbal expressions such as intonation can exclude and include.

An individual's choice in the organizing of social systems is inherent in the terms *affiliate – withdraw*. Thus, one controls one's destiny, to some extent, by learning certain vocabulary items; by adopting certain expressions, such as 'in' talk; by acquiring similar gestures; by learning how to spell. Or one can withdraw from a particular group in society by refusing to do any of the above; or by using obscenities; or by wearing certain clothes; or by carrying certain artifacts; or by living at a certain address. One must not think of 'rejection' only in a negative sense. It can be liberating and productive in new avenues. It can be illuminating and it can free one to an independence in spirit and creativity. Likewise, one must not think of 'acceptance' as always being a positive good. It can be destructive, as when a young person is accepted into the drug-consuming group; or when a person in business or a politician is accepted into an illegal group of operators.

The forces of human interaction can be seen in human behavior in extralinguistic ways. For example, the appeal of a women's knitting society, or a quilting bee, is not knitting or quilting, or the subject of knitting, or even to talk, per se; the appeal is the opportunity to make contacts. This creates the bonding that holds individuals and groups together.

Note also the value of the postmortem which is held after a function for the 'in' group. It serves to re-evaluate the members and their relationships in terms of new information, and to establish the roles of new relationships that they have just acquired.

In business and management, the necessity of affiliation has long been recognized. A business consultant calls this bonding the 'art of huddling', and notes that it is one of the most productive and widely used tools that management has. He says:

> Huddling is a natural process focused directly on getting results. A huddle is a temporary, task-oriented encounter between two or more people trying to get something done.
>
> Huddles occur on demand in the hallway, before and after – even during – formal meetings and appointments, in the men's room, on the golf course. It is in these extemporaneous, obscure interactions that the big decisions are made. Most sensitive information is communicated in huddles. (Merrell 1979a)

In the business structure then, one can see that the forces that unite and separate operate in established ecological arrangements, such as the golf course and the restroom, in a *Context of Situation* that linguists have not often used in their linguistic analyses of speech acts.

The reason that I am discussing these dimensions in a chapter on theoretical modeling is that I believe we must close our eyes to old approaches, in order to 'see' new visions that could explain the 'why's' of people communicating – at times – and not communicating – at times. This is a positive approach – contrary to the theoretical thrust of the last couple of decades in linguistics (and in other disciplines?). We have gone through an era during which we were given ideas on new theoretical possibilities only through attack on others' theories. The study of human behavior/communication is at a point now where positive, creative thinking will be welcomed.

The final section in this book comprises articles from two scholars who come from very different backgrounds and training. What they do hold in common is that we could profit in the unity of science – learning from each other – in our search for the elements of human interaction. Charles Hockett wrote his article in 1948; it continues to challenge us with stimulating ideas. H. Pierre Noyes is a physicist, who treats the 'eternal triangle effect' by analogy to human behavior. Imagine two people in a room with a closed door . . . whose dialogue abruptly changes when they realize that a third person is outside the door.

We are going to find the answers we seek, for by definition, a 'problem' has a 'solution'. It remains only for us to stir our brains – by means of such thought-provoking writings as these.

NOTE

1. From *100 Selected Poems*, New York: Grove Press, 1959 [1923], p. 15.

PART II

Ecological and Artifactual Patterning

J. SONNENFELD

The Communication of Environmental Meaning: Hemispheres in Conflict

> What [primitive man] had to do was to live, and to live he had to come to terms with his environment . . . [He] had no conception of forces and laws; the only activities of nature that he knew were those mysterious phenomena round about him which did things to him, and it was with these that he felt the necessity of establishing friendly relations. The very phenomena of nature were deity to him – actual mountains, stones, springs, trees, animals, storms . . . . They were greater than he; they controlled his destiny; upon them he was dependent and their good-will was necessary to his well-being. He accordingly attempted to control them to his own advantage . . .
>
> (Meek 1960: 86).

We often attribute man's dominance over nature to his technology; yet we know that technology has never been sufficient to assure the control that man seeks. Some go beyond themselves and offer up prayer, or sacrifice, or engage in other ritual in an effort to gain the control that nature seems to deny them; and in this there is often enough relief of some kind to reinforce the effort.

The prayers offered imply a recognition of the existence of supernatural powers or forces who (which) listen to our supplications, and understand us. In this sense, and perhaps only in this sense, do we communicate verbally with nature, or with the God who controls nature. And though this communication has been referred to as a dialogue (Tournier 1975), the communication with our God(s) is more often perceived to be unilateral, unidirectional, from us to Him (them); it is only by sensitivity to nonverbal cues that we determine that we have been heard and responded to, or ignored.

By implication, our communication with nature depends on nonverbal information, and constitutes communication only in the sense that information is transferred from one system to another. The messages we receive are not always consistent with the information transmitted by or from environment, but this is a characteristic shared also by verbal communication.

1. COMMUNICATING THE NATURE OF ENVIRONMENT: NATURAL AND DESIGNED

Environmental meanings ought to be unambiguous, but they are rarely so for a variety of good reasons, mostly related to the fact that environment has different meanings for different users, and communicates different values accordingly. The values which nature communicates are not intentional; rather, we have created a variety of filters which provide us with information we perceive to be meaningful in environment, and we make use of such information as if in fact it *were* environment communicating with us.

The Gestalt psychologists made this kind of communication easier to understand by their concept of the psychological or behavioral environment, elements of which take on a 'demand character' consistent with ego needs or sensitivities (Koffka 1935; Lewin 1936). Valences, positive and negative, are attached to objects according to their effect on ego. Some environmental objects are attractive; others are repulsive. Forces associated with attractive objects demand some specific kind of action: e.g. 'a mountain wants to be climbed'; 'a handle wants to be turned'. Repulsive forces differentiate less, they demand avoidance or escape, or that action be taken against the repulsive object.

Some of the objects in our behavioral environment Koffka described as having 'physiognomic character'; these express or communicate emotions, and include objects or landscapes which seem to us to be gloomy or cheerful or sad, quite apart from our own moods. Koffka insisted that these qualities are not simply a function of empathy or projection, or of our 'mystical knowledge' of the objects; rather they are qualities which belong to the objects themselves. But it is clear that not all perceive these qualities equally; in Koffka's terms, one requires a receptive ego, 'such as those of primitives and children, for whom ego and environment are considered less separated and more unified' (p. 361).

Designed environments

If there is reason to question the content of the messages derived from the natural environment, those derived from the intentional environment are of a different nature, for while much of the geographic or natural environment exists apart from (or despite) man's presence, there are many environments, small and large scale, that *are* of his making, intentional environments which communicate as they do because they were created to so communicate (Hugill 1976). These include not only the completely artificial environments of buildings and communities, but also the protected environments of nature.

Designed environments are intended to communicate efficiency, status (differentness), complexity, simplicity, 'naturalness', etc. And yet even here there is implicit a compatible population of sensors able to transform the imagery, to process the information received, in ways which produce the intended results: a sense of status, efficiency, awe, or whatever else was intended. But that such intentions may not be so communicated is also clear; intended clients change their priorities; city populations get displaced; depression converts open space to waste; the affluent come to view spatial efficiency as excessively constraining or dysfunctional. Communication of meaning in any environment still depends more on the person (sensor) than on the message, if indeed any message is intended.

II. COMMUNICATING THE CONCERNS OF MAN: THE ENVIRONMENT AS SYMBOL

Environment communicates in yet another way for us. Results of early tests that I developed for identifying landscape preferences of different populations seemed to indicate an adaptation to home environments (Sonnenfeld 1967). Yet, as in all such surveys, there were individual and group differences. Males, for example, preferred the rougher landscapes, while females had stronger preferences for water scenes; and level of education seemed to correlate with preference for landscapes different from those of home environments. Later testing permitted some probing into the relationship between landscape preferences and environmental personality, in terms which had more explicit social meaning. As part of a study of teenage students in Texas schools which dealt with the environmental correlates of the decision to migrate (Sonnenfeld 1974), two tests were designed to probe the meaning of environmental preferences. Both tests were for the most part nonverbal; one involved choices between landscapes, and the other required construction of a community map.

In the landscape choice task, students were asked to choose from each of 50 pairs of slides those places they preferred for short-term vacation, and, by contrast, those they preferred for long-term residence. Indices were constructed to show strength of preference for conditions of topography, vegetation, and water; for open vs closed landscapes (a closure index); for accessibility; and for cultural features indicating the presence of man (a 'social' index). Differences between short- and long-term preferences provided the basis for a 'consistency index', while differences between preferred environments and local (home) landscapes yielded an 'exotic index'.

Landscape preferences were surprisingly consistent, though the axes of consistency varied. In some cases major differences were between males and females, regardless of community; in other cases, community or ethnic differences were the more critical. And while the decision to remain in or to leave the home community (the mover-stayer distinction) seemed to influence the landscape choices of all groups, in many cases male and female stayers differed more from each other in their landscape choices than they did from male and female movers; which suggests that if they decide to stay in their home communities, males and females do so for different reasons, and for reasons which may differ from community to community. In terms of the purpose of the study, movers and stayers seemed to transform migration intentions into consistent environmental or landscape preferences, though the reasons given (in written statements) for their decision to stay or to leave home seemed to express social or economic rather than environmental concerns.

Results of the community map test were similarly insightful. Students were asked to design an ideal community, which was to include the student's own home, home of parents, of siblings, and of close friends; also church, school, police, hospital, shopping, job location, recreation center, and park. Stayer and mover groups were, again, clearly differentiated. A combination of distant placement of parents, close placement of friends, and a tendency for parks to be placed nearer to home suggested, for movers, an environmental transformation of social attitudes in which closeness to nature seemed to represent social isolation or escape to a less demanding nonsocial environment. As with the landscape test results, these environmental transformations imply meanings of a kind that verbal probings of environmental preference rarely uncover.

Home place and the security of subsistence

Place meanings and resource meanings also have social associations. A strong sense-of-place, or of home place, generally communicates the significance of social relationships which extend beyond the immediate family, to include also the broader community of friends and relatives; it is the reason for not leaving home, or for returning for visits or for good, once having left. In home communities there is security, orientation, and a different quality in the experience of a present imbued with the past.

But such sensitivity to home place is hardly universal. For many, the sensitivity is negative, or lacking; home is where the family is, and it is family interest that determines community behaviors. And while the negative experience of other places may at times strengthen attachment to one's home community, geographical mobility – the movement of home as well as of person – more often communicates a minimal sense of community; the quality of the home environment in short-term or transient settings is more a measure of personal affluence than of community commitment or well-being.

Social behaviors also communicate environmental meanings of a different kind. Social cooperation, for example, including 'reciprocal altruism' (Sonnenfeld 1978a), may indicate (communicate) environmental instability. Voluntary social cooperation is often enforced by the insecurity or uncertainty of limited resources, or of natural (or social) hazards; there is a tendency for many social relationships to dissolve once security or stability is achieved, as through an improving technology. Perhaps most social cooperation is of such a nature. A concern with the viability or fragility of the relationships one maintains with the social or natural environment on which one depends denotes not only a limited geographical mobility, but implies more broadly also a sense of the lack of options to manipulate, or escape, the local environment.

What environment communicates, in all of these cases, is as much a function of social values as it is of the success or failure of one's environmental adaptations.

III. PSYCHOPHYSICAL AND CULTURAL SOURCES OF ENVIRONMENTAL MEANING: FIELD DEPENDENCE AND COGNITIVE SKILLS

Much of what we see in environment, and many of the skills that we develop for contending with environment, are the result of more or less distinctive cognitive styles. Some of us focus on particulars; others emphasize relationships and view environment holistically. Some think visually, others in terms of abstractions. Some emphasize the similarities from place to place, others look for differences. And though we may shift from one style to another depending on circumstance, the styles more often are mutually exclusive. Such is the case with the field dependence-independence distinction (Witkin et al. 1954, 1962). Environment communicates differently to the field dependent and independent in an obviously nonverbal sense; and the means by which one arrives at a field dependent or independent state – assumed a long-term conditioning process – may also be as much nonverbal as it is verbal in nature.

In its more basic sense, field dependence or independence refers to the influence of context on perceptual judgments. The more field dependent individuals are more influenced by context; the less field dependent – or more independent – are able to make judgments freer of context. For example, the field independent perform better on tests in which subjects are expected to identify the vertical position of a rod within a tilted frame (Rod-and-Frame Test); the field dependent are more likely to make errors in judging the vertical, given the influence of context (the tilted frame). For similar reasons, the field independent are more able to find figures hidden in a complex design (Embedded Figures Test) than are the field dependent for whom contextual controls make such identification difficult. By implication, the field independent would appear to have advantages in spatial tasks which demand analytical skill, sensitivity to critical orientational cues, and the ability to maintain one's bearing despite the distorting effects of environmental context. Curiously, this psychophysical trait seems to generalize to social personality: field independent types tend to be less submissive to authority, while the field dependent are more likely to change attitudes in the direction of authority; similarly, the field independent are more autonomous and less socially sensitive or socially oriented than field dependent types, who, by contrast, are the more sensitive to social relationships.

The sources of these differences are complex. While field dependence is considered a normative measure (i.e. tests are used primarily to distinguish between the more and less dependent members of a group), it has been extended to cross-cultural contexts, and here it appears to vary rather consistently with social structure and subsistence economy (Witkin and Berry 1975). Thus, subsistence patterns influence social organization to require greater or lesser control over resources. The greater the need for such control, as in traditional agricultural societies, the more structured the social system becomes, and the stronger the social hierarchy which develops: this appears, also, to be associated with the use of harsher discipline in the training of children (Barry et al. 1959). The effect is to produce a population of individuals who at all stages are relatively field dependent. If this produces, as a consequence, a population also with lesser spatial skills, such deficiency is relatively unimportant considering the sedentary nature of the economies – primarily agricultural – of the more field dependent of subsistence societies.

By contrast, among those populations for whom there is perceived need for independence in subsistence decision-making, for example among hunters and fishermen, a more egalitarian society develops, and a more permissive strategy is applied in the raising of children. The product, in this case, is a population of individuals more capable of operating independently, less amenable to authority, and generally with more developed spatial skills, as befits a mobile population required to function far from home under conditions that can be quite demanding of skill in way-finding: e.g. in polar (Eskimo), desert (Australian aborigine), and open-sea (Micronesian) environments.

Not only do tests of field dependence distinguish between cultures, they also distinguish between groups within cultures. Among the young, for example, field independence increases with age; this is in part a developmental (cognitive) function, and in part experiential, related to learning. Among the aged, there is an apparent 'reversion' to a more field dependent state, especially among males for reasons which are still unclear; deterioration of spatial skills also appears to occur with aging, but this appears to be more related to cerebral or motor dysfunctions than to field dependence, though the latter are not unrelated.

Sex differences also occur; typically, females test out as more field dependent and have less developed spatial skills than males. This is a pattern which appears to be almost universal, though the differences between male and female are less evident among the more field independent societies.

An additional population variable is handedness, especially left-handedness, the incidence of which is generally lower among the more field dependent societies and generally is least common among females (Dawson 1974). The effect of left-handedness on spatial skill is still unclear; some studies suggest advantages and others disadvantages (see Dawson 1974; Levy 1977).

Regardless of source, the field dependent or independent state ought to have some influence on what it is that environment communicates. For the field dependent, environment should communicate 'wholeness' and interdependence in an ecological sense; for the field independent, environment should appear less integrated, and less distorting or constraining. Whether such differences exist remains to be tested; but there is evidence for this kind of distinction in the social environment. In parts of India, for example, needed technological change may be rejected because of concern over the impact of the new technology on viability of significant social relationships (Beals 1962). By contrast, rapid changes in subsistence have occurred among the field independent Eskimo, including massive game depletions made possible by unconstrained hunters minimally sensitive to their impact on either community or environment. Yet opposite situations are also known: of hunters who resist change, for example, Bushmen and Australian aborigines; and of peasant societies (Europe, Asia, Africa, Latin America), which can experience rapid breakdown of authority as well as changes which at times are destructive to both community and environment. These exceptions do not necessarily invalidate the relationship suggested between field dependence and system sensitivity, but only suggest that the sources of cultural conservatism and change are complex. The submissiveness to authority by members of peasant societies makes them candidates for stability *or* change, depending on the decisions of community leaders; the independence of members of egalitarian societies makes whatever change occurs a less consistent one for the community-at-large: individuals feel free to change or not, as they individually decide.

Orientation style

The relationship between field dependence and way-finding has already been noted. A number of different styles of geographic orientation exist. One (the 'domicentric') focuses on local and familiar places and requires a sense of the wholeness of one's home space (territory). The more sedentary and field dependent populations are the more likely to employ this form of geographic orientation. In this system, landscape communicates all kinds of messages, sensitivity to which is a function of intimate experience with place. Individuals tend to be aware, during movement through this space, of where they are in respect to everything else relevant to position, in front, behind, and to the side; compass direction may be irrelevant in this system. Such sensitivity to the spatial relationships of known places is precisely what one would expect of field dependent travelers; but for the same reason – a dependence on known place relationships – they become easily disoriented when away from home. By contrast, the field independent may be equally comfortable (oriented) at home, but they learn rules of orientation which transcend space; the environment 'speaks' differently to them: their orientation is of a 'geocentric' style, which depends upon stimulus elements external to community, and includes stars, patterns of wind-formed waves and sand and snow, as well as compass bearings. It is not that the field independent are incapable of domicentric orientation; they simply have freed themselves from place constraints through an orientation system that applies beyond home space.

While there is no necessary conflict between being field dependent for certain activities (social) or in certain locations (home), and field independent for other activities (job) or locations (away from home), conflicts can occur in the cognitive styles dominant in any given situation. This represents the kind of conflict better explained in terms of cerebral functions.

IV. LATERALIZATION OF COGNITIVE SKILLS: HEMISPHERES IN CONFLICT

One of my problems as a practicing geographer is an embarrassing inclination to lose my bearings, to get lost. And while there may be a number of reasons for this, including being left-handed and having been brought up in a city of street signs, in which the patterns of streets are sufficiently consistent to generate in even a nonnative a general sense of position and direction, I am also aware that under certain circumstances, moving through settings that I know as well as my own home, I may still lose sight (almost literally) of where I am; very simply, the act of engaging in conversation with a fellow traveler is enough for such visual mindlessness to occur. And I am aware of a related condition affecting a good friend of mine. Our walks together often seem interminable, primarily because he regularly stops walking when he feels the need to comment about something on his mind; it is as if he will not or cannot engage in thoughtful conversation while walking, implying a form of interference akin to mine, though it also represents an adaptation which protects his orientation in space.

My friend is an older man, now over 70, who has lived almost all of his life in the mountain highlands of northwestern Mexico; I have lived most of my life in the urban canyons of cities, some large, some small; and though the manifestation of conflict in our spatial and verbal behaviors differs, I have no doubt that the cause of our affliction is similar, involving some form of blockage of cerebral functions.

The literature on cerebral specialization is of long standing. Much of the early work on lateralization dealt with the effects of brain lesions on behavior. Generally, visual and spatial skills were found to be affected when damage occurred to the right hemisphere, and verbal and computational skills were affected when the left (or 'dominant') hemisphere was involved; this, at least, is the pattern that appears among right-handers. Studies of normal subjects have tended to confirm these differences in hemispheric function (Bogen 1975). But while there appears not to be much question that hemispheric differences exist, the significance of these differences for normal individuals is unclear, since most of us do have access to both left and right hemispheres. And while there may be differences in the locus of cognitive controls, related to differences in handedness and sex, we still operate with integrated brains. Yet, there are indications of differences which transcend the universal variables of sex and handedness, that relate also to the effect that culture has on cognitive style and skills.

That all groups of mankind have essentially equivalent brains with equivalent capacities for learning is for the most part considered a reasonable, if not also necessary, proposition. But such equivalence has little to do with determining that all populations use their brains equivalently. To the extent that differences in use also produce differentials in cerebral development, one would expect that differences in early training would yield differences in cerebral conditioning of a kind capable of influencing the skills available for contending with environmental demands. Such a position assumes that there are many ways of doing things, not all of which are equivalent either in kind or in degree of skill demanded. Some craftsmen use eyes and touch alone for measuring scale and fit; others require precision tools. Some long-distance travelers navigate by memory, by 'feel', by sense of position; others require complex instrumentation. Each may produce equivalent results, but different 'senses' or cognitive styles have been used to achieve these.

Skills differ for a number of good reasons. Rather obviously, not everyone receives the same training; in the cases above, some train to be carpenters, others to be navigators. Developmental differences also exist; it requires time for cognitive skills to develop among the young, and aging also appears to have its effects on skill deterioration. But skills differ also because of the way we have learned our skills; we apply different techniques to accomplish similar tasks, and these may be differently demanding of cerebral involvement.

Normally, for right-handers, the alignment of hemispheric functions is as one would expect; left hemisphere dominance for verbal and sequential tasks is consistent with the use of the right hand for writing, and it is this hand which is critical for most other manipulations as well. All appears conveniently arranged, given a right handed world. What happens, however, with the left-handers and the ambidextrous who make up from 5–20% and more of some populations? What of those whose need for writing or reading is minimal or lacking completely; for whom, by contrast, the right hand functions primarily to perform spatial and mechanical tasks, of a kind normally considered a right hemisphere function? What of the typists and the musicians who are equally demanding of both hands? One might infer from these examples that the brain is not so specialized; that adjustments can be made to accommodate for the kinds of circuitry demanded by alternate cerebral functions. Considering the skills achieved by some groups, one might also conclude that certain variations from 'normal' are not only not at a disadvantage, but may be at some advantage. For example, data exist suggesting a larger than normal proportion of left-handers among journalists, computer programmers, and architects (Peterson and Lansky 1977). And while women, as a group, typically perform poorly on spatial tasks in almost all societies in which such skills have been tested, they also tend to exceed men in verbal skills, a difference which some have attributed to differences in experience and others to biology.

My own research in this area, so far at a preliminary level (Sonnenfeld 1978a), has focused on differences between left- and right-handers in certain spatial skills useful for way-finding or navigation. Results seem to suggest that *either* hemisphere may be activated during given tasks, but that performance differs according to hemisphere, occasionally with handedness relevant, and at other times apart from handedness. This is research that needs to be extended, to include cross-cultural testing, not only to verify the significance of handedness for spatial skills, but also to identify effects of variation in culture and environment on hemispheric involvement during spatial tasks.

The pattern of lateralization associated with left-handedness is complex. Since for right-handers the left hemisphere is the verbal and the right the spatiovisual hemisphere, one would expect for left-handers that the right hemisphere would assume dominance; but it is apparent that this is not always or even often the case. Hemispheric dominance is under genetic control at the same time that it relates to handedness; and while left-handedness may also be under genetic control, this is not necessarily coordinated with the genetic control for hemispheric specialization. The result may be that for left-handers, both hemispheres assume verbal function, while the spatial function somehow gets squeezed out or is less developed. But if this is the case, it may be so only because of the high value that Western culture places on verbal skills: any nonspecialized or flexible cerebral capacity, which apparently is more likely to be in the right than in the left hemisphere (Levy 1977), gets put to uses which are culturally selected for: if this is for verbal skills in Western societies, among subsistence populations which lack any need for writing or reading skills, left-handers retain the spatiovisual capability of the right hemisphere which may even be enhanced by increased use of the left hand. By the same token, it may be that for right-handers in nonliterate societies the left hemisphere takes on additional spatial and mechanical functions, in this case at the expense of the verbal.

The data, unfortunately, are less than consistent, but this is for good reason. For one, it is not clear why left-handers are left-handed; some suggest genetic controls, others suggest brain damage or other nongenetic reasons for left-handedness. And, as indicated previously, there is no consistent association between left-handedness and left or right cerebral 'dominance' (Hardyck and Petrinovich 1977). And while there is also no necessary association between verbal and spatial skills (some studies suggest that left-handers, and others that right-handers, are superior in both verbal and spatial tasks), a not uncommon inverse relationship between the two has been found (Smith 1964), suggesting either interference (blocking) or a preempting of cerebral capacity for the one or the other function, on a more or less permanent basis. This seems to apply especially to those who have developed bilateral rather than lateralized functions; and this may be more common than assumed, affecting not only left-handers, but also females, and those with highly developed verbal and/or spatial skills regardless of handedness.

The contribution of both hemispheres to communication, and the complex nature of communication itself, make it difficult to ascribe responsibility to one or the other hemisphere alone for communication; and indeed, both hemispheres may work effectively together. For example, Paivio (1978) has found that it is easier to remember pictures than words, implying a right hemisphere advantage for visual memory; but this advantage is reduced for sequential memory, which is consistent with the concept of left hemisphere control over sequential processing. Yet Paivio also found that 'naming enhances memory for pictorial items and image coding increases memory for words' (p. 116), suggesting an enhancement effect for hemispheric cooperation to which bilaterality also ought to contribute.

While interference can occur when tasks or activities differ, as was suggested in the introduction to this section, such interference is not universal. Some are able to listen to music and to work or study simultaneously, without the appreciation of the one appearing to diminish the effectiveness of the other; and some would insist that music even enhances performance in other tasks (makes it more bearable?). Yet, for others, or for certain kinds of work, performance is adversely affected, but whether because of competition for specific cerebral sites or circuitry, or for reason of other source of interference is uncertain.

Similar interference seems to occur in certain spatial behaviors. In a study of way-finding, for example, Sandstrom (1951) has determined that there is conflict between concentrating on direction markers (involving processing of a sequence of visual cues) and maintaining a sense of general orientation; and Smith (1964) has commented on a related conflict between the perception of visual patterns and the identification of details; the enhanced capacity to perceive structure, he indicates, is associated with 'loss in the richness of experience because of a diminished capacity for switching attention easily from one detail to another' (p. 291). These appear to represent differences in cognitive style; and while some individuals may be able to switch from one style to another according to what is appropriate for performance of a given task, this appears not to be universal.

My own test data indicate differential involvement of left and right hemispheres for both verbal and spatial tests, with related differences in performance level. How much of this difference is a function of hemispheric enhancement rather than conflict is uncertain, as are the reasons for differentials in hemispheric involvement. And how much is a function of genetics, or of culture, or of individual experience and learning is also unclear; and perhaps the question 'how much' is irrelevant. More critically, for whom does enhancement occur, and for whom does interference occur; and for which activities and under which circumstances? Some can do different things, involving simultaneous processing of different kinds of information; others can only do similar, related, things at the same time; yet others can do only one thing at a time. The variable effectiveness of nonverbal communication, when this depends on the addition of visual modifiers to verbal messages, may relate to the conflict (interference) rather than enhancement effect of information processing involving both hemispheres.

There is clearly need for more information concerning both the particulars and the patterns of enhancement and conflict which can be attributed to cerebral specialization. I have the uneasy feeling that the rigidification of our cerebral circuitry, and the concomitant increase in patterns of interference, is ontogenetic (developmental) in nature, the exceptions of enhancement notwithstanding. But that enhancement can occur also suggests that cognitive styles may be as much at issue as developmental changes in the capacity of the brain to process information.

V. SUMMARY AND CONCLUSIONS

Environment has many kinds of meanings. Some meanings we derive from information that nature provides, and are nonintentional. Some environmental meanings are intended, and derive from structures and organization that man has imposed on nature by design. The environmental 'messages' in both cases are nondemanding; they provide the basis for meaning, but they cannot require a response, certainly not a consistent response given the perceptual filtering and transformation of stimulus elements which cause our experiences of environment to vary. The ambiguity of nonverbal information, and the variable significance of such information for those who use and value environment differently, also contribute to the complexity of the environment-as-perceived.

Yet we are required to accomodate for this complexity, to contend with environment as it is presented to us. Our ability to deal with it competently is based on our experience with specific environments, but is conditioned also by differently developed cognitive skills. These vary not only because of differences in the need to develop such skills, but also because of differences in the way our brains process environmental information, a function of hemispheric specialization as influenced by genetics, cultural learning, and aging.

Environmental meaning obviously is complex, as is its communication to others, whether in verbal or nonverbal form. Communicating environmental meaning is important not only for the development of environmental skills (competence), but also for the management and planning of the environments we are required to share with each other. It would be nice to think that in time we could learn to process the critical data relating to environment and to environmental values and needs through a more effective cerebral circuitry, one more productive of enhancement effects and less liable to the interference and conflicts which make so many of our environmental problems seem so difficult to resolve.

PART III

Physiological and Social Aspects of Interaction

BETTY A. EDWARDS

The Effect of Verbal/Visual Interactions on Drawing Ability

Ability to draw a realistic image of a perceived form is a rare skill among American adults and indeed among adults from many cultures throughout the world. American children begin around age nine or ten to proclaim that they can't draw and that their lack of skill proves that they have no talent for drawing. These children become the adults who say they can't draw at all, not even a straight line.

A widespread assumption about drawing ability is reflected in the children's proclamations: that skill in drawing depends on genetic good fortune and the inheritance of talent. Since most teachers share this assumption, art classes have as a main objective the possible discovery or identification of talented students, who are expected to be very few in number. Because of the negative mind-set of most students – the conviction that they can never learn to draw well – and because of the difficulty of teaching the visual, perceptual skills of drawing, the assumption becomes a self-fulfilling prophecy. In any given drawing class, only one or two or three students will learn to draw skillfully. Those few are designated as the lucky ones, the gifted ones, and the majority of students move on to some other subject.

For other skills, reading, writing, and arithmetic, for example, we make another kind of assumption: all children with normal brains can learn these skills. The question of talent or genetic good fortune is not considered crucial. We simply expect that the majority of students will learn to read, to write, to deal with numbers, and that only a few will fail to learn the basic skills. The skills are deemed important by teachers, parents, and children because they are regarded as forming the very basis for thinking. Consequently, extensive teaching and testing strategies have been developed, and the bulk of the educational system in America is devoted to training verbal and numerical skills. In the educational hierarchy, nonverbal and noncomputational skills such as drawing are almost always ranked as lower-priority.

Recent research, however, offers possibilities for revising widespread assumptions about the role of talent in nonverbal skills and may help to change educators' views about the teachability and value of nonverbal skills. On the basis of the recent research, and confining the following ideas to my own field of drawing and perceptual skills, I propose some new assumptions:

1. That all individuals with normal brains have the capacity to learn to draw a realistic image of a perceived form.
2. That the nonverbal skill of realistic drawing can be taught by teachers and learned by students through use of specifically designed teaching strategies.
3. That the learning of drawing skills is important because such learning increases perceptual skills: in learning to *see* better, the students learn to gain access to the nonverbal mode of thinking and communication.
4. That long and exclusive emphasis on the verbal mode in education may have the effect of diminishing an individual's ability to make cognitive shifts in information-processing mode as required for specific tasks.
5. That the nonverbal mode is important and must be trained because it forms the very basis for a kind of thinking which is qualitatively equal to verbally-based thinking, but which differs in content and method of information-processing.

I will briefly review some of the relevant research, describe an experiment designed to test a strategy for enabling individuals to make a cognitive shift to the nonverbal mode in order to draw a perceived image, and suggest some implications of the experiment.

LATERALIZATION OF HUMAN BRAIN-HEMISPHERE FUNCTION

Many artists have spoken of seeing things 'differently' while drawing a perceived form. This way of seeing is difficult to describe in words but seems to involve a fading away of awareness of time, a profound attentiveness to the thing seen and observed, a sharp alertness to visual configuration and detail, and a sense of grasping relationships hitherto unnoticed.

The mental state or mode described by artists appears to conform with the findings of brain research during the 1960s which defined two major modes of human brain-hemisphere function (Sperry 1968). A brief review of that research follows.

In the brains of animals, the cerebral hemispheres are essentially alike, or symmetrical, in function. Human cerebral hemispheres, however, develop asymmetrically in terms of function. The most noticible outward effect of the asymmetry of the human brain is handedness.

For the past 100 years or so, scientists have known that the function of language and language-related capabilities is mainly located in the left hemispheres of the majority of individuals – approximately 98% of right-handers and about two-thirds of left-handers. Knowledge that the left half of the brain is specialized for language functions was largely derived from observations of the effects of brain injuries. It was apparent, for example, that an injury to the left side of the brain was more likely to cause a loss of speech capability than an injury of equal severity to the right side.

Because speech and language are so closely linked to thinking, reasoning, and the higher mental functions that set human beings apart from the other creatures of the world, nineteenth century scientists named the left hemisphere the dominant or *major* hemisphere; the right brain, the subordinate or *minor* hemisphere. The general view, which prevailed until fairly recently, was that the right half of the brain was less advanced, less evolved than the left half – a mute twin with lower-level capabilities, directed and carried along by the verbal left hemisphere.

A long-time focus of neuroscientific study has been the functions, unknown until fairly recently, of the thick bundle of millions of nerve fibers that cross-connect the two cerebral hemispheres. This connecting cable, the *corpus callosum*, occupies a strategic location as a connector of the brain halves and gives every appearance of being an important structure. Yet enigmatically, available evidence indicated that the corpus callosum could be completely severed without observable significant effect.

Through a series of animal studies during the 1950s, conducted mainly at the California Institute of Technology by Roger W. Sperry and his students, Ronald Myers, Colwyn Trevarthen, and others, it was established that a main function of the corpus callosum was to provide communication between the two hemispheres and to allow transmission of memory and learning. Furthermore, it was determined that if the connecting cable was severed the two brain halves continued to function independently, thus explaining in part the apparent lack of effect on behavior and functioning.

Then during the 1960s, extension of similar studies to human neurosurgical patients provided further information on the function of the corpus callosum and caused scientists to postulate a revised view of the relative capabilities of the halves of the human brain: that both hemispheres are involved in higher cognitive functioning, with each half of the brain specialized in complementary fashion for different *modes* of thinking, both highly complex.

Because this changed perception of the brain has important implications for education in general and for learning to draw in particular, I will briefly describe some of the research often referred to as the 'split-brain' studies. The research was mainly carried out at Cal Tech by Sperry and his students Michael Gazzaniga, Jerre Levy, Colwyn Trevarthen, Robert Nebes, and others.

The investigation centered on a small group of individuals who came to be known as the *commissurotomy*, or 'split-brain' patients. They are persons who had been greatly disabled by epileptic seizures that involved both hemispheres. As a last resort measure, after all other remedies had failed, the incapacitating spread of seizures between the two hemispheres was controlled by means of an operation, performed by Phillip Vogel and Joseph Bogen, that severed the corpus callosum and the related commissures, or cross-connections, thus isolating one hemisphere from the other. The operation yielded the hoped-for result: the patients' seizures were controlled and they regained health. In spite of the radical nature of the surgury, the patients' outward appearance, manner, and coordination were little affected; and to casual observation their ordinary daily behavior seemed little changed.

The Cal Tech group subsequently worked with the patients in a series of ingenious and subtle tests that revealed the separated functions of the two hemispheres (Sperry 1968). The tests provided surprising new evidence that each hemisphere, in a sense, perceives its own reality – or perhaps better stated, perceives reality in its own way. The verbal half of the brain – the left half – dominates most of the time in individuals with intact brains as well as in the split-brain patients. Using ingenious procedures, however, the Cal Tech group tested the patients' separated right hemispheres and found evidence that the right, nonverbal half of the brain also experiences, responds with feeling, and processes information on its own, using its own mode of information processing. In intact brains, communication through the corpus callosum melds and reconciles the two perceptions, thus preserving our sense of being one person, a unified being.

In addition to studying the right/left separation of inner mental experience, Sperry and his group examined the different ways in which the two hemispheres process information. Evidence accumulated showing that the mode of the left brain is verbal and analytic, while that of the right is nonverbal and global.

New evidence found by Jerre Levy in her doctoral studies (Levy-Agrestí and Sperry 1968) showed that the mode of processing used by the right brain is rapid, complex, whole-pattern, spatial, and perceptual – processing that is not only different from but comparable in complexity to the left brain's verbal, analytic mode. Additionally, Levy found indications that the two modes of processing tend to interfere with each other, preventing maximum performance; and she suggested that this may be a rationale for the evolutionary development of asymmetry in the human brain – as a means of keeping the two different modes of processing in two different hemispheres.

Based on the evidence of the split brain studies, the view gradually emerged that *both* hemispheres use high-level cognitive modes which, though different, involve thinking, reasoning, and complex mental functioning. Over the past decade, since the first statement in 1968 by Levy and Sperry (Levy-Agrestí and Sperry 1968), scientists have found extensive supporting evidence for this view, not only in brain-injured patients, but also in individuals with normal, intact brains.

A good deal of recent research during the 1970s has centered on determining the location and division of the two major information-processing modes within the hemispheres. Since understanding the mode-characteristics is of greater value to educators than knowing the exact physical location of the modes in the brain – location being of great importance to neuroscientists and neurosurgeons – I have used the terms 'L-mode' and 'R-mode' in order to avoid the location controversy and still clearly designate the two modes (Edwards 1979: 37–43). L-mode is a syntactical mode, and in this mode the brain verbalizes, abstracts, analyzes, counts, marks time, plans step-by-step procedures, constructs propositions based on logical, linear thought. R-mode is a global mode, and in this mode the brain processes simultaneously great amounts of incoming data, mainly visual in nature whether by means of imaging and visualization or direct perception of visual information. In R-mode, the brain seeks patterns even though part of the data may be missing, recognizes configurations in a global, synthetic manner, extremely rapidly, and without using step-by-step analysis to arrive at an answer. The mode produces what seems to be an intuitive response – the 'ah-ha!' response. R-mode includes spatial perception, part-to-whole and figure-to-ground perceptions. R-mode does not include counting up, doing first things first, or marking time. Nor does it include naming or symbolizing – those are L-mode functions. In R-mode one sees the thing-as-it-is, the concrete thing, the thing unconnected to a name or a word. In short, in R-mode, one sees as an artist sees.

PERCEPTUAL SKILLS IN DRAWING AND COGNITIVE SHIFT THEORY

Realistic drawing of perceived forms seems to require a cognitive shift from the more usual verbal/analytic mode of information-processing (L-mode) to a less-familiar, less-used spatial/perceptual mode (R-mode). The verbal/analytic mode mainly uses symbols (words, numbers, signs, etc.) as the means of processing incoming information. Drawing in L-mode produces symbolic drawing, using the system of symbols developed during childhood as a language-linked (Paivio 1971) method of communication. In this system, an eye, for example, is a circle enclosed in two curved lines. The sun is a circle with radiating lines. A tree is the familiar lollipop shape. In figure drawing, a sequential system that is quite rigidly structured proceeds from top to bottom in a step-by-step fashion: first a circle for the head, then details of features and hair, then the neck, body, arms, hands, legs, and feet. Each separate observation of the perceived form calls forth the *name* of the part and its corresponding (childhood) symbol (Edwards 1976). Examples of typical symbolic drawings of children are shown in Figure 1 (Gellert 1975).

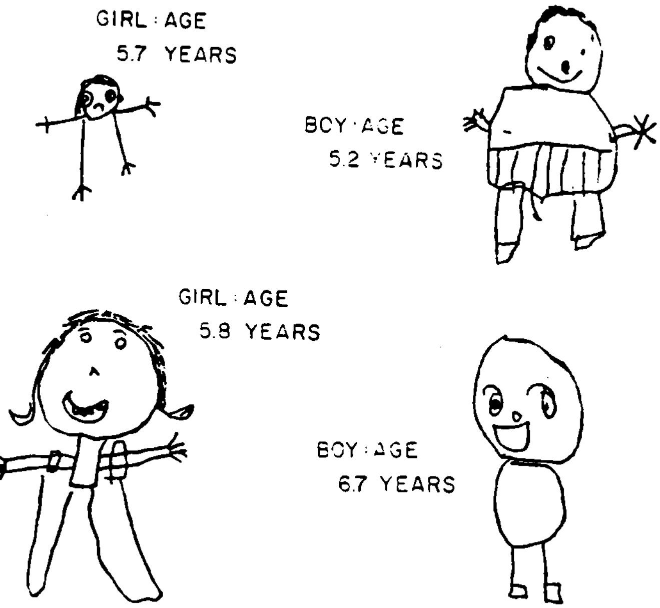

Figure 1. *Typical drawings by young children.* (Reprinted with permission of author and publisher from: Gellert, E. [1975], 'Children's constructions of their self-images', *Perceptual and Motor Skills* 40: 307–324, Figure 1)

Most adults who are untrained in realistic drawing, when confronted with a task of drawing a perceived human figure, are unaware that their usual cognitive mode (L-mode) is inappropriate for the task of drawing, which requires the R-mode of global, relational, spatial/perceptual processing. Their drawings, therefore, consist of the memorized symbols of childhood, and most adults reject these drawings as being awkward, hopelessly naive, and embarrassing. Learning how to draw is discouragingly difficult because the old, embedded strategy of translating visual perceptions into symbolic signs is difficult to set aside (Wittrock 1974). Most individuals soon give up trying, convinced that lack of innate artistic talent is the problem.

Recent work in this area (Edwards 1976, 1979) indicates that lack of talent is not the problem and that most adults – and children over the age of about six or seven – can draw well. Individuals can learn the basic skills of drawing easily if they are taught how to make the cognitive shift used by artists to the appropriate spatial/perceptual mode of processing incoming visual information in order to draw. Teaching strategies which enable individuals to achieve the desired cognitive shift are strategies which minimize or make difficult verbal analysis, naming of parts, or linkage of perceptions with verbal categories and memorized symbols. The following section describes one such strategy.

AN EXPERIMENT IN PERCEPTUAL SKILLS: UPSIDE-DOWN DRAWING

Eighty-four college-age students, none of them art students, were randomly assigned to four treatment groups. About three weeks before the experimental treatments, the students were asked to draw a person to the best of their ability – a procedure similar to the 'Draw-A-Person' test (Goodenough 1926). This procedure was used in order to elicit from each student the pre-existing symbol system developed during childhood for the human figure (see Figure 2).

The experiment elicited two additional drawings from each participant: a copy of Picasso's 1920 pencil-line full-length portrait of the composer Igor Stravinsky (Figure 3); and a copy of a 1920s photograph of the Irish writer James Joyce (Figure 4).

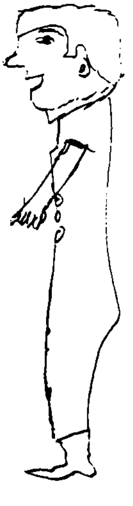

Figure 2. *A typical example of the 'Draw-A-Person' drawings by a college-age student*

Figure 3. *Picasso's drawing of the composer Igor Stravinsky*

The participants first viewed and drew the Picasso drawing. Half of the students viewed and drew the Picasso in the normal, upright orientation; the other half viewed and drew the Picasso upside-down – that is, the students were presented with the Picasso drawing turned upside-down, and were instructed to copy the drawing, also upside-down.

The prediction was that the drawings done upside-down would be judged to be more realistic, that is, more closely resembling the original. Furthermore, the symbols appearing in the Draw-A-Person drawing would appear less frequently in the upside-down drawings.

For the second drawing, the James Joyce photo, all of the students saw the photo right-side up, but the instructions differed. One set of instructions stressed naming and categorizing: 'This is a man wearing a hat. He has a little moustache, and he is wearing eyeglasses, etc.'. The other set of verbal instructions stressed visual relationships, part-to-whole relationships, angles, shapes,

Figure 4. *A 1920s photo of the writer James Joyce. (Reprinted with permission of The Beinecke Rare Book and Manuscript Library, Yale University).*

spaces: 'Notice the angle of this form compared to the edge of the photo. Notice the shape of this space. How wide is this form compared to its length, etc.'.

The hypothesis predicted that the relational, spatial instructions would elicit more realistic drawings with fewer instances of use of symbolic childhood forms.

The drawings were scored by five art teachers on a one to five scale, with five indicating greater resemblance to the original. The interrater reliability for the judges' ratings of the drawings from the two treatments were 0.80 with an s.d. of 0.04 (image orientation) and 0.80 with an s.d. of 0.03 (verbal instructions). Means of the ratings are shown in Table 1.

The results of the data analysis indicated the following.

1. Upside-down orientation of a perceived image significantly increased ($p < 0.01$) accuracy of perception and ability to draw realistically as represented by the drawings.

2. Drawing instruction which stressed relational processing and encouraged attentiveness to spatial, relational information significantly increased ($p < 0.01$) accuracy of perception and ability to draw realistically as evidenced by the drawings. Preexisting symbolic forms appearing in the Draw-A-Person

Table 1. *Means of judges' ratings of the students' drawings (scores for drawings of Picasso's 'Stravinsky')*

Image orientation treatment			
		I	II
Image orientation	Inverted	M = 3.06 S.D. = 1.30	M = 3.93 S.D. = 0.97
		III	IV
	Upright	M = 1.80 S.D. = 0.84	M = 2.68 S.D. = 1.29
Verbal instructions treatment			
		Symbolic/Analytic	Relational/spatial
		I	II
Image orientation combined with verbal instructions treatment	Inverted	M = 2.29 S.D. = 1.16	M = 4.05 S.D. = 1.24
		III	IV
	Upright	M = 1.92 S.D. = 0.98	M = 3.49 S.D. = 1.15

N. B. Participants in each of the four treatment groups were first given the image orientation treatment, using Picasso's 'Stravinsky'. Participants in each group then were given the verbal instructions treatment, using the photo of James Joyce.

Judges' scores were on a 1 to 5 scale, with 1 the lowest and 5 the highest possible score.

drawings appeared less frequently in the differential instruction drawings than in the inverted image drawings, but appeared more frequently both in the verbal-naming instruction drawings and in the right-side up drawings than in drawings from the other treatments.

DISCUSSION

There is an old saying among art educators: 'If you can teach a person to *see*, that person will then be able to draw'. The results of the experiment described above imply that that different way of seeing occurs when the student is presented with visual information in upside-down orientation, or when attention is directed toward visual information not generally noticed, such as the shapes of spaces.

Image orientation has been studied extensively by Irwin Rock (1971). Rock found that mirror-image or side-by-side reversals had little effect on recognition of forms. In a series of experiments on the effect of upside-down and right-side up images, however, Rock and his colleagues found the recognition fell off rapidly when figures, letters, writing, and faces were viewed in inverted orientation. Rock ascribes this to the fact that orientation affects the way the brain processes information about form. Viewing an inverted form triggers an attempt to 'correct' the perception, to mentally turn it upright. If the form is simple, for example a single letter, the correction may be successful and naming is possible, though the form will still look strange. In a more complex form, however, such as a word or a face or a figure, the corrective mechanism may become overtaxed (p. 78).

Jerre Levy (1974) suggests that the cognitive process of object recognition and naming may involve two possibly independent factors: on the one hand, *hemisphere dominance*, defined as the tendency for the major (left) hemisphere to control responding; and on the other hand, *hemisphere capacity*, the ability of each hemisphere to perform certain tasks when the contingencies of the experiment force one or the other hemisphere to attempt the task. Levy states, 'It is as if the left hemisphere simply does not bother to handle information which can be handled by the right' (p. 159). In the upside-down drawing experiment, therefore, that contingency may force a cognitive shift to the subdominant right-hemisphere mode. Since this mode is the appropriate mode for drawing a perceived form, the students apparently could then *see* as a trained artist sees and could therefore draw with a higher level of skill than students working in the usual mode (examples are shown in Figures 5, 6, 7, and 8).

Additionally, a simple change in the emphasis on *what to look at* in the verbal instruction treatment produced a significant difference in how well the

Figure 5

Figure 6

Figure 5 and 6. *A copy of the Stravinsky drawing in normal, upright orientation*

drawings came out. Referring again to Levy's (1974) work, the difference in the drawings implies that dominant L-mode rejected the task when attention was directed toward angles, comparative lengths, shapes of spaces. One could speculate that the left hemisphere may find this visual information 'boring' to the extent that the task of dealing with the information is passed to the subdominant R-mode. Conversely, instruction which names and categorizes *fits* the mode of the left brain, so that it stays with the task and responds with its language-linked childhood symbol system for 'man with a moustache wearing a hat, etc.' (examples are shown in Figures 9 and 10).

To speculate further, training students in the basic perceptual skills required for skillful drawing might proceed more rapidly and with a greater percentage of success if teaching methods stressed learning to gain access to the subdominant R-mode. Talent in drawing then might be redefined as an ability to enter the right-hemisphere mode at will and to use its special capabilities for spatiovisual information processing. It surely seems possible

Figure 7. *A copy of the Stravinsky drawing in upside-down orientation*

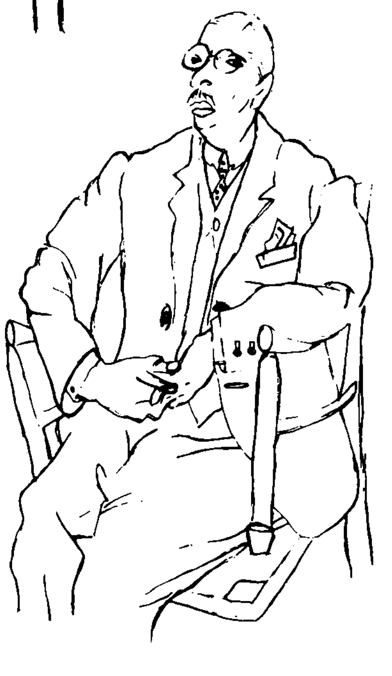

Figure 8. *A copy of the Stravinsky drawing in upside-down orientation*

Figure 9. *Drawing of James Joyce: Naming, symbolizing instruction*

Figure 10. *Drawing of James Joyce: Spatial, relational instruction*

that those abilities are present in the brains of the large majority of individuals, latent and viable, ready to emerge when the contingent conditions, as in the experiment described above, facilitate a shift away from the dominant left-hemisphere mode. (See examples of students' drawings before and after instruction: Figures 11 to 16.)

Figure 11. *'Before drawing' by a 19-year-old student, Ken Darnell. A student modeled for the drawing*

Figure 12. *'After drawing' by Ken Darnell (drawn at the end of two semesters). A self-portrait done by using two mirrors*

IMPLICATIONS OF THE EXPERIMENT

The main inference drawn from the results is that instructional conditions and strategies can facilitate a cognitive shift by students to the less usual R-mode of visual information processing which results in increased ability to accurately see and realistically draw a perceived image. The results of the

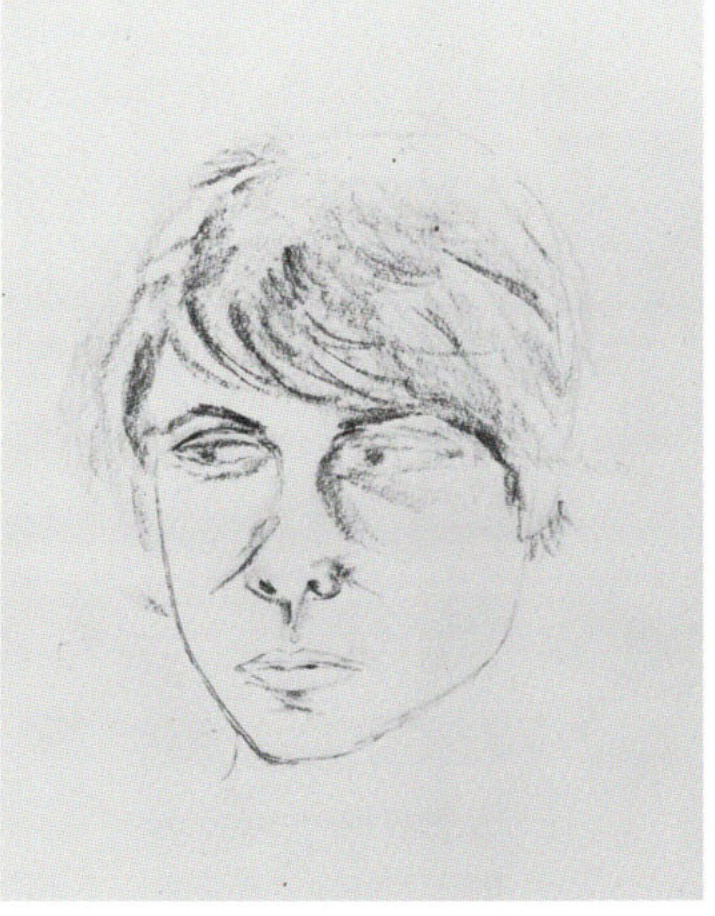

Figure 13. *'Before drawing' by Alice Abel of a student model*

study may also imply that training in art might be used as a means of teaching students to improve access to the less usual R-mode by providing practice in making cognitive shifts in order to bring the appropriate brain-mode to bear on given tasks. The study suggests that cognitive shifts in brain-mode can be influenced by the method of presentation of tasks. Clearly, a great deal of work will be required to extend the directions suggested by the study, and a

Figure 14. *'After drawing'. A self-portrait by Alice Abel after a nine-week course of lessons, one lesson a week*

number of questions are raised. For example, how can we define appropriate brain-modes or combinations of modes for large numbers of learning tasks? How can we teach students to make cognitive shifts at conscious (or sub-conscious) level? Are there examples of other skills (perhaps dance, music, reading, etc.) where capabilities are blocked because of interference or interaction between the verbal and visual modes? Might learning be facilitated by increased participation of the visual R-mode?

Figure 15. *'Before drawing' by student John Boomer of a student model*

The results ot the experimental study are heartening for the many individuals who have suffered from the ringing pronouncement that they have no artistic talent. And indeed, evidence is accumulating that all individuals with normal learning capacity can learn to draw just as they have learned to read and write. The before and after drawings, Figures 10 to 15, indicate that the basic perceptual skills are available to everyone, given instructional techniques designed to facilitate R-mode functions.

That is not to say, of course, that every individual will become an artist. A great artist must surely have special abilities, must be able to use both brain modes at a high level. Perhaps in the future, R-mode skills such as drawing will be taught routinely just as we now teach reading and writing without necessarily expecting that all students will become writers or poets. In the

Figure 16. *'After drawing' by John Boomer after a nine-week course of lessons, one lesson a week*

future, we may teach perceptual skills to enable students to *see* better, in all the senses of that verb: to see the whole picture, to understand, to grasp relationships, to see what things add up to, to perceive meaning, to intuit consequences, to communicate nonverbally. We are presently teaching verbal/analytic skills to facilitate language-based thinking. New research and new teaching methods encourage equal emphasis on teaching visual/global skills to facilitate relational, intuitive thinking.

In a prophetic essay, written in 1961, Aldous Huxley said,

The most basic of our faculties, to use an old term, is that of perception. Our thought, our feelings, our will – all are based upon perception, and perception may be either good and discriminating or else poor and inadequate. We don't do very much to train perception. We do a lot, I think, in the sphere of music, to train the auditory senses, but we do very little in regard to the other senses. There is a great deal to be said for systematic training of perception and other kinds of awareness, which I would call the nonverbal humanities. We give training in the verbal humanities, and we think this will somehow offset specialization in the scientific field, but what we are actually doing is merely trying to offset one specialization in terms of symbols with another specialization in terms of symbols. I am all for courses in humanities, but I don't think they are enough. I think we require now to add courses in the nonverbal humanities, beginning with the training of perception. (Huxley 1961: 69)

Altogether aside from the inherent value and pleasure of art, instruction in drawing may one day help to fulfill Huxley's plea for training the whole brain.

MAYNARD KIRK DAVIS

Abstract: A Study of the Blushing Response Using Self-Reported Data from College Students[1]

The study is concerned with normal blushing at embarrassment. The previous neglect of this response by psychology is considerable; recent research contributions on social embarrassment and on facial expression fall far short of any adequate treatment of the phenomenon.

A brief review of the sparse literature on blushing indicates that the work of Burgess (1839) and of Feldman (1941) concerned abnormal blushing as much as or more than normal blushing; that articles by MacCurdy (1930) and Goodhart (1960) consisted primarily of impractical speculation about the evolution of blushing; and that Darwin's discussion (1872) of the topic was derived from unsystematic observation. The only basically empirical research psychology has mustered on blushing is by Partridge (1897). However, though the overall strategy embodied in Partridge's study is sound, his research was inadequately designed and poorly analyzed.

Despite the failings of the existent literature, viable research questions can be gleaned from it in five areas: (1) situations eliciting blushing; (2) personality variables affecting blushing; (3) a sex difference in the propensity to blush; (4) age differences in blushing; and (5) inheritability of the response. The research reported in the present study addressed these five topics. It proceeded with a combination of the narrative self-report methodology originated by Partridge (1897), a questionnaire on blushing and related issues, and a personality assessment instrument (the Epstein Personality Inventory).

Initial findings, based on 50 male and 50 female college-age subjects, included the occurrence of bodily reference in a majority of the blushing incidents reported by subjects; the instance in over a third of the situations of the subjects' notification by others of their blushing; the infrequency with which adequate face-saving responses were made in the blushing incidents; and the overwhelming acknowledgment by subjects of at least some tendency toward blushing.

Intermediate data organization was accomplished in three ways. First, the content analysis of the subjects' reports yielded variables indicating simply the presence or absence in each report of selected prominent blushing incident features. Second, a factor analysis of ten 'embarrassability' items on the

questionnaire on blushing pointed to a triadic organization of the embarrassability trait interpretable in terms of general reticence, shame, and modesty. Third, the high reliability of the 15-dimension Epstein Personality Inventory allowed the Inventory's consolidation as a unitary measure of general psychological health.

The final analyses were correlational in nature. However, the explication of the findings based on data from the subjects' narratives ultimately required reference back to the subjects' records themselves. The results included the following: individuals who blush from embarrassment about sexual reputation are liable to be told that they are blushing; ridicule or teasing provoking blushing often extends to notification to the blusher of his response; such ridicule concerns the body-self of the ridiculed significantly often; and finally, a group setting is powerfully intimidating for blushers, inhibiting face-saving responses.

Among the findings from the questionnaire data were four significant results. Positive correlations existed between the self-reported blushing rate measure and the incidence of blushing in the subject's family, the degree to which embarrassing childhood memories are present for the subject, and the sense of shame embarrassability factor. In addition, females reported a higher tendency toward blushing than males. However, in a multivariate prediction task the sense of shame was found to be a nonsignificant predictor of blushing. This result was discussed, and it was argued that the three remaining variables are more basic than the present-day psychological makeup of the subject.

The study concluded with a caveat to the effect that all of the relationships found may be confined to the particular age group of the subjects, that of late adolescence and young adulthood.

NOTE

1. This abstract is taken from the unpublished thesis of the same title, submitted to the University of Massachusetts, for the M.S. degree in psychology, 1977.

HOWARD S. FRIEDMAN

The Modification of Word Meaning by Nonverbal Cues[1]

Scenario: Teacher is talking to student. The teacher is smiling – the teacher's overall facial expression is judged 'happy' by a group of observers. The teacher says, 'You received the lowest grade in the class'.

Scenario: Doctor is talking to patient. Doctor is tense and his face is sad. Doctor speaks in a nervous voice: 'Everything is fine. All your tests are normal'.

This teacher is conveying a good deal of information to the student and we see the communication as a meaningful one. However, various aspects of meaning change if the teacher says the same sentence with an angry face, or a sad one, and so on. Similarly, the doctor, knowingly or unknowingly, is sending a complex message to the patient. The patient may or may not believe 'Everything is fine'.

In 1952, Solomon Asch wrote that 'expression assists speech by completing meaning' (p. 185). In his experiments on impression formation (Asch 1946), Asch had shown that the final impression formed on the basis of a list of traits was not a simple combination of each piece. Certain traits were 'central'; the overall unity was critical. Thus, it is not surprising that Asch would be sensitive to the context of verbal communication. Although the specific models used to explain and explore impression formation have changed over the years, the concern with accounting for a unique overall impression on the basis of the distinct, individual components remains. But, although Asch's demonstrations are pointed to in theoretical discussions, they are often forgotten in empirical research. In the area of communication, where the nonverbal context of words is obviously of great importance, research remains fragmented. For example, regarding the heavily researched area of facial expression, a recent reviewer was forced to conclude that 'the relationship of facial expression to other components of body language and to language itself is sparsely examined' (Key 1975). It will be argued that much research in the area called 'nonverbal communication' can profit from a change in perspective, specifically that we should remember to look at the *whole* after studying the parts. More specifically, this paper will explore some of the ways facial expressions of emotion and other nonverbal cues may influence the meaning of words.

The idea that meaning depends on context is not new and, in fact, is now a truism in psychology. The early Gestalt psychologists did the most to emphasize the importance of context, proposing principles of perception such as 'proximity' – which says that things located close together tend to be grouped together. For example, these six lines are seen as three pairs of lines: // // //. The simple but important point is that perception is *active*: meaning is constructed and is a function of cognitive structure and past experience as well as the information at hand. However, in practical terms we cannot analyze all of the information, experiences, and expectations held by the interactants in a given instance of communication. Fortunately we do not usually have to do so. Shared experiences (and sometimes innate bases) permit researchers to act *as if* certain cues have objective or independent meanings and then examine their combination effects.

This point is well illustrated by the case of facial expressions of emotion. The extreme view, first stressed by Sherman (1927), proposes that knowledge of context is essential in identifying facial expressions of emotion. For example, Munn (1940) showed pictures of facial expressions of emotion taken from *Life* magazine to psychology students. The judges viewed the faces alone, and then in context (i.e. the whole picture). Although some emotions such as happiness and surprise were judged with high agreement in both conditions, other judgments such as of 'determination' were heavily influenced by context. Similarly, a study by Frijda (1958) varied the descriptions of the situations in which certain facial expressions supposedly occurred. Rather ambiguous facial expressions were used. Not surprisingly, situational cues influenced the interpretations of the facial expression, although even here some evidence of invariant perceptions of facial affect appeared across situational descriptions. It is now very clear that, overall, distinct meaningful facial expressions of emotion can be identified (Ekman et al. 1972; Ekman and Friesen 1975). Certain facial expressions such as happiness, anger, surprise, and sadness will be identified as such by a high percentage of observers even without contextual cues (or, to put it more accurately, with 'standard' or 'common' contextual expectations). Thus we can use such expressions as a stimulus unit in studies of verbal-nonverbal cue combination. However, it will be seen that the natural correlation between expression and context necessitates the use of complementary experimental and observational research strategies.

PAST RESEARCH: EXPERIMENTAL CONTROL VERSUS EXTERNAL VALIDITY

A limited number of previous studies have looked at the mutual influence or interactive effects of verbal and nonverbal cues. Two basic approaches or methods have been employed. The first, which might be termed the *experimental* approach, tends to view verbal and nonverbal cues as distinct elements which may be combined in special ways; this approach tends to employ methods in which selected cues are combined and the resulting meaning then judged. The second approach to verbal-nonverbal interactions is much more concerned with the external validity or representativeness of the pairings. This latter perspective tends to employ *observational* methods to examine which kinds of nonverbal cues accompany which verbal messages. Of course the former approach is often more precise and conducive to the drawing of causal inference while the latter approach may be more 'externally' valid (cf. Campbell and Stanley 1963). However, in the case of nonverbal communication, the issue is more complex than the usual internal versus external validity tradeoff. In studying nonverbal communication as the context for words, we are faced with a special problem concerning the *unit of analysis.* Although verbal communication is exceedingly complex, it is relatively easy to select a clear unit of analysis such as a phoneme, syllable, word, phrase, sentence, or paragraph. For a variety of reasons, no comparably 'available' units exist in the study of nonverbal communication. Attempts have been made to codify nonverbal cues (see Knapp 1978, for an overview of various notation systems such as that of Birdwhistell) but none have approached the success of written language in capturing the spoken word. Although it is sometimes suggested (and is probably true) that the difficulty is due to the incorrect notion that nonverbal cues are conceptually distinct from verbal ones, this assertion is rarely if ever accompanied by a suggestion of how to proceed with research in any other fashion.

In this section of the paper, the two approaches to verbal-nonverbal interactions are illustrated through the description of relevant theoretical frameworks, and typical methodologies are illustrated through a review of selected studies. Each method has certain advantages and drawbacks worth noting. In the following section, a current program of research will be sketched which attempts to combine the strengths of each approach.

The experimental perspective

The experimental approach tends to view nonverbal communication as conceptually distinct from words and hence can systematically examine various verbal-nonverbal cue combinations. The emphasis tends to be on evaluative meaning.

Dramatics. It is significant that one of the most illuminating recent discussions of the role of nonverbal cues in verbal communication comes not from a psychologist, but rather from a man of the theater. Jonathan Miller (1972), assuming that 'nonverbal behaviour achieves most of its communicative significance in the context of syntactically organized utterances' (p. 359), points out that acting consists of the use of nonverbal cues to create full meaning out of the 'bare grammatical meaning' of the scripts. Although in usual social interaction communication is communication and nonverbal cues fade into the flow, the world of the theater lets us peek behind the curtain of everyday life to glimpse the structure of meaning.

Miller notes that the lines of *Hamlet* may be performed in 100 different ways; it is up to the actor to somehow smile, pause, or nod at the appropriate instant. It is up to the actor to *perform* his lines (using rules he often cannot pinpoint) in such a way as to create an identity for the character being portrayed. The words themselves are empty. Nonverbal cues modify word meaning. And yet, no matter how good the actor or director, the perceptions and reactions vary from audience to audience. Meaning always depends also upon the larger context. Miller even suggests that it may be appropriate for the director to advise the critic in advance as to what to expect from a performance. The dramatist may create the context. The theater is a microcosm of social interaction and should be a rich source of insight into verbal-nonverbal communication effects.

Since the combination of verbal and nonverbal cues is so much a part of theater, it is not surprising that such issues play an important role in the writings of Erving Goffman. Goffman (1959, 1967, 1974) takes a dramaturgical approach to all social interaction. According to this framework, social actors must carefully play complex roles following subtle but unstated social rules. For example, greetings and farewells clarify current interpersonal roles and serve to tie the present situation to past and future interactions (1967). However, although likeability of one's greeting has been shown to be positively related to one's overall nonverbal expressiveness (Friedman, DiMatteo, and Taranta 1980), the ties between greetings and subsequent verbal interaction remain unstudied. But we know where to look: like Miller, Goffman believes that 'the focus of dramaturgical discipline is to be found in the management of one's face and voice' (1959: 217).

Frame analysis. In *Frame Analysis* Goffman (1974) considers the role of nonverbal cues in regulating social interaction and the role of expression in day-to-day acting, but then goes further. The book is an analysis of social reality in terms of organizational principles or 'frames'. Applying the idea of different levels of understanding to face-to-face conversation, Goffman sees the communication of complex social meaning in the following light:

> It is plain that sarcasm, irony, innuendo, and other members of that family are to be found, all of which allow a speaker to address remarks to a recipient which the latter will understand quite well, be known to understand, know that he is known to understand; and yet neither participant will be able to hold the other responsible for what has been understood. (1974: 515)

This view, that facial cues allow us to express matters that should be left 'unsaid', is commonly expressed by students of nonverbal communication, but without much systematic evidence. The subtleties of communicated meaning, so important to the maintenance of complex human interactions, remain almost completely unstudied.

Some recent work in the dramaturgical or self-presentational approach to social relations involves the concept of self-monitoring (Snyder 1974). This framework assumes marked individual differences in self-presentational behavior or 'wearing the right face'. Although this concept is presently mostly limited to expressive behavior, it holds promise of being combined with notions of verbal ability and disclosure and is encouraging social psychological research on the dynamics of face-to-face interaction (Snyder 1979).

Thus, there is ample theoretical reason to think that nonverbal expressions are of critical importance in the framing of words and the resulting impressions. However, empirical research along these lines is still at its earliest stages as a few examples will indicate.

Conflicting channels. A number of researchers have investigated reactions to an inconsistency between verbal and nonverbal channels. For example, a verbal message classified as positive, such as 'You're great', might be spoken with a negative tone of voice. The concern is then with whether a perceiver views the total message as positive or negative.

Bugental et al. (1970) showed acted, videotaped messages with conflicting affect (friendly and unfriendly) in three channels (verbal content, voice tone, and visual) to 80 children and 80 parents. It was found that picture accounted for almost twice as much of the variance of evaluative ratings as either script or voice. In addition, there was a strong interaction between verbal and vocal channels – if either was unfriendly, the other was discounted. A linear model of information integration was not adequate. The researchers also made an attempt to go a little deeper. They collected 'qualitative' information about conflicting messages (by having subjects pick an adjective which 'best described' each scene), and produced a table containing the proportion of subjects selecting a given adjective to describe each scene. They found evidence for certain scenes to be judged as sarcastic (positive script, negative picture, negative voice) or as joking (negative script, positive picture, positive or negative voice).

Argyle et al. (1971) asked students to judge nine videotapes which paired friendly, neutral, or hostile nonverbal cues (voice, face, and posture all combined into one gross affect) with friendly, neutral, or hostile verbal ones (whole paragraphs). There was only one performer – a female student. The ratings results showed that inconsistent pairings (i. e. friendly verbal cues with unfriendly nonverbal cues) were rated as more confusing and insincere than were consistent pairings. Another study employing a relatively large verbal unit of analysis involved eye contact (Ellsworth and Carlsmith 1968). It was shown that frequent eye contact may increase the perceived positivity of positive words (conversation) but may decrease the positivity of reactions to negative verbal content.

In a study by Mehrabian and Ferris (1967), female undergraduates listened to the neutral word 'maybe' spoken in various tones of voice. They rated each stimulus on a scale of 'like' to 'dislike'. They then rated head-only photographs of varying facial expression in a similar manner. Finally, the voices were paired with the faces and presented to new female subjects; they judged the 'attitude' being communicated by these stimuli (to another person). It was found that facial expression had a strong influence on total attitude, voice tone had a moderate influence, and the two factors did not interact. Verbal content was not varied, and the precise characteristics of the faces and voices are unclear. In a similar study, Mehrabian and Wiener (1967) combined positive, neutral, or negative words (great, maybe, scram) with varying tones of voice. Inferences about attitude were found to be mainly influenced by tone of voice. Although face was never combined with verbal content and the verbal content that was used consisted of only one word, Mehrabian (1972) was willing to conclude from these two studies that Perceived Attitude = 0.07 (verbal) + 0.38 (vocal) + 0.55 (facial). Such a general equation of cue combination cannot be justified on the basis of Mehrabian's limited data. Regarding the reliability of the findings, many more replications involving various cue combinations are needed. More importantly, such conclusions raise serious questions about external validity.

The observational perspective

A different approach to the question of verbal-nonverbal combination effects is to study the important variables which make up an existing situation. That is, we can examine characteristics of the interactants, the words they say, and their expressions when they say them. Two research traditions which focus on just such issues concern schizophrenia and speech perception.

Facial-verbal discrepancies and schizophrenia. In their influential theory of schizophrenia, Bateson et al. (1956) proposed that normal people rely on nonverbal media such as facial expression to frame and label messages, but that schizophrenics have difficulty understanding the communicated mode. For example, a schizophrenic might not recognize that a smile has changed a given episode from a serious mode to a 'play' mode. 'If an individual doesn't know what sort of message a message is, he may defend himself in ways which have been described as paranoid, hebephrenic, or catatonic' (1956: 252). Furthermore, a hypothesized cause of schizophrenia is the 'double bind' in which the primary message (usually verbal) is contradicted by a higher-level message (usually nonverbal).

Although the double-bind theory is intuitively appealing, in most social communication it is difficult to specify what a contradiction between different 'levels' might be. So some investigators have settled on simply observing verbal-nonverbal cue conflict. For example, Bugental et al. (1971) compared videotaped interactions of 20 families with a 'disturbed' child to those of 10 'normal' families. Five trained female judges classified the verbal, vocal, and visual components of parental messages as either positive or negative. It was found that the mothers (but not the fathers) from the 'disturbed' families were more likely to show verbal-nonverbal cue conflict than were the 'normal' mothers. For example, a mother might say 'That's not nice' in a positive manner. It is presumably very difficult for a child to process and respond to such a conflicting communication. Unfortunately, the correlations between nonverbal cues such as certain facial expressions and definable verbal exchanges have not been much studied even in 'normal' interactions.

Speech perception. One research area which implicitly studies the influence of nonverbal cues on word meaning in normal populations concerns formal lecturing or 'informative speaking'. For example, the influence of the speaker's style of delivery on the audience's comprehension might be studied. Since 'style of delivery' often refers to qualities like voice tone, rate of speech, gesturing, and eye contact, such research is actually examining verbal-nonverbal cue interactions. Unfortunately, the results of such studies are mixed and their application to the issues of this paper are complicated by the different theoretical framework in which they are cast (see Petrie 1963; Rogers 1978; and Knapp 1978, for reviews of this literature).

An obvious instance of nonverbal cues providing the necessary complement to verbal messages involves those signs Ekman and Friesen (1969) have termed 'illustrators'. Saying 'Look over there' and pointing with one's finger is perhaps the simplest case. Such cues are obviously especially important in certain situations such as when giving directions (Cohen 1977).

Much more observational data of this kind are needed concerning which nonverbal cues typically accompany which verbal utterances, and, at least in general terms, the apparent effects of such messages on the audience.

Finally, it should be noted that there are some observational studies of the nonverbal cues accompanying conversation which emphasize evaluative rather than informational matters. For example, in what might be seen as the observational counterpart of the Ellsworth and Carlsmith gaze manipulation study described above, a study by Rubin (1970) recorded amount of eye contact of various pairs of couples. It was found that couples strongly in love were more likely to engage in eye contact in a casual waiting period in a laboratory. Although it makes intuitive sense that a sentence like 'I'm really happy to be sitting here with you' will indicate greater love if the speaker is looking at the partner's eyes rather than at the ceiling, such a causal inference cannot be drawn from the Rubin study. Observational research can only suggest possible variables of interest and units of analysis which must then be brought under experimental examination.

CURRENT RESEARCH: COMPLEMENTARY EXPERIMENTAL AND OBSERVATIONAL STUDIES

The preceding frameworks reveal a number of difficulties and raise serious methodological challenges to the study of verbal-nonverbal cue combinations. None of these problems has yet been completely solved. But important issues can be addressed using complementary methodologies and complementary experimental and observational approaches.

As research on nonverbal communication progresses, certain cues emerge as likely candidates for use as units of analysis. As mentioned above, one area in which certain relatively 'clear' cues have been isolated involves facial expressions of emotion (Ekman and Friesen 1975). In an attempt to specify precise combination effects, facial expressions of emotion were paired with a very important yet relatively simple unit of verbal meaning, namely the sentence (Friedman 1979). This research attempted to combine precise, salient stimuli and to collect and understand all possible responses.

In this study, a powerful systematic design was employed in which four basic facial expressions (happiness, surprise, anger, and sadness) were paired with various sentences and the total meaning was judged. The sentences varied along two dimensions (positive-negative and dominant-submissive). Most importantly, there were a number of dependent measures which attempted to capture the various shades of combined meaning. These measures included scales of positivity, dominance, and sincerity; choice of perceived emotion; and open-ended questions asking judges (raters) to explain the situation. So for example, the judges (who were students) might see a happy teacher's face saying 'Listen, as far as I'm concerned you're the worst student I've ever had'. By closely examining all the dependent measures, it was possible to arrive at a likely interpretation of this and other facial-verbal pairings.

Various unique combination effects clearly emerged from this study. For example, although happy faces saying positive sentences were seen as very positive, sincere, and dominant, even to the point of indicating 'pride', happy faces accompanying negative sentences were seen completely differently. Such pairings were seen as extremely insincere, quite submissive, and often as indicating 'joking'. Other interesting combination effects also emerged. The insincerity, bitterness, and derision characteristic of sarcasm clearly resulted from angry faces saying positive sentences. Sometimes, the dominance of the sentence also seems to make a difference. For example, sad faces seemed especially likely to produce perceptions of sympathy when paired with submissive sentences. Ability to express sympathy is often cited as very important in various helping professions but the precise verbal-facial combinations which produce such nuances of meaning have not previously been systematically identified.

Such rigidly controlled systematic experiments are important for telling us where to look for certain subtleties of meaning created by verbal-nonverbal combinations. But although such studies are themselves predicated on an adequate understanding of certain nonverbal cues like facial expression, they are only the first step. It may be the case that certain combination effects such as sympathy can be and perhaps usually are produced through other cue combinations. To examine such possibilities, controlled observational methods are required. Furthermore, it seems clear that judges (students) are able to interpret practically any experimental pairing of verbal and facial cues by thinking back to a similar situation they have experienced; exploring the natural correlation between expression and 'verbal' meaning also necessitates the use of observational methods.

In order to ascertain whether reliable differences in facial expressions accompanying specific verbal utterances could be detected in naturally occurring speech, we studied television news broadcasters (Friedman, DiMatteo, and Mertz 1980). In investigating broadcasts of the anchorpersons during the 1976 Presidential campaign, we had a controlled situation in which facial expressions were clearly observable and the speakers (e.g. Walter Cronkite) were held constant. To hold the verbal content constant in this first study, we observed the facial expressions which accompanied the uttering of the candidates' names (Ford, Carter). It was found that there were indeed reliable differences in the facial affect (positivity) which each broadcaster used when saying the names 'Ford' or 'Carter'. Although the interpretation of the meaning of such differences can be problematic, such findings do, at the minimum, demonstrate that discernable differences are available for use by viewers. In this study we used brief (2.5 second) segments as the unit of analysis. The larger context is also probably important. Fortunately, other units such as the facial expressions accompanying stories with 'good news for Carter' can be studied in the same manner. The main difficulty arises from the extreme time demands of selecting and defining units and collecting and analyzing observations.

Our study of television news broadcasts demonstrates the feasibility of observing nonverbal correlates of naturally occurring speech but presents a problem of limited topic. For example, returning to the case of the communication of sympathy, it is apparent that many hours of natural conversation may have to be observed before even a few instances of sympathy might be observed. To deal with this problem, we have moved into the laboratory and continued controlled observation but with some control over the content. First of all, a number of sentences are selected, some thought to be conducive to the expression of sympathy and others thought to be incompatible with such expression on the basis of the previous experimental work (Friedman 1979). Then, people (subjects) are given these sentences and asked to communicate a number of complex forms of meaning including sympathy. Their attempts are recorded on videotape. Finally, the videotapes are edited and judges are asked to indicate what is being expressed in given segments of communication. Once segments which have successfully communicated sympathy have been isolated, we can examine these segments in detail to see which combinations of verbal and nonverbal cues produce such perceptions. Similarly, failures to appear sympathetic can be systematically analyzed. Again, such procedures are quite time consuming, but seem to be yielding quite precise pictures of the complex ways in which expression assists speech in creating meaning.

In sum, the study of the influence of nonverbal cues on the meaning of words necessitates a representative research design (Petrinovich 1979) in which we move back and forth between controlled observation and experimental manipulation. Such an approach not only guides us towards a precise and meaningful understanding of cue combinations but also aids us in choosing appropriate units of analysis for this newly developing field.

CONCLUSION

In communication through the written word, various clues of syntax and punctuation help the reader understand the meaning of the words. Most of the needed information is fixed in black and white on the printed page, although some shared expectations are implicit. For example, although in understanding this paper it helps to be a twentieth century social scientist and it helps to know that this paper is part of a book of research rather than part of a novel or a comic strip, most of the cues necessary for understanding are present in the paper. However, spoken language is quite different; the nonverbal cues which accompany speech and are necessary for understanding spoken words are subtle, transitory, and mostly ill-defined. This fact has strictly limited progress in understanding the ways nonverbal cues provide a context for and hence modify word meaning.

Recent progress in the field of nonverbal communication has allowed us to specify certain cues and begin to examine the larger issues. A new field of inquiry has been opened. Whereas past research has struggled first to define nonverbal communication and then to demonstrate its importance, it is now time to begin to retrieve some perspective. Nonverbal expression functions along with words as part of a larger process of interpersonal interaction and future research should be guided by this broader perspective.

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GLENDON SCHUBERT

Nonverbal Communication as Political Behavior[1]

Political behavior seldom has been studied from an ethological point of view, either by political or by other social scientists, due certainly in substantial measure to strictures that limit to human cultural data (and with an overweening emphasis upon verbal communication) the scope of perceived relevance. In their ethnographic reports of vestigial hunter-gatherer societies (Gluckman 1955; Swartz et al. 1966), social anthropologists have come closer by including ethological observations of political interactions in the attempted reconstructions of the cultures of those temporal as well as geographic enclaves of human populations (Schubert 1979a). Also available are an abundance of speculations about political behavior by biologically-trained persons (Bigelow 1969; Odum 1971), anthropologists (Tiger and Fox 1971), and others (Roberts 1938; Ardrey 1976); and political ethology is a subject of contemporary discussion (Masters 1976; Schubert 1979b). The present article focuses upon data resulting from an attempt to use an ethological approach to study human political decision-makers in action, in the field and as unobtrusively as was feasible.

A. RESEARCH DESIGN

The subject political elite included the judges of the Swiss Federal Tribunal, a group which in both the political and legal sense is for the Swiss polity the closest available analogue to the American Supreme Court (Rice 1967; Morrison 1969). The Swiss judges are elected as the nominees of political parties by the national legislature; they are assisted by appointed law clerks. The fieldwork was carried out during the latter half of 1970, and consisted of survey research (including extensive interviews, partly structured and partly unstructured, with 41 of the combined group of 48 judges and clerks) as well as the observations of decision-making of primary interest here. The individual interviews developed extensive information about attitudes and ideologies, as well as about the social background, group affiliations, and experience of the judges and clerks (Schubert 1977a, 1977b). The protocols of the decisions observed, as well as the subsequently published reports of decisions of the Tribunal for a three-year period enveloping that of the field observations, were analyzed at a later time. The Swiss study was part of a larger project that involved similar survey (although not observational) research in the Republic of South Africa; and the central focus of the overall project was upon cross-cultural analysis of the effect of subcultural differences upon political decision-making (Schubert 1979c).

The observation of the Swiss Tribunal was enabled by a Swiss statute of long-standing which requires decisions to be made publicly, in open court, for four of the five principal panels. The panel that decides criminal appeals is an exception, ostensibly to safeguard the privacy of defendants. A law clerk was present, to record the 'legally significant' aspects of the discussion preceding each decision; but clerks took virtually no part in the exchange of oral communication, and none as initiators. The data here consist, therefore, of observations for some 20 of the regular judges, plus a dozen occasional substitutes, clustered in more-or-less stable subgroups of five to seven. A total of some 200 decisions were observed, mostly by a Swiss lawyer research assistant more fluent in German and French (in which most discussion took place) than the present author, who in any event was preoccupied with interviewing. But the research assistant was less well trained as a behavioral scientist, and undoubtedly only a portion of the nonverbal communication ongoing during observations was recorded. A reinforcing reason for a large information loss was reliance upon paper-and-pencil techniques of recording. For present purposes we shall treat the available sample of non-verbal communication as through it were a random sample, although the extent to which it is so is of course unknown. Consideration was given to using one of Bales' (1950) contraptions, but that was rejected on grounds of social as well as technical marginal inefficiencies; and suitable modern alternatives (e.g. DATAMYTE) were not then available. Permission would certainly have been needed, and not forthcoming, to have videotaped the proceedings of the panel sessions observed; but this would surely be a preferable method for use in the many contemporary forums (sessions of American legislatures, committee meetings, municipal council sessions, etc.) where, under recent 'sunshine' and other public information statutes, it would be possible today.

All of the judges were trained as lawyers, and legal training places great emphasis upon the inculcation of oral as well as written language skills; and their judicial role presumed the continuing articulate exercise of such skills. Their role also presumed that they would all be at least bilingually fluent; but that goal was poorly approximated in practice. Deutschsweitzers and French maternals could understand each other's language; but only the tiny minority of two Italian maternal judges were equally disposed to speak either German or French. (They were of course even more fluent in their maternal Italian language, but they were on different panels and rarely had an opportunity to use it; and no one else spoke it to them.) Deutschsweitzers generally spoke in Swiss German, and French maternals in French, so that group discussion tended to proceed stochastically in either language, and of course sometimes both when more than one person spoke at the same time. Beyond such complications of formal language, utterances tended to be imbedded in a matrix of simultaneously and much more rapidly transmitted facial, gestural, and other forms of nonverbal communication (Morris 1977), so that to abstract the verbal semantic while ignoring the accompanying behavioral substrata – as political scientists, at least, almost universally do – is akin to throwing the baby out while keeping the bath water. An attempt was made here to capture both; but undoubtedly with imperfect success. Certainly the assumption was and is that the decisions reached and individual votes recorded, together with the abstracted aspect of their verbal rationalization, were the resultants of a complex process of social exchange of attitudes, moods, and feelings of affinity or disharmony, modulated by the institutional roles which constrained the interaction process.

The unit of content was the interaction statement, defined as a MESSAGE in a particular MODE, transmitted by an INITIATOR to a RECEIVER. The MESSAGE content of each interaction was *either* assertive, *or* reactive, *or* emotive; an interaction perceived to manifest more than one characteristic therefore required repetitious coding. (A smiling indication of assent, for example, was coded twice, as 'reactive: agree' and as 'emotive: happy'.) MODE is a scale hypothesized to be a surrogate for the biological variable of *arousal*. Speaking one's maternal language is presumed to be least arousing; and speaking some other formal, but for the INITIATOR, secondary language, is only slightly more stressing. The remaining categories, in sequence of what is imputed to be increasing arousal, are: oral but nonverbal sounds; facial expressions; movement of entire head; manual; corporal; and, most arousing physiologically, ambulation. (Obviously there are more dynamic forms of human action that are off-scale, which one might need to include for certain American political groups; similarly, daydreaming and various stages of somnolence lie off-scale in the other direction; but unlike some American Supreme Court justices, at least in times past, these judges did not sleep at the bench, nor did they indulge in any activity more strenuous than walking around behind the bench.)

An INITIATOR or a RECEIVER was usually an individual judge, although several (or, in any given panel, all) of them could act in either role; and 'impersonal' was also both recognized and empirically important as a RECEIVER category. The language of all verbal interactions was denoted by the first and second categories of MODE.

Other variables describing the situational, institutional, group affiliational, or other characteristics of the judges were associated with the interaction-sequence data for purposes of analysis. Seating order at the bench for every panel in each case varied according to seniority (and hence changes in participation) for each case or group of cases; and situational status influenced the order of discussion as well as of voting. The rapporteurial role similarly changed from case to case; and this was important because the rapporteur was recognized by the presiding judge to make the initial and usually the most comprehensive oral statement (supplementing the written statement that had been circulated among all participants prior to the meeting), together with his proposed disposition of the case. The presiding judge chaired the discussion.

B. DATA

Of the interaction modes, 78% were in the maternal language of the initiator, only 6% were in a language nonmaternal for him, and the remaining 17% were nonverbal. Of the maternal-language initiations, only 1% were in Italian, although all *except* 1% of the secondary-language initiations were by Italian-maternals. The most frequently observed (or at least, scored) nonverbal communication mode was facial (6%), followed by movement of entire head (4%), oral nonverbal (3%), manual (2%), corporal (1%), and ambulatory (1%). Even with the substantial coding bias that we assume to prejudice these data in favor of verbal communication, it is manifest that nonverbal communication is considerably more important than secondary languages are to the interaction process among these judges. Indeed, except for the three judges who represent the smallest subcultural minority, all of the nonverbal modes are at least as important as secondary language, and most of them considerably more so, for the other 29 judges whose behavior underlies these data. Evidently also, the popularity of the nonoral behaviors is in the same sequence as their scale order; and this tends to support the hypothesis that each successive behavior involves progressively more of the human muscular and skeletal system, and therefore more physiological effort. According to the scale hypothesis, therefore, these judges smile and frown and grimace more frequently than they get up and walk around because the facial signals are relatively easier for them to make than the ambulatory ones. But it is equally possible to infer, from strictly cultural premises, that their seated positions, as reinforced by the canons of Tribunal decorum, discourage locomotion around the bench while at the same time encouraging such conventionally acceptable forms of face-head expression as smiling and nodding. So these frequencies of nonverbal behaviors are probably the joint resultant of both cultural and psychophysiological stressors, and it is not improbable that the cultural norms themselves are a product of human experience of the effects of the psychophysiological stressors as causes, over a much longer period of time than there have been humans living in Switzerland – to say nothing of their having developed such a complex institution as the Federal Tribunal.

Because of the strong preponderance of verbal behaviors in these data, the nonverbal tend to get smothered statistically when verbal and nonverbal are aggregated as in the MODE scale; and therefore we must look also at AROUSAL: a truncated version of MODE deleting the two verbal categories. The average scores of the individual judges range on that scale from 3.7 to 5.9, which corresponds to the difference between a repressed, thin-lipped smile and the kind of stilted hand-chopping motions favored in recent years by the available sample of major-party Presidential candidates, especially for purposes of television performances.

Of the MESSAGE categories, assertive and reactive were observed much more often than emotive behaviors; and within each of these categories interactions tended to be declarative rather than persuasive, in agreement rather than disagreement, and pleasant rather than unhappy, by margins of more than two to one in each instance. A typical communication for this group is therefore a statement of the initiator's own opinion of the case, or else of his agreement with the opinion of a previous speaker; and to the extent that emotion is manifest in either instance, the feeling exhibited is pleasant. This projects an image of generally harmonious, mutually supportive, constructive social interchange.

With a single exception, the direction of communication is remarkably controlled by situational position, which alternates to the right and left of the presiding judge, according to seniority; for a member of the audience looking *at* the bench, therefore, the judges are arrayed in the sequence: 6, 4, 2, 1, 3, 5, 7 or 4, 2, 1, 3, 5. The most economical way to report these data is by means of the matrix shown in Figure 1, in which the '0' position implies either initiation or (much more commonly) reception by more than one individual or else by a person or persons not seated at the bench. The most senior nonpresiding judge, who sits on the right hand of the chairman (and incidentally these *are* all males) initiates more communication to the judge president than he receives from him. Otherwise, the practice is invariant: situational superiors preempt the initiative in their communications with subordinates.

The Number Ones (chairmen) are highest in maternal-language initiations; but they are low, and often lowest, in all other MODE categories. Number Two is highest by far in the use of secondary language (French or German), and also in oral nonverbal, facial, capital, manual, corporal, and ambulatory

Initiator's position	Receiver's position 1	2	3	4	5	6	7	0
1		109	88	103	103	6	6	211
2	136		87	113	76	5	6	215
3	85	75		57	80	2	2	179
4	97	107	49		51	4	5	184
5	99	57	44	48		5	3	163
6	7	5	5	3	3		5	17
7	10	5	4	2	2	4		17
0	3	1	0	0	0	0		6

Figure 1. *Frequencies of interactions, by sitting position*

Note: For each dyad, of the first five positions, the ***higher*** of the two frequencies is circled. Therefore, the most senior side judge (Number Two) sends more messages *to* the presiding judge than he receives *from* him; but otherwise, the trend is consistently for seniors to initiate more interactions to, than they receive from, their respective juniors.

initiations. Number Two also has the highest total (23%) of *all* initiations, notwithstanding Number One's considerable edge in the frequency of maternal-language initiations. Evidently it is the chairman who does more 'straight' communication than anyone else; but it is the most senior side judge who performs the lion's share in all other modes of interaction. These data are in perfect accord with Bales' (1950) distinction between 'task' and 'social' leadership, a differentiation of functions previously identified for the United States Supreme Court (Danielski 1961). Here it is the presiding judge who not only is cast, but also acts, as task leader; while his right-hand man is the social leader, deferring to his colleagues by speaking in *their* language, and displaying to them by means of his use – more than any of his colleagues – of all types of nonverbal communicative behavior. And these data, it should be emphasized, hold not for just one of the four panels observed in the present study, but for all four combined.

A very different pattern obtains for the reception of communications, for which the marginal frequencies by seating order are: (1) 437; (2) 359; (3) 27;

(4) 326; and (5) 315. Manifestly, the judges to whom least attention is paid by the others are not the least senior in position No. 5, but rather they are the second-most-senior who sit in position No. 3 on the immediate *left* side of the chairman. Recent research in laterality tends to support, at least in regard to the point of relevance here, the ancient semantic bias in many languages, according to which Number Three would be denigrated as a sinister position; and its incumbent usually does labor under a special disability because the chairman will ordinarily be right-oriented and therefore it will be more difficult for him – perceptually, physiologically, psychologically – to confront Number Three than any other person in the group in face-to-face engagement. I regret that, at the time this fieldwork was done, I was too ignorant of these matters to have undertaken the determination of each judge's lateral orientation, which could so easily have been made both observationally and with confirmation through the interviews with the subject judges, reputationally through their colleagues or court employees, or by other means. Since then research has linked laterality not only with political behavior (Laponce 1972, 1976, 1978), but also with the morphology and behavior of many other kinds of animals (Corballis and Morgan 1978; Morgan and Corballis 1978).

Number Two, the social leader, receives the highest proportion of facial messages, while the chairman and Number Four get the largest share of the personalized capital and manual communications; and Number Four is the recipient also of the most corporal messages. But 'off-the-bench' targets get not only the largest number (838, almost 40%) of all maternal language communications; they receive also disproportionate shares for the higher levels of arousal: manual, corporal, and ambulatory. This finding gets confirmation in many other facets of the data: bodily movement indicating high arousal tends to be directed at *impersonal* targets.

There are two obvious explanations, either or both of which may be correct. An observer of a courtroom or any similar social scene finds it difficult to be certain precisely to whom the grosser and less finely tuned bodily movements are oriented. A turned head or a sharp glance usually has an apparent target in a small group that is well spaced about a linear baseline such as a judicial bench. But what about a raised fist, hunched shoulders, or a body that rises partly out of a chair? These latter may well be perceived as *a threat to all*, or to anyone; and this is precisely where the alternative explanation drawn from ethological theory comes in: an animal in a social group of conspecifics may display gross bodily changes in position in order to relieve its own inner tensions whether caused by hunger or the perception of a predator or something else that changes its own neural and hormonal messages and muscular intentions. The hypothesis drawn from studies of animal behavior is that it is more socially acceptable for such an animal to *avoid* a personal focus upon any other individual in the group, for the very good reason that directed communication of the animal's *own* arousal may invite reaction from some other member of the group. We can assume that among a group of judges in open court the likelihood of one judge launching an immediate and violent physical attack upon another can usually be evaluated as quite a low probability (but cf. *In re Neagle*, 135 U.S. 1 [1890]); but certainly that is not the case for many if not most other primate groups of similar size in field settings. It is not even the case for a similar group of humans in many field settings even today; it was not the case for many human groups two centuries ago; and it was probably not the case for *any* human groups as recently as 20,000 years ago. But our species and subfamily (hominid) evolutionary development has to be measured in hundreds of thousands of years, on the one hand, and in millions, on the other. Such gestures as a raised arm (to say nothing of a clenched fist), or a body rising rapidly from a seated (or at least not a standing) position communicate meanings that are very much older, and very much more profound in the most fundamental psychological as well as physiological senses, than any cultural messages that can be transmitted in formal language. But the initiator of 'body language' messages knows this just as well as do his receivers; and hence, when he finds himself in such a quintessentially cultural setting as a supreme court room, he 'takes the curse' off his threats to the group, by putting his nonverbal communication in as socially acceptable a form as he can. That requires him to act *impersonally*, which leaves no one in particular obliged to reply (retaliate).

In regard to types of messages there are marked differences between verbal and nonverbal communication, as Table 1 indicates.

Table 1. *Verbal and nonverbal communication in assertive, reactive, and emotive messages*

Mode	Message											
	Assertion				Reaction				Emotive			
	Persuasive	Declarative	*N*	% Total	Agree	Disagree	*N*	% Total	Happy	Unhappy	*N*	% Total
Verbal	28	72	1290	95	70	30	951	84	56	44	44	16
Non-verbal	63	37	62	05	80	20	184	16	70	30	219	84

Verbal communications are preponderantly declarative while nonverbal are almost as strongly persuasive, although assertions tend overwhelmingly to be verbal rather than nonverbal. On the other hand, there is little difference between verbal and nonverbal in reactive messages, although again by far the largest number of reactions are communicated verbally. The opposite is true, however, of emotive communications, the great majority of which are both nonverbal and happy. As the table makes clear, declarative assertions are likely to be verbal while the communication of pleasant emotion is likely to be done nonverbally.

Types of messages vary also according to situational differences. Only the task-leader chairman initiates the majority of his assertions persuasively, and receives a majority declaratively. Social-leader Number Two receives a higher proportion of agreement than any of the other judges in the five major positions. But the chairman is highest in both the initiation and reception of happy communications, 90% or more in either instance; while Number Two is next highest in their reception, and Number Three is *lowest* (at only 49%) in their initiation. The highest agreement is communicated both to and by the peripheral judges who occupy positions Number 6 and 7 when the larger panels sit; and their emotive initiations are distinguished by 100% happiness. They are, of course, the least senior and therefore generally the least experienced and most insecure members of those larger panels.

C. SIMPLE ECOLOGICAL PATTERNING

When we examine the pooled interaction data, nonverbal communication is correlated at + 0.30 with conservatism in general ideology, and + 0.24 with institutional status (in the direction low); it is - 0.23 with political affiliation, - 0.20 with religion, and - 0.20 with military rank; but it is only - 0.06 with maternal language. All of these correlations are low, and the one with maternal language is so small as to indicate statistical independence. Based on observations of typical gesticulators representing a diversity of national cultures, in which he *did* (incidentally) employ videotaping, Desmond Morris (1979) has denoted sharp differences in the ecological patterning of nonverbal communication at the *cultural* level. But the judges here represent *sub*-cultures within a common national culture; they share a common profession and socioeconomic status; and they were observed in the performance of a role that is designed to constrain maximally some of the more colorful gestures (e.g. cuckolding) that were exhibited with such zest by some of Morris' subjects. So there is perhaps no incongruity in the present finding that nonverbal communication (or nonverbal *arousal*, as we have described it above) is so largely independent from the principal cultural variables of this study. The profile implied by these correlations is that there is some tendency for the judges displaying the most nonverbal communication – and therefore, those manifesting the highest level of arousal – to be conservative in their overall attitudes; junior in status and seniority; conservative in political and religious preference; relatively high ranking military officers; and with no particular language-subculture bias.

It is possible also to organize the data in terms of the pooled averages of the individual judges on the interaction variables. Correlation across the judges shows that both verbal and nonverbal arousal are moderately negatively associated with high reception of communications, so persons who act aroused in their initiations get relatively fewer receptions. High initiators and those who show nonverbal arousal also provoke (or at least receive) reactions at a low rate; and aroused initiators are the recipients of unhappy messages. Judges who receive a high proportion of reactive communications tend to be low in the reception of messages conveying either verbal or nonverbal arousal; while those who do get many emotive messages are receiving communications conveyed at the relatively high level of + 0.61 for nonverbal arousal. Those voting in support of a relatively high level of reversals of lower court decisions tend to receive messages accompanied by a low level of general arousal. And these correlations show religious conservatism (Roman Catholicism) to be associated with relatively high arousal, both verbal and nonverbal; and also with emotive initiations, and a relatively higher level of initiations than of receptions. But from this perspective political affiliation is conspicuous for its generally low level of correlation, not only with arousal but also with all of the other interaction variables as well. Aroused and emotional messages are directed toward military officers of higher rank; and judges who were socialized in nonpoliticized families tend to receive a high proportion of messages signifying nonverbal arousal. Those whose legal socialization was Sweitzerdeutsch are recipients of relatively high levels of verbal arousal, assertion, and emotional messages; while Romand maternals are distinguished by their high reception of unhappy messages. The older judges sit in the center of the bench and play the roles of task and of social leaders; the younger ones at the periphery initiate more messages that are emotional-nonverbal, or in their secondary language. Ideological conservatism is associated with both the initiation and the reception of disagreement, with the reception of messages indicating both verbal and nonverbal arousal, and with emotion in general and unhappiness in particular.

D. COMPLEX ECOLOGICAL PATTERNING

Factor analysis enables us to examine in a more systematic and holistic manner the interrelationships between the arousal variables and a much larger set of other interaction variables, for both initiating and receiving behaviors. In Figure 2, we can observe a planar perspective of one pair of the first four factors of principal component analysis of correlations for initiation behaviors between interactional variables such as those discussed in the first part of the preceding paragraph. Three types of leadership are distinguished: Task, which here is associated with the role of rapporteurs rather than that of chairmen (that is Formal), and Social. And they are weighted in that sequence. The remaining factor, the second one, is Decisional, as high loadings on it by all five voting variables make clear. 'Arousal' here denotes the MODE variable, or what we have called verbal arousal above; 'Nonverbal' identifies nonverbal arousal or nonverbal communication. Neither of these is important in regard to the Task Leadership or the Decisional factors; but they are the principal defining variables of Social Leadership, in association with speaking nonmaternal language, disagreeing in reactive communications, and indicating emotion in communication. But all of these five variables are only weakly correlated with Formal Leadership. Hence we can infer that arousal (including nonverbal communication), and showing language deference, disagreement, and emotion all are of considerable importance to the initiation of messages concerned with the attempts of judges to influence each other – to break or maintain 'the Tar' in Paul Bohannan's (1957) phrase – but that they are not characteristic of the behaviors of either rapporteurs or chairmen, nor are they of much importance in influencing the votes of the judges in the decision of any particular case. After all, these men have a much bigger investment in maintaining tolerable relations with each other than they do with the outcome of any particular case. Cases displace each other in a seemingly endless stream; the handful of colleagues with whom one must continue to interact are an exquisitely intimate, and most definitely finite, population.

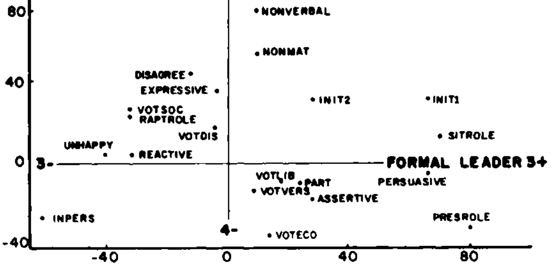

Figure 2. *Components of interactive initiations*

Receiving behaviors show the same four factors except that here Decisional and Social Leadership are more important, and correspondingly Task and Formal Leadership are less important, than was true for initiating behavior. Social leaders receive (as well as dish out) communications indicating considerable arousal and emotion, but their receptions are not characterized by disagreement (see Figure 3). Unfortunately, we remain uninformed about their reception of messages in what were secondary languages for initiators; this information was lost due to a coding error, so the NONMAT variable does not appear in this figure. Disagree is sufficiently moderately (as well as negatively) loaded on the Decisional factor to indicate that judges who receive expressions of agreement tend to vote liberally in the decisional outcomes, and also that task leaders tend to receive messages of agreement. But neither Nonverbal, Arousal, nor Expressive shows any important relationship to either Task or Formal Leadership.

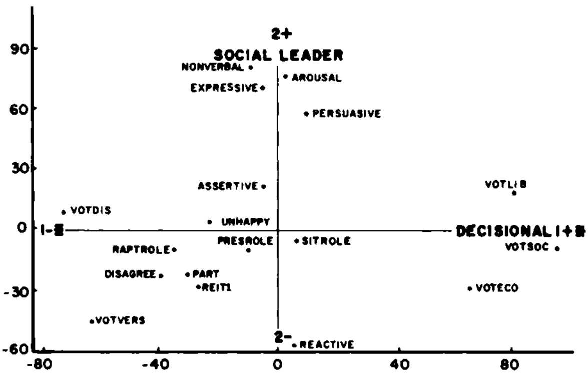

Figure 3. *Components of interactive receptions*

Figures 4 and 5 are the results of a factor analysis of a matrix of correlations including the most important attitudinal and attribute variables in addition to the major interactional ones for initiation. 'AROUSAL' is a somewhat differently calculated measure of nonverbal communication. In this context the interaction variables coalign to define the third factor; and the major non-interactional variables (general ideology, COMBATT; and political and religious affiliation, POLAF and RELIGAF) define the first factor, which is oriented in the direction Conservative. These new factors have supplanted Task Leader and Social Leader; but Decisional and Formal Leader remain. In Figure 4, both emotional messages and nonverbal arousal are strongly associated with ideological conservatism, while speaking nonmaternal language is

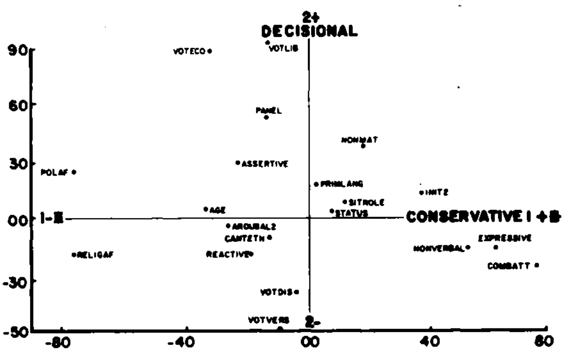

Figure 4. *Components of interactive correlates: ideology and decisions*

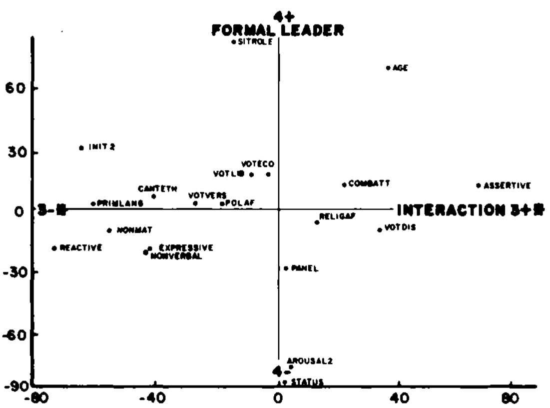

Figure 5. *Components of interactive correlates: interaction and leadership*

moderately associated with liberal voting. In Figure 5, nonverbal and emotional and speaking nonmaternally are strongly disassociated from assertive communications on the Interaction factor; while Arousal 2, which measures the average nonverbal communication of each judge, as a ratio of the highest nonverbal communication average for any individual judge, emphasized how almost completely verbal are the communications emanating from the middle of the bench. The initiation matrix based on the pooled interaction data also was factor analyzed, and nonverbal communication was loaded importantly only on the factor of Social Leadership, where it is associated with youth, civilian status, Romand language maternalism, unhappiness, and psychological conservatism, as a behavior of judges *not* social leaders in the initiation of communications. In the corresponding analysis of the reception matrix, however, nonverbal communication is associated with political liberalism and civilian status.

Some indication of the importance of nonverbal communication as a predictor of other behaviors is made possible through a series of multiple regression, discriminant, and causal analyses that were undertaken with various sets of the variables discussed above. Only highly selective results, relating to nonverbal arousal, will be discussed here. In the regression of liberalism in voting in decisions, for example, nonverbal communication was tied with conservative ideology as the second most important predictor variable, which in both instances is negatively weighted. Stated otherwise, judges who indulged in considerable nonverbal communication tended to vote conservatively in the decision of cases, like judges whose replies to an extensive questionnaire manifested conservative general attitudes. In another regression of VOTLIB which used only initiation interaction variables as predictors, nonverbal communication was the most important predictor with the highest negative weighting; and *verbal* communication with a positive weighting was next most important. A discriminant analysis of VOTLIB yielded two functions; and on the second function nonverbal communication was the most important predictor of conservative voters.

In the regression of dissent in voting, nonverbal communication is only slightly less important than conservative ideology, and as a predictor of dissent it is equally important as liberalism in political affiliation. In the regression of voting to reverse the cantonal decisions under review, nonverbal communication is second only to high institutional status as a predictor. The same finding is confirmed by discriminant analysis which shows nonverbal communication to be the most important predictor of reversal voting; while verbal communication and speaking maternal language only are also important but as predictors of voting for affirmance.

The discrimination of MODE predicted to the two category-groups 'verbal' or 'nonverbal' on the basis of a matrix of over a dozen attitudinal or attribute variables, which were associated with separate pools of initiated interactions and of received interactions. Most of the independent variables used in this analysis were reasonably good predictors of verbal communication. The best predictors of nonverbal communication were emotion in either initiation or reception, economically conservative attitudes, and Romand language maternalism.

A causal model, too complex for presentation here, includes four classes of variables in linear sequence, of which we shall be concerned with three: attributes, processes, and functions. Age and religious affiliation are relevant attributes, and both have moderately strong negative correlations with nonverbal communication (a process). Nonverbal communication shows a moderate positive correlation with an intervening process that measures rate of initiation (as a ratio of initiation plus reception); and nonverbal communication has a weaker negative correlation with a preference for impersonal receivers; but its only link with functions is a moderate negative one with voting liberally in economic decisions. The model indicates that younger judges and religious conservatives who frequently communicate nonverbally are responsible for much of the conservative voting in decisions raising questions of economic policy. The links through the two intervening variables are weaker, and show mainly that these aroused young Roman Catholics are active initiators who tend not to waste their nonverbal displays on impersonal targets.

E. DISCUSSION

Nonverbal communication, hypothesized here to be an indicator of arousal, was an important component of the social interaction observed to occur among small groups of judges of the Swiss Federal Tribunal in a fieldstudy conducted in 1970. These nonverbal behaviors took place in the context of a matrix of conspicuously verbal and multilingual discussion oriented toward the formally legal decision of cases appealed from cantonal courts below. The nonverbal component was coded, by regrettably primitive techniques, as constituting over a sixth of the total communication action observed; in fact the proportion of nonverbal to verbal communication was much higher than that. The frequency of use of a presumed scale of nonoral behaviors (ranging from facial through movement of entire head, manual, and corporal to ambulatory) is progressively less, in phase with the increasing psychophysiological stress entailed by larger and more complex motor patterns of activity.

The role constraints of these groups are such that the patterning of both verbal and nonverbal communication is strongly influenced by situational status, which in turn is a functional transformation of formal institutional status. The general rule is that superiors 'talk down' to inferiors, in the sense that superiors initiate to inferiors more communications than they receive from them. Not specified in the formal role model is a division of communicative functions predicted by experimental studies of small laboratory groups, with leadership divided between one member who specializes in the efficient accomplishment of the assigned task, and another who monitors and manipulates the level of cohesion and social solidarity within the group. In the present study, the formal (as well as informal) role of task leadership was shared by the regular chairman and an ad hoc rapporteur in each case; while the informal role of social leadership was exercised by the group member seated adjacent to and on the right side of the chairman. A third informal functional role, predictable from contemporary research in laterality but not a component of the experimental group theory and not anticipated in the present study, is the pariah status assigned to the person seated adjacent to but on the *left* side of the chairman. The hypothesis is suggested that, although the person in this situational role has superior formal status to those seated peripherally, he is the one who for a combination of psychological and physiological reasons is most difficult for not only the chairman but also the other members generally to see *and therefore to communicate with nonverbally*, assuming that right laterality predominates among these Swiss judges to the same extent that it undoubtedly does in the parent population of the national culture from which they are drawn.

Assertive messages are communicated mostly verbally; reactive messages are about equally verbal or nonverbal; while emotional messages are mostly communicated nonverbally. The high proportion of nonverbal communication directed at *im*personal targets is interpreted, on the basis of ethological theory, as a socially acceptable means of conveying meanings which, if they had been personalized, frequently might have invited reactive responses too expensive in terms of the cost-benefit calculations of initiators.

Simple correlational and factor analysis agree that nonverbal communication is an important element in social leadership, together with high verbal communication and in association with speaking in nonmaternal language and the expression of emotion in both the initiation and the reception of messages. But nonverbal communication did not have much bearing upon other factors of task and formal leadership, and relating to policy preference in decisional outcomes, except that an alternative measure of nonverbal communication confirmed that panel chairmen are remarkable for their restraint in communicating other than verbally. However, alternative multivariate analyses, including regression and discriminant and causal, indicated nonverbal communication to be an important predictor of conservatism and dissent in voting, and also of voting to reverse lower court decisions. Nonverbal communication itself was best predicted by emotional communication, economically conservative attitudes, and Romand language maternalism. The relative youth and Roman Catholicism of some judges causes them to communicate nonverbally before voting conservatively on questions of economic policy.

It is pointed out that improved technology today makes feasible the collection of nonverbal data, in studies of political behavior, better in both quality and quantity than that analyzed in the present study. There have also been important advances in theory that certainly are relevant in principle to the empirical behaviors of concern here. Attention structure (Chance and Larsen 1976) suggests a model of small-group nonverbal social interaction, stemming from ethological observations, and alternative to the Balesian laboratory theory on which I built; and it might be worth pursuing such a lead, notwithstanding certain views critical of attention theory that I have expressed (Schubert 1979b). Furthermore, the Lacey hypothesis of the cardiovascular-cognitive relation between arousal and attention (Lacey and Lacey 1974; Elliott 1972, 1974) suggests a sophisticated theory that bears directly upon my own (untested, in the present study) hypothesis that nonverbal communication can be used as an indicator of arousal; and certainly in laboratory work (Gow 1981) and potentially in fieldwork as well (Tanenhaus 1977) the prospect of operationalizing the Lacey hypothesis is now sufficiently feasible to be considered in the design of research on nonverbal communication in human groups.

NOTE

1. The author thanks the Netherlands Institute of Advanced Study in the Behavioral and Social Sciences, where he was a Fellow during 1978–1979, for assistance in the preparation and typing of this paper.

MICHAEL ARGYLE, JEAN ANN GRAHAM, and
MARGA KRECKEL

The Structure of Behavioral Elements in Social and Work Situations

SUMMARY

A set of 26 behavioral elements, which were verbal and/or nonverbal in nature, was drawn up. These covered the main events in two situations – a date and boss-secretary interaction. Each element could be potentially produced by either person in each situation. Subjects of each sex rated each behavioral element (assuming it was emitted by the other person) on 10 scales for each situation (thus there were four conditions). The ratings were analyzed in terms of similarity, using a Wishart hierarchical cluster analysis for each condition. As predicted, the general pattern of clustering which emerged was rather different for the four conditions. There was a fairly clear separation of positive and negative acts, particularly in the two date conditions. There was a clearer separation of task and personal/social issues in the work situation than in the date, particularly for boss rating secretary's behavior. Ratings (of the other person) by males and females were more similar to each other for the date than for the work situation. Where similar clusters appeared in more than one condition, their profiles of ratings were plotted; these were quite similar across conditions. Comparisons of similarity scores for particular pairs of elements indicated some interesting differences; for example, work- and socially-oriented behaviors are differentiated more in the work situation.

INTRODUCTION

Duncan (1969) contrasted the structural approach and the external variable approach to the study of nonverbal communication. By the structural approach he meant 'studies which identify fundamental elements (or units) of nonverbal behaviors, and explore the systematic relationships among these units' (p. 121), as has been done by Birdwhistell, Scheflen, Kendon, and others. The present study deals with some of the concerns of the structural approach. The central hypothesis is that the verbal and nonverbal elements in different conditions, i.e. situations and sex roles, will be structured differently in ways that can be predicted.

The structuralist approach to nonverbal communication is derived from structuralism in linguistics, and initially from Saussure (1915). The meaning of a word is partly derived from the other words with which it is contrasted; for example the meaning of a color word depends partly on the other color words used in a language. In this paper we shall be concerned with the structure of the main elements of social behavior, which produce social consequences (Austin 1962). The assumption of early constructors of social acts, like Bales (1950), was that the same categories of elements could be used by observers in any social situation. Our expectation is that the way in which acts are grouped and contrasted will vary in the different conditions.

If a functional approach is taken to situations, then the features of a situation can be understood by showing how they enable the goals of that situation to be attained; this can be done for the rules, the role-systems, and the repertoire of elements (Argyle et al. in press). The elements can be seen in some cases as the steps used to attain the goals. Elements may be grouped together if they lead to the same goal, and contrasted if they lead to different goals.

What we mean by a 'situation' is a culturally-defined social event with generally accepted rules and roles, such as interviews, committee meetings, meals with the family, casual chat with friends, going to the doctor, and so on.

The structure of elements can be studied from the 'etic' point of view of the investigator. It is possible to discover how units are structured by means of sequence analysis. If elements A and B have similar antecedents and consequents, then A and B can be grouped together as equivalents. For example Kendon (1976) found that for a couple kissing on a park bench, the girl had two main kinds of smile in terms of their consequences: one led to her being kissed, the other led to withdrawal. Van Hooff (1973) produced a grouping of equivalent elements of chimpanzee social behavior based on similarities of consequents and antecedents.

In the so-called 'emic' approach, the perceptions and categorizations of participants are the criterion. There may be some variation between individuals, but unless there is a considerable degree of sharing of concepts communication would be impossible. If each act is rated on a number of scales, various kinds of analysis can be used to find how the elements are related in the minds of the raters – factor analysis, principal components analysis, multidimensional scaling, and cluster analysis are the main alternatives. In all these methods, however, elements are grouped together if they are perceived as similar, or as invoking similar reactions; this is different from grouping elements which could fit in at the same point in a sequence, like nouns or verbs in linguistic analysis.

We decided to use hierarchical cluster analysis, since it shows grouping and contrasts most clearly. It is however questionable, in any domain, whether a dimensional or clustering analysis is more appropriate: for facial expression for example both have been used, and one can be plotted on the other (Stringer 1973).

In the study to be reported we tested the general hypothesis that the structure of elements will vary between conditions. There are several ways in which this is expected to happen.

Bales (1950) supposed that one of the main distinctions between elements is between positive and negative. The main factor in the semantic differential is between high and low evaluation (Osgood et al. 1957); the factor analysis of social behavior usually produces a friendly-hostile factor (Foa 1961); dimensional analysis of facial expressions produces a pleasant-unpleasant factor (Ekman et al. 1972). It looks as if in the interpersonal sphere, for primarily social activities, positive versus negative, or friendly-hostile, will be an important distinction. In functional terms this can be understood if it is assumed that one of the main goals in such social situations is to elicit positive responses from others.

The second main division made by Bales was between task and socio-emotional behavior. It is common to distinguish between task and social situations; in task situations both kinds of behavior should be found, whereas social situations contain little task behavior, and task versus social should not be an important distinction.

The second main dimension found in factor analysis of social behavior is dominant-submissive (Foa 1961). We should expect a division between giving and receiving orders, or social influence; this distinction should be most important when there are large differences of power and status in the situation.

Where there is a definite task, this will affect the grouping of social acts. Acts which take those present nearer to the goal will be contrasted with those which interfere. The meaning of acts may be changed by the nature of the task. If a man touches a woman, this act will be grouped differently if they are in a doctor's surgery rather than in her flat.

When people are playing a game, or are in some formal situation with rules, the rules will affect the grouping and contrasting of elements. If they are playing rugby football it makes a difference whether the ball is thrown forward or back; if they are playing association football it makes a difference whether they use hands or feet. At a committee meeting there is an important difference between a vote and a straw vote, a motion and an amendment, and between votes which are unanimous and *nem con*.

Distinctions between elements can be invented and taught to others. This is clear from the history of recording social behavior in the classroom. In addition to the widely-used Flanders (1970) categories, there are over 100 other sets of categories (Simon and Boyer 1974). Some of these distinguish between higher-order questions and other questions, some have a category called 'structuring', some have a category for 'pupil initiates'. It depends on what the inventor thinks is important; most of these systems have been used for teacher training, and learned by pupil teachers.

In the investigation reported here we used two situations, a boss-secretary situation in an office, and a date. In each situation there were two roles, male and female. We chose 26 elements of behavior which we thought covered most of the repertoire of both situations, and which could occur equally well in either. And we used 10 rating scales which we hoped would cover the main forms of reaction to these elements. The elements and dimensions were derived from our own previous studies.

We developed a number of expectations:

1. That the general structure of clusters would differ in the different conditions. In particular it was expected that the positive-negative distinction would appear in all conditions but more clearly in the date, and that the work versus social distinction would be clearer in the work situation.
2. That the similar clusters of elements which appear in different conditions would be likely to have different profiles.
3. That specific pairs of elements would be seen as similar in one situation but not in another:
   i. Asking about work and private life would be seen as similar on a date (element 1 versus 6), but different at work.
   ii. Invitations to home and pub (9 versus 18) would be seen as similar on a date but different at work.
   iii. Information about private life and work (13 versus 20) would be seen as similar on a date but different at work.
   iv. Teasing and favorable comments on appearance (7 versus 3) would be seen as similar on a date but different at work.

These expectations were based on a commonsense analysis of the goals and nature of the two situations.

METHOD

Subjects

There were ten male and ten female students who volunteered to participate in the experiment. They were all aged about 25 years. The male and female subjects were run in separate groups.

Design and procedure

Two situations were examined: a work situation involving a conversation between a male employer (boss) and a female employee (secretary), and a more social situation involving a date between a male and a female. The male subjects were required to take the viewpoint of the male in each situation and the female subjects were required to take the viewpoint of the female in each situation. They were asked to rate (on 10 different 7-point rating scales) how they would perceive each of 26 behaviors emitted by the *other* person in the situation: for example, a male subject would be required to rate how desirable it would be for a female secretary to 'ask about work' in the work situation. The set of 26 behavioral elements and 10 rating scales are listed in Tables 1 and 2 respectively.

Table 1. *The 26 behavioral elements rated by subjects*

1. Asking about work
2. Giving suggestion for next meeting
3. Making favorable comment on appearance
4. Smiling
5. Complaining about tiredness
6. Asking about private life
7. Teasing
8. Avoiding looking at partner
9. Inviting for a meal at home
10. Asking for assistance
11. Advising on personal affairs
12. Disagreeing
13. Giving information about private life
14. Looking in other person's eyes
15. Laughing
16. Agreeing
17. Making unfavorable remark
18. Inviting for a drink in pub
19. Showing disapproval
20. Giving information about work
21. Being emotionally upset
22. Encouraging
23. Refusing help
24. Telling rude jokes
25. Accusing of unreliability
26. Promising future benefits

Table 2. *The 10 rating scales used for rating each of the 26 behavioral elements*

Frequent	___ ___ ___ ___ ___ ___ ___	Infrequent
Undesirable	___ ___ ___ ___ ___ ___ ___	Desirable
Socially skilled	___ ___ ___ ___ ___ ___ ___	Socially unskilled
Irrelevant	___ ___ ___ ___ ___ ___ ___	Relevant
Emotionally arousing	___ ___ ___ ___ ___ ___ ___	Not arousing
Hostile	___ ___ ___ ___ ___ ___ ___	Friendly
Submissive	___ ___ ___ ___ ___ ___ ___	Dominant
Difficult to deal with	___ ___ ___ ___ ___ ___ ___	Easy to deal with
Pleasant	___ ___ ___ ___ ___ ___ ___	Unpleasant
Unpredictable	___ ___ ___ ___ ___ ___ ___	Predictable

Half the subjects in each group were asked to rate the behavior in the work situation followed by the date situation, and vice versa for the other half of the subjects. Within these subgroups the order of presentation of the rating scales was reversed for half of the subjects.

The instructions were as follows.

In this experiment we would like you to imagine typical examples of two situations and to give your reactions to various things that can happen in them – a date (between a young man and a young woman), and a boss-secretary conversation in the office. We would like you to think of a typical encounter of each kind, so please would you use partly your own experience, and your knowledge from other sources.

We will give you a number of bits of behavior, like 'agreeing' or 'advising on personal affairs'; take the role corresponding to your own sex – so, as you are male, imagine you are the boss (as you are female, imagine you are the secretary), and imagine that this piece of behavior has been emitted by the *other* person.

The first set of pages will be about one of the situations, the second set about the other one. Please do them in the order in which they have been given to you. For each element put a √ on each of the 10 rating scales to show how you would perceive it, if it happened to you. There are seven possible points on the scale which may be used. Any questions?

RESULTS

Four Wishart hierarchical cluster analyses were carried out on the rating scale scores, to give an indication of the similarity with which behavioral items were rated, one in each of the following conditions:

males' ratings of secretary's behavior in the work situation;
males' ratings of girlfriend's behavior on the date;
females' ratings of boss's behavior in the work situation;
females' ratings of boyfriend's behavior on the date.

1. *General structure of clusters*

The four dendrograms can be seen in Figures 1 to 4. In these figures the items which join at the right of the dendrograms are dissimilar; those which join at the left of the dendrograms are similar. A common cut-off point of 2.30 on the similarity coefficient was taken across each dendrogram. Elements which joined below this point were treated as one cluster (of highly similar elements). From observation of the pattern of clustering for each of the four conditions, the general structure of the clusters was described. The clusters were described in terms of whether the behavioral elements clustering together were positive/negative, intimate, work, etc. Thus, the general structure of clusters emerged as seen in Figure 1.

Using a similarity coefficient of 2.3 as the cut-off point we obtained six subclusters, which join up to form three larger ones and two smaller clusters. There are 'work' and (positive) 'nonverbal', which make up the 'positive' cluster. 'Invitations' and 'intimacy' form the 'social' branch of a larger 'social and negative' cluster; 'withdrawal' and 'conflict' make up the 'negative' part of it.

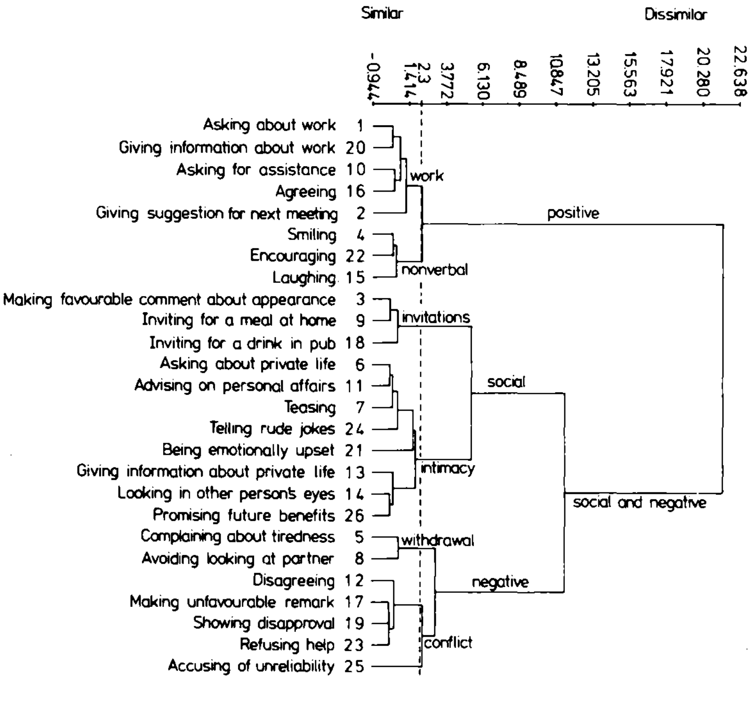

Figure 1. *Dendrogram for males' ratings of secretary at work*

Females' ratings of boss at work. Compared with the six subclusters of Figure 1, Figure 2 shows only four groupings, which are part of two clear-cut higher-order clusters, namely 'positive' and 'negative'. For both 'positive' and 'negative' clusters there is an 'intimacy' subcluster. The remaining elements fall under the subclusters of 'work' and 'conflict'.

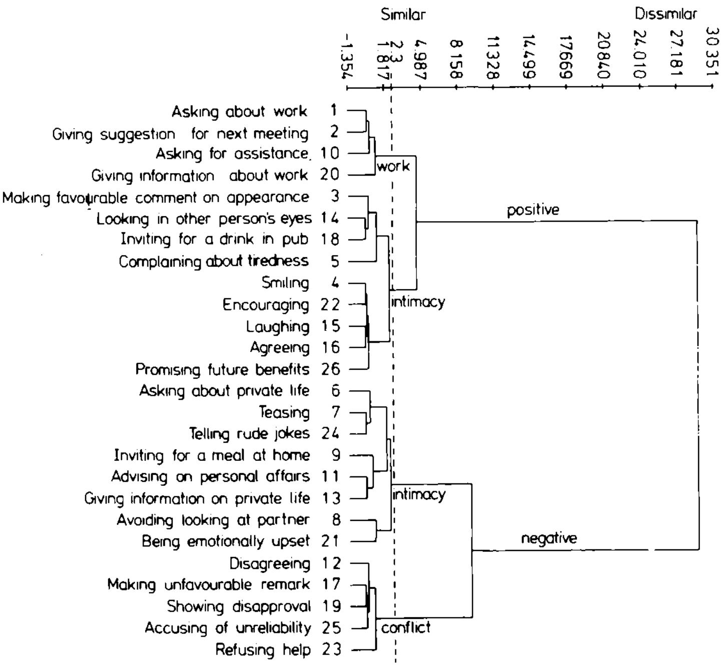

Figure 2. *Dendrogram for females' ratings of boss at work*

Males' ratings of girlfriend on date. As Figure 3 indicates, the two superordinate clusters 'positive' and 'negative' are both composed of two subclusters: 'support' and 'approach' for the 'positive' cluster, and 'conflict' and 'avoidance' for the 'negative' one.

Females' ratings of boyfriend on date. The 'positive' cluster is composed of 'work', 'intimacy', and 'approach' subclusters. The 'negative' cluster is composed of 'withdrawal', 'conflict', and 'avoidance'.

As mentioned above, the behavior of secretaries as seen by males in the work situation is characterized by six subclusters (Figure 1) and the behavior of bosses as seen by females is characterized by four subclusters (Figure 2).

For the date situation, the outcome is reversed. For males' ratings of girlfriends on the date there are fewer subclusters (four) (Figure 3), whereas for females' ratings of boyfriends on the date there is a more differentiated picture (six subclusters).

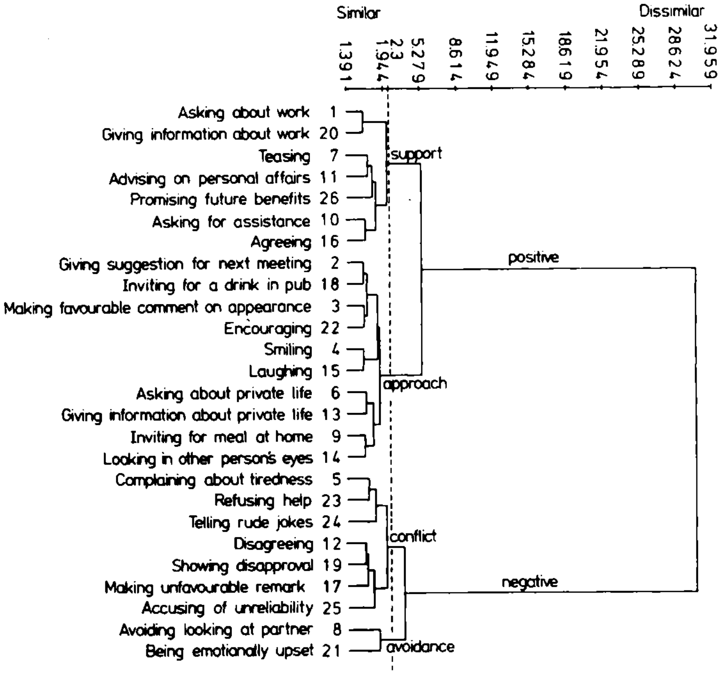

Figure 3. *Dendrogram for males' ratings of girlfriend on date*

2. *Do similar clusters of elements which appear in different conditions have different profiles?*

Some indication of similarities and differences, in the ratings of elements in the different conditions, is provided by plotting the profiles of the scale ratings of clusters which occur in more than one condition. In fact, most of the clusters which are given the same label are not identical in terms of the elements which make up the clusters. Those elements which *are* common to more than one condition, however, may be looked at by plotting the mean rating which such a group of 'common' elements was given on each scale in each condition. The clearest example is the 'negative' cluster; this had a

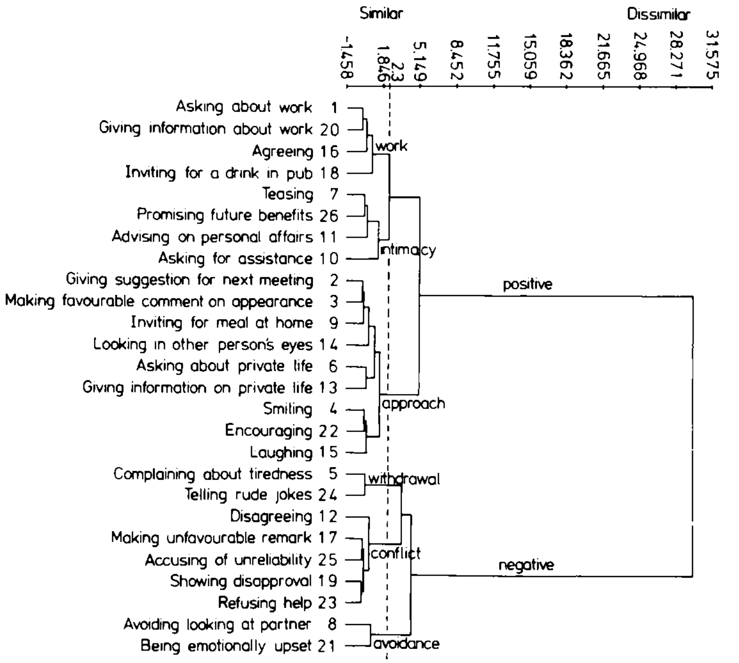

Figure 4. *Dendrogram for females' ratings of boyfriend on date*

different composition in each condition, but it always contained the elements 12, 17, 19, 23, and 25 (disagreeing, making unfavorable remarks, showing disapproval, refusing help, accusing of unreliability). The profiles for these elements of the four negative clusters are shown in Figure 5. It can be seen that these four profiles are quite similar.

The main divergence is on the *difficult to deal with* scale: males rated females as more difficult to deal with than females rated males in both situations.

Another comparison was made for the intimacy cluster of elements (6, 7, 11, 13, 21, and 24) for males and females at work (asking about private life, teasing, advising on personal affairs, giving information about private life, being emotionally upset, telling rude jokes). The results are shown in Figure 6. It can be seen that again the profiles are very similar; none of the differences appear to be as great as those for the negative cluster. Similar results were obtained for the 'approach' clusters.

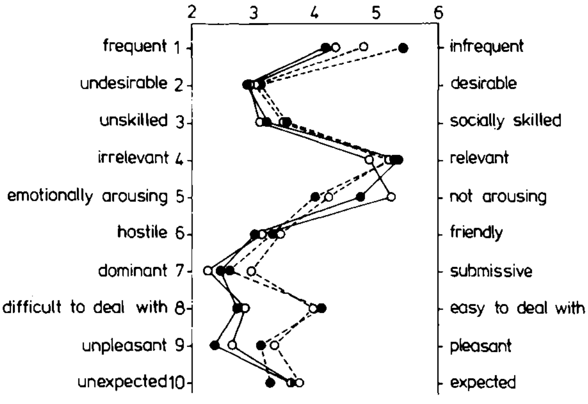

Figure 5. *Negative cluster: males' and females' ratings of behavior of other at work and on date. (Items making up cluster: 12, 17, 19, 23, and 25)*
Key: Males' ratings of secretary at work ●——●
Females' ratings of boss, at work ●– – –●
Males' ratings of girlfriend on date ○——○
Females' ratings of boyfriend on date ○– – –○

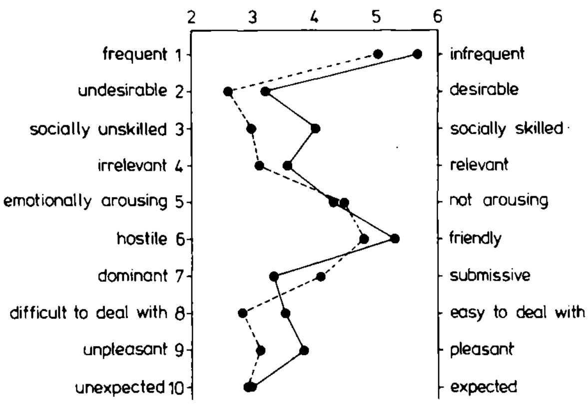

Figure 6. *Intimacy cluster: males' and females' ratings of behavior of other at work. (Items making up cluster: 6, 7, 11, 13, 21, and 24)*
Key: Males' ratings of secretary at work ●——●
Females' ratings of boss at work ●– – –●

3. ***Are specific pairs of elements seen as similar in one situation but not in another?***

The approximate similarity scores (read off directly from the dendrogram) for certain pairs of elements in each condition are shown in Table 3. These values are the points along the similarity scale at which the clusters, containing each of the two behavioral elements being compared, join. The higher the score, the more different are the two behaviors thought to be, in that condition. The criterion for whether two elements were similar was that they should appear in the same cluster.

Table 3. *Table of approximate similarity scores for certain pairs of elements within four conditions*

Elements	Date		Work	
	Males rating girlfriend	Females rating boyfriend	Males rating secretary	Females rating boss
1 and 6				
Asking about work v. asking about private life	5.3	5.3	21.0	28.0
9 and 18				
Inviting for a meal at home v. inviting for a drink in pub	1.8	5.2	1.0	28.0
20 and 13				
Giving information about work v. giving information about private life	5.3	5.2	21.0	28.0
7 and 3				
Teasing v. making favorable comment on appearance	5.3	5.2	5.0	28.0

Scores shown are approximate similarity scores – low scores mean the two elements are very similar.

From these tables it can be seen that there appears to be some support for the expectations:

1. Asking about work and private life would be seen as similar on a date (1 versus 6) but different at work. This was confirmed.
2. Invitations to home and pub (9 versus 18) would be seen as similar on a date but different at work. This was confirmed for females rating males. For males rating females they were seen as similar in both situations.
3. Giving information about private life and work (13 versus 20) would be seen as similar on a date but different at work. This was confirmed.
4. Teasing and favorable comments on appearance (7 versus 3) would be seen as similar on a date but different at work. This was confirmed, for females rating males. For males rating females they were seen as similar in both situations.

DISCUSSION

The first expectation was that the general structure of clusters would differ in the different conditions, in particular that the positive-negative division would be found in all four conditions, but more clearly in the more social situation (the date). There was indeed a positive/negative division for all four conditions but more clearly in the date condition: the separation of the divisions within the positive and negative clusters occurred at a lower point in the scale for the date than for work, so the positive and negative aspects were more tightly clustered within each division. Furthermore, the negative branch (in males' ratings of secretary at work) was not separate in itself but was linked with a social branch to form a large social and negative cluster. The explanation in this condition may be that both negative and obviously social elements interfere in different ways with the main goals of the situation. This is seen more clearly by the boss (evaluating the secretary's behavior) than vice versa.

It was also expected that the work versus social distinction would be clearer in the work situation. In fact there were no clear work clusters for the date situation. In the office situation the next division of clusters after positive and negative was into work and social. In the date, males saw work-related elements of behavior from their girlfriend not as separate but as forming part of a 'support' subcluster which linked with an 'approach' subcluster to form an overall positive group of behaviors. In females' ratings of the boyfriends' behavior on a date, the work-related items were grouped with 'inviting for drink' and 'agreeing' in the 'work' subcluster. In addition, this cluster was strongly similar to the intimacy cluster (these two joining to form a branch of the 'positive' cluster).

One of the unexpected findings was the overall pattern of the work and date situation as perceived by males and females. Males saw the work situation in a more differentiated way than did females (6 v. 4 clusters), whereas females made finer distinctions within the date situation than males (6 v. 4 clusters). One is almost tempted to say that both males and females perceive their 'culturally allocated domain' in a more differentiated way.

Surprisingly, perhaps, it was found that the profiles (of mean scores on each of the 10 rating scales) for the 'negative', 'intimacy', and 'approach' clusters were all rather similar in the different conditions – the main exception was that males found negative behavior in females difficult to deal with.

Of particular interest in the comparisons of the similarity scores for some of the pairs of elements is that the distinction between work and social *behaviors* appears to be more salient in the work situation than in the social situation. For example, asking about working and asking about private life were seen as very similar on a date but totally different when at work.

It should be emphasized that these results are exploratory. The next stage could be to use a method which makes it possible to use tests of significance.

PART IV

Expressive and Linguistic Aspects of Nonverbal Behavior

NICO H. FRIJDA

The Meanings of Emotional Expression

Nonverbal communication rests, to a large extent, upon expressive behavior. This paper intends to explore the nature of expressive behavior, in order to assess the nature of its contributions to nonverbal communication.

There are a number of double meanings and ambiguities which lurk behind words that are used, and which befuddle the issues involved. The word 'communication' can be used in a variety of ways and it is disastrous when the connotations of one use are carried over to another one. 'Communication', in a wide sense, is used to refer to the mere fact that the behavior of one animal is influenced by his perception of the behavior of another animal. 'Communication' may also be used in a more proper, much more restricted sense, when it refers to behavior produced in order to be perceived by another animal, and in order to influence the latter's behavior. 'In order to' may refer to intentional activity, as in most language production; or it may refer to the evolutionary advantages which, supposedly, have led to the development and survival of the behavior concerned, as in animal calls and rituals. The wider and the more restricted sense should be kept clearly separate. There is no doubt that emotional expression contributes to communication in the wide sense. An important problem, however, is to what extent emotional expression has anything to do with communication in the second, more proper and more purposive, sense.

Related to the distinction of communication in a wide or in a restricted sense is the distinction between messages sent and messages received. The fact that some person or animal 'receives a message' does not necessarily imply that such a message was sent in any meaningful sense. A somber landscape and depressing weather are cases in point: the person receives an impression, but the landscape or the weather never sent one. Physiognomics present other examples. People wearing spectacles appear, on the whole, more honest, intelligent and diligent than people without spectacles, even if these same people have laid down their glasses (Thornton 1943). Moreover, such messages that may be sent need not be understood correctly or, conversely, messages received do not necessarily correspond to the messages that have been sent. 'Receiving messages', receiving impressions, being influenced by the behavior of others does not imply that a message was sent, that the impression was in some sense 'correct', that the other person's behavior intended the resulting influence. For every behavior which participates in 'communication' in the wide sense, it has to be determined anew whether it is 'communicative' in a more restricted sense – as well as whether the messages received to correspond to messages emitted. Disentangling a few of these issues is the aim of the present paper. To put it more specifically: how communicative (in the restricted sense) is emotional expression, and what does it communicate?

EXPRESSION AS USEFUL BEHAVIOR: DARWIN'S FIRST PRINCIPLE

Much of emotional expression, although it may convey information to an observer, indeed does not appear to be meant to do so. Rather, it appears, as the first part of Darwin's (1872) first principle has it, to be of 'direct or indirect use' for the subject, in ways which have nothing to do with communication.

Of course, Darwin emphasized in his first principle the apparent uselessness of expressions under some of the conditions in which they are manifested. At the same time, however, he stressed this direct or indirect use, not only in the phylogenetic past but also in the actual present. In fact, such use can be found in much of expression, to such an extent that it has given rise to an 'action theory of expression', in such authors as Darwin's contemporary Piderit (1867), or more recently Karl Bühler (1934). The principle that expression (much of expression) is useful, or at least meaningful, behavior can be applied to the detail of much expressive behavior and, in particular, to facial expression.

Most writers on emotion connect positive emotions to approach behavior and negative emotions to avoidance or withdrawal, for example, Arnold (1960). In fact, positive emotion can hardly be defined other than as disposition or inclination toward approach, or at least toward sustained intercourse with its object. Negative emotion, similarly, can best be defined as the tendency toward withdrawal, or, at least, toward abandonment of the situation and toward toning down its effects. Much of expression can be considered as variants of approach or withdrawal activity, or, more precisely, as either turning toward the source of the emotion, sensory readiness, readiness for approach and for response to his or her action; or protective activity, inhibition of action, turning away and decrease of sensory readiness and vulnerability. As an example one may take expressions of fear. Fear may manifest itself in various ways, but protective components are, it would seem, present if anything at all is translated into behavior: protective narrowing of the eyes; withdrawal of the head, both backwards and into the shoulders; wary control or inhibition of movement; or all-out protective activity such as hiding behind mother's skirt or some object.

The 'typical' facial expression is, it seems, part of overall protective crouching. If subjects are asked to adopt a fearsome facial expression, and to 'complete' that expression, they tend toward that crouching attitude (Frijda 1956).

It may be stressed, in passing, that components of such protective behavior occur as admixtures to other behavior. Full-blown frightened expressions may be relatively infrequent, but not so fear's traces: constrictions of movement; protective slowing, in which movement and speech are overly controlled because the subject never knows what consequences his movements may elicit; a readiness for fuller constriction manifest only in its beginning, the frown (cf. Landis and Hunt 1939); or a furtive mode of looking, in which all that remains of protective behavior is an unwillingness to face a situation frontally, with concomitant longer latency of flight.

Patterns of looking indeed offer clear arguments for an action theory of expression. The gaze contributes heavily to expression; and its functional nature is evident. Looking is establishing some sort of contact, and varieties of looking represent modulations of such contact. Looking steadily, or intently, or stealthily or hesitantly, or looking away are of 'direct use' for seeing more, or better, or more continuously, or while maintaining readiness for flight, or while dividing attention, et cetera, et cetera. A sad stare goes sideways or downward because attention is directed toward things absent, or because it avoids things present. Razran (1961) has pointed out that affective behavior is characterized insufficiently by just approach and avoidance behavior; one should add the category 'versive behavior'. Opening up and closing down, both visually and with respect to bodily contact, form a dimension of expression at least as important as approach and avoidance. The behavior concerned corresponds intelligibly with emotional states such as attention, fascination, 'innocence', receptivity, fearlessness on the one hand, and boredom, distaste, worry and anxiousness, reticence and distrust on the other. That such emotions and such behavioral traits may in fact correspond is suggested by correlations between such traits and judgments of emotions (Frijda 1969).

Not all expressions are equally transparent, but still their functionality may be evident. As an example I mention the expression of concentration, consisting of a frown and possibly slightly narrowed eyes. The frown and narrowed eyes are clearly instrumental in maintaining eye-fixation in outward concentration. Oddly enough, they also seem instrumental in mental concentration (Schänzle 1939); it is hard to suppress them, in particular during efforts to overcome a distraction and the reason may be that they are a handle, so to speak, for voluntarily manipulating attention, whatever its nature.

The functional nature of (much of) expression deserves emphasizing for several reasons. First, expressive behavior, facial expression included, is *behavior*; it is action, and not usually the manifestation of some localized bodily signal, such as pointing may be, or pursing the lips to signal doubt. It is behavior of a special kind, to be sure. Expressive behavior can be interpreted as relational behavior – behavior, that is, whereby the subject establishes, enhances or weakens his actual or potential relation with the environment, or with specific objects in that environment.

Actual relations are involved in looking or approaching, or withdrawal; potential relations in exposure and in protective activity. Expression is behavior which primarily modifies such a relation without modifying the environment, or which at least endeavors such modification. This holds generally for expressive phenomena. Someone who eats greedily, for instance, does not add an expression of greed to his eating behavior. He eats because he intends to ingest food, and he eats greedily because he wants to ingest it as fully and as rapidly as possible. That is precisely what his 'greedy' behavior consists of: speed, grasping a new bite when the previous one is still being chewed, stuffing his mouth, et cetera.

The second reason for emphasizing the functional nature of expression is that it shows expression to be linked to emotion in a nonarbitrary, nonconventional, intrinsic manner. If emotion consists, apart from evaluations, of action tendencies, as Arnold (1960) among others puts it, then expression is the realization or implementation of these tendencies. If fear is a tendency away, or anger a tendency against, or greed or interest a tendency toward, that is precisely what expression manifests, in its own incipient, or preparatory, relational way.

I have labelled expression, a few paragraphs above, 'useful or at least meaningful'. One may doubt, under many circumstances, the usefulness of approach tendencies, or of protective impulses. Emotional tendencies may be silly. But *if* protection is desired, crouching may be the only remaining possibility.

The hypothesis of an intrinsic relationship between emotion and expression encounters a number of difficulties. One of these is the fact that a given kind of emotion, say fear or anger, may be expressed in a large variety of ways, many of them rather unspecific. Empirical evidence concerning such variety (e.g. Landis and Hunt 1939) has been criticized on the grounds of experimental confusions and of the posibilities of mixtures of emotions and of inhibition of expressions (Izard 1971; Ekman et al. 1972). However, the 'standard expressions' mentioned in the literature (Izard 1971); Ekman et al. 1972) can better be considered 'prototypes' (in Rosch's sense – Rosch 1976) than as the true original expressive patterns corresponding to the major emotions. A reasonably unselected sample of spontaneous expression did show such variety and, sometimes, nonspecificity (Frijda 1953). In fact, extreme emotions seem to tend rather to expressive flatness than to the violent stage-expressions; that at least is what current newsreels from crisis areas suggest. It does not appear too difficult to account for variability of expression, even while maintaining an intrinsic relationship between expression and emotion, if it is assumed that an emotion consists of a relational tendency or impulse, evoked by an evaluation. It is obvious that a tendency may be implemented, in principle, in a variety of ways, and that one and the same relational goal may be achieved by various means. Any behavior instrumental for protection may occur as an expression of fear: crouching, narrowing the eyes and frowning, backing away, hiding behind the table or behind mother's skirts, just inhibiting all action; the selection of behavior may depend upon individual predilections, upon acquired skills and, particularly, upon the dynamics of the situation which may shape freezing rather than crouching or the fearful face. No doubt some of the behaviors implementing a given tendency are more original, more innate, than others, but such difference does not necessarily imply a difference in adequacy as expressions, or in spontaneity in their occurrence. An insult, while certainly learned, is no less a proper manifestation of the desire to hurt than spitting, or clenching one's fists, or the readiness to bite which may be involved in some angry snarls.

USELESS BEHAVIOR:
DARWIN'S FIRST PRINCIPLE, SECOND HALF, AND SECOND PRINCIPLE

The difficulties of a functional interpretation of expression are more serious, however, since some expressions are clearly useless and do not help the subject in any meaningful way. A disgusted expression may be shown in response to a morally repulsive situation although it is then obviously of no 'direct use'. Several interpretations are possible which are variations upon Darwin's associational theme, without having to draw upon evolutionary explanations. The responses concerned may be considered, for instance, as the product of 'errors of judgment' rather than as mere communicative symbols of evolutionary origin. Repulsiveness remains repulsiveness whatever the sensory nature of the event; a repulsive story may, on occasion, be truly nauseating. It would take, one might say, a discriminatory effort to realize the uselessness of disgusted rejection when the eliciting event is nongustatory, as is the case in realizing that the eye-blink does not help in response to a sudden loud noise. Also, it is likely that in much human emotion and expression, magical thinking plays a role (cf. Sartre 1934): when I do not look, things cease to exist; when I dislike events, they may end. Some roots of this magical thinking will be discussed in the next section.

It is important to realize that, if these interpretations are valid, the uselessness of useless expressions is, so to speak, a psychological rather than an evolutionary phenomenon. The person does not use hereditary signals but manifests primitive behavior.

Other expressions, or expressive aspects of instrumental behavior, which seem to defy a functional interpretation are those which fall under Darwin's second principle – that of irradiation of nervous energy. One may update Darwin's terminology, however, and come to the conclusion that much of expression is the direct manifestation of 'activation' – of the presence or absence of impulses to act and to respond. Exuberance in joy and retardation of movement in grief are prime examples. They are neither 'useful' in any meaningful sense, nor 'expressive' in the sense of exteriorizing some inner state; they just translate the existing state of enhanced or diminished 'intentionality' into overt action.

This notion of 'direct manifestation of activation' may be extended beyond variations in activity per se. Behavior may be expressive not because it implements some form of coping with the environment, but because it evidences a failure to do so. To some extent this is the case with sorrow and sadness. The lack of intentional, or attentional, direction in a wandering and vacuous gaze or in a gaze slanted downwards may translate not merely an absence of activation, but also an inability to deal with the situation at hand. This is clearly so in some expressions of anxiety. Inhibition of movement, unsteady glance, general rigidity are the behavior patterns corresponding to the impossibility of more constructive interaction. Absence of action or inability for action leave behavioral images – one cannot become invisible – which are 'expressive' precisely because they translate absence of impulses for action, or absence of structure in those impulses. The behavior patterns are expressive to the observer, although no 'expression' is produced in a positive sense – a clear example of the discrepancy between messages received and messages sent, as mentioned in the beginning of this paper.

INTERACTIONAL EXPRESSIONS

The expressive behaviors discussed in connection with Darwin's first principle are functional because they modify sensory readiness and bodily vulnerability, or because they are part of approach and withdrawal tendencies, or preparations for attack, for bracing oneself and the like. Their form and existence, it is asserted here, owe nothing to communication, although they may be utilized as cues by conspecifics, and eventually, in some secondary fashion (in make-believe) by the subject himself. The same holds for those expressions discussed in the preceding section.

There exists, however, expressive behavior which is useful primarily because of its effects upon others, and which presumably, therefore, derives its form and existence from that effect.

The most obvious examples of what will be called 'interactional expressions' are found in expressions of anger. Expressions of anger are often considered mere remnants of, or preparations for, attack behavior, or 'redirected' derivations thereof. For some features of angry behavior, such as clenching of fists and bracing oneself, these may be adequate explanations. Most aspects of angry behavior, however, appear to be more akin to bluffing behavior; that is, they are geared to intimidating others and causing them to abstain from obnoxious activity, either by suggesting readiness and willingness to fight if the other might continue to annoy, or by the mere suggestion of power.

Much human angry behavior appears quite similar to bluffing behavior in chimpanzees, by which they, for instance, may assert their dominance (Van Hooff 1973). Loud shouts, erect posture, slamming of tables and doors and demolishing the dinner-service have their close chimpanzee counterparts, such as loudly beating oil-drums or swinging broken-off branches. These behaviors, in the chimpanzee, do not look like redirected aggression (an interpretation sometimes given to human angry destructiveness) but are, rather, behaviors which effectively frighten the bystanders into flight or submission. Let it be stressed that a human angry behavior such as foot-stamping appears to be an innate response, which might weaken the notion of redirected aggression; the evidence comes from Eibl-Eibesfeldt (1973) observing the response in an idiotic, blind-deaf girl.

The point I want to emphasize with respect to the expression of anger is its effectiveness in modifying the behavior of other people or other animals. Angry behavior is, to repeat, frightening and awe-inspiring, or at least oppressive; the person showing it is to be treated at least with circumspection.

Interactive expressions, too, are not mere evolutionary remnants, retained because of some signal value. They are actually functional, in a manner which fits the presumed emotional tendencies, just as with the relational behavior discussed previously. In protective fear, an effort is made to diminish some of the annoying consequences of the event; in anger, an effort is made to diminish the annoying event itself.

There are, of course, other interactive expressions than those of anger. Most notable among them are those exquisitely human expressive patterns, crying and smiling. Crying in its vocal aspects is obviously equivalent to animal distress calls, as they are emitted by, I believe, every infant bird or mammal, and it is as effective in eliciting care-taking behavior. Murray (1979) has recently discussed crying as a releaser in the ethological sense; for our present purpose this means its compelling demand upon the hearer, and its interactional effectiveness. Murray quotes Konner (1972) who reports that in a society which does not condemn giving in to crying, the average response latency of the caretaker is six seconds. If the appeal of crying is resisted, for instance due to its excessiveness, strong negative affect seems to result, as suggested by the evidence concerning a relation between excessive crying and child abuse. Crying in adults, too, appears to be hard to resist, leading either to 'softening' and sympathy, or to what most likely is an opposition to this appeal, irritation or anger ('no, please, don't cry!'). The impact of crying may, in part, derive from its sheer loudness and conspicuousness, although it is likely that some special sensitivity in the hearer is involved. As for its characteristics, it may possibly be argued that these stem from noise-making during excitement, and from the resulting fatigue. The facial pattern, weeping included, remains so far without a satisfactory explanation.

Smiling is another of the expressions – together with crying and laughter – which defies a functional, relational interpretation. Its significance is usually seen as being an expression of joy (e.g. Izard 1971). Insight into its meaning or significance is hindered by its confusion with laughter, of which it may sometimes, but probably not always, be a weak form. Van Hooff (1972) presents evidence of both a functional difference, and a difference in phylogenetic origin of smiling and laughter. Smiling, or its homologues, according to his evidence, might originally be a submissive signal, indicating to other animals that no hostility is intended, which has gradually become a reassurance signal and finally one of 'friendliness'. The common component is explicit nonhostility, rather than joy. The smile may function in this manner because it is a conspicuous modification of the 'vocalized bared-teeth-face' – a defensive threat expression; it may have evolved as a distinctly 'neutralized' version of the latter, somewhat in the sense of Darwin's third principle. The smile, indeed, may be viewed as an action which is explicitly nonapproaching, nonwithdrawing and nonaggressive; it has, in fact, been viewed as the expression of a state of 'active rest' (Buijtendijk 1947) and, thereby, as a reaction of 'adequacy' (Goldstein 1957); and its effect on other people may precisely derive from these characteristics. At any rate, the smile, too, is a compelling stimulus. Its reward-value for the mother in infant-mother interactions has been discussed by Vine (1973). It is quite difficult to resist the pressure of a smile, by remaining frozen in response to a smiling greeting, as much as it is uncanny when one's own friendly approach is answered by an unmoved face, as for instance in autistic children. In short, the smile appears, to a large extent at least, to function as a pacifier, or to set the tone in friendly interaction.

There is a class of expressive behaviors which appear to lie midway between relational effectiveness and interactional effectiveness: those behaviors which have to do with the subjects' visibility and, thereby, attraction of attention. Freezing, in frightened rats or rabbits, is obviously useful behavior in this manner; it ties in with the predators' perceptual activities. In human expressive behavior the same interplay operates. Fearful crouching may have perceptual inconspicuousness as its aim, as much as physical protection. Such inconspicuousness is clearly the desired state in the subdued movements of shyness and timidity, and a similar aim may be at the root of the low voice, the intellectual reticence in conversation and possibly even the intellectual blocks in examination anxiety or stage fright. Clearly, inconspicuousness may be achieved or sought in a variety of ways, either by posture and voice, by inaction, by avoiding catching other peoples' glances, by avoiding the focal points of the others' visual field, such as the middle of an open space. Conversely, attention-seeking behavior plays upon the other person's attentional propensities in a positive way. It does so in intimidation, angry or otherwise, in postures of pride and self-confidence, or in the pure attention-seeking of impatient moving about, talking, shouting, looking at and trying to catch someone's eye. All these conspicuousness-inconspicuousness behaviors are, it seems, as primitive and fundamental as the relational expressions of fear, distaste, or interest. The animal freezing attests to this, as does the 'guilty' slouching behavior of a dog, or its various ways of forcing its owner to pat it, to play with it, or to take it for a walk. Similarly, a number of 'classical' emotional expressions – the face of guilt or remorse, with bent head and downcast eyes, for instance – follow from these principles of social visibility.

The interactional aspects of the gaze have been alluded to above, and have been treated extensively by Argyle (1975), Kendon (1973), and Exline and Winters (1965). He who looks does not only see but is seen to be looking; he who looks away is seen to be not looking, and he knows this. Or, at least, he regulates his own looking behavior and accordingly the dynamics of the gaze; hesitant, askance, stealthy, nervous, steady, can be functional in this fashion too. Staring-down, as intimidating behavior, is observed in chimpanzees (Van Hooff 1973), and the other gaze modes can probably also be traced a long way back, both phylogenetically and ontogenetically. They constitute functionally effective behaviors, in which the relational and the interactional blend or fade into one another.

UNDERSTANDING EMOTIONAL EXPRESSION

The foregoing considerations concerning the nature of emotional expression have implications for the theory of 'understanding expression', and thus for nonverbal communication (cf. Frijda 1956, 1969).

'Understanding expression' involves, primarily, nothing but the appreciation of the content of expression in the senses just outlined. One perceives the subject's opening up or closing down, his reticence or responsiveness, his readiness for approach or withdrawal; or one perceives his threat, power, his fuller or lesser presence, et cetera. Understanding expression amounts, in many instances, just to an immediate reading of the 'directions' and activity levels inherent in the expression, without any reference to feelings behind the manifest behavior. The sources of such understanding seem fairly simple: a general appreciation that the approach and sensory readiness imply enhanced intercourse with the subjects' environment, and the sheer perceptual impact upon the observer of size and vivid movement, of loud noise, etc. The only thing which seems to be required, in addition to the preceding, is the ability to view a piece of behavior as the possible starting-point of its continuation – a threat as a possible beginning of attack and the like (for sounds such as crying, more specific sensitivities may be involved). In any case, understanding expression involves an appreciation of relations where appreciation remains primarily in the behavioral and environmental domain. It consists either of sensing an impact upon me, the observer, or of sensing a situational referent for the perceiver's behavior: protective withdrawal indicates either success and leeway for me, or it indicates its complement, the presence of some threat in the environment. Only secondarily may the observer hypothesize some 'mental entity' – a feeling, an intention – behind that behavior. This is not necessary, however, for 'understanding' to occur. And it is obvious that to this primary understanding, the question of 'communication' – of feelings or intentions communicated – does not pose itself. The meaning is there, outside, as relational activity, as reference to possible forthcoming activity and to external events, and as impact upon me, the observer.

THE IMPACT OF EXPRESSIVE BEHAVIOR

In a preceding section it was assumed that some expressions owe their existence as well as their form to their interactional effectiveness. They have emerged as evolutionary products, or they emerge as products of forces in the actual psychological field (cf. Lewin 1937), thanks to their impact upon others.

These expressive behaviors, here termed interactional, are not the only ones which exert an impact upon others. Most expressions do, even those for which no such impact has to be assumed as a formative influence. Such angry behavior as is instrumental for attack frightens as much as threats or intimidation; somebody looked at may feel to be made an object (Sartre 1943) although this may, for the observer, be a mere, and possibly unwanted, side effect.

There is much expressive behavior with powerful effects. Most notable, in addition to anger, are all forms of helplessness: sadness and grief, timidity, fear, but also friendliness and happiness. The effects depend upon the relationship involved. Fear in others may incite enhanced attack and bullying, the opponent sensing leeway; but given a close relationship, fear may constitute a pressure toward protection. Phobias often form the basis for a complementary union, in which the nonphobic spouse derives his or her security from supporting the other (Barendregt and Bleeker 1973). The same is true for the helplessness of the alcoholic: here, as in the marriages of phobics, the nonsuffering member may collapse when the sufferer is cured, the former being deprived of a sustaining satisfaction. Insecurity may lead to abuse by others, to pestering and taking advantage; grief may give rise to irritation. Both, however, may lead to consideration and to succor, to patient listening and consolation. The roots of these various forms of considerate and supportive response may lie in part in compassion; but they lie at least as much in 'sympathetic distress' as Hoffman (1975) calls it. In an effort to get rid of annoyingly appealing events, for example nurses may go out of their way to quieten excessively crying infants, as Murray (1979) mentions. The pressure may be heavily felt, particularly if the observer feels responsible, or is made to feel responsible, for the sorrow, helplessness, or pain.

The point is that the subject undergoing emotion knows this, or, more generally, that the effects upon others of his expressive behavior are fed back and influence his tendencies to manifest such behavior. Emotion is used, willingly or unwillingly, as a way to manipulate the human environment. For anger this is most evident: a man or woman may tyrannize the family by outbursts of anger; the same for superiors in hierarchical relationships – employers or military superiors, as many a war-novel illustrates. Such anger appears to be a function of its success: it is, it seems, enhanced when the environment tends to give in and be tyrannized, and it seems weaker or absent when the environment is immutable or apt to strike back. Nor is such anger to be valued only negatively, as it may be a driving force in securing some social change, as in the Black Power movement, or other social protest movements, where self-confidence and the success of anger reinforce each other.

The instrumental use of crying by infants may not be as solid a fact as was once believed (Murray 1979), but crying in pain and sorrow, in children as well as adults, still seems to be highly dependent upon the help and compassion elicited. Crying is an effective indirect appeal for help – the more effective, it seems, because it does not express helplessness but *is* helplessness in behavioral form. Plessner (1941) interpreted weeping as a 'reaction of capitulation'. It in fact is used in a variety of circumstances as a coercive method for obtaining help, or at least indulgence, such as replacing an admission of failure in oral examination (personal observation), or avoiding having to make a confession concerning painful matters (Janet, as quoted by Sartre 1934). In such situations crying amounts to soliciting understanding by nonexpensive means.

Coercion by being hurt or, generally, sadness, is a subtle but widely used and usable technique: not responding to a remark, but looking in a slightly wounded manner out of the window. It may be consciously applied, as in the traditional ploy of 'mother is not angry but sad', but it may, less consciously, pervade the interactions in a relationship, with the additional advantages of filling the partner with guilt. Examples are found in Berne's (1964) *Games People Play*, together with other mentioned forms of emotional and expressional blackmail. In fact, sadness and anger fade into each other, since sorrowful withdrawal – any form of withdrawal – may deprive, and thereby hurt or punish or irritate the other person. Many people are masters in manipulating contact such as by striking, provoking, or tantalizing. Obviously, the application of the effects of one's own openness and accessibility, or its opposites, and of one's own conspicuousness or inconspicuousness, are not confined to the context of anger and sadness, that is, to the effects of intimidation and appeals for help. A major domain, of course, is that of the sexual emotions and of obtaining attention with its various emotional backgrounds.

To some extent all the above secondary applications of expression involve instrumental use of the behaviors concerned. The occurrence, or enhancement, of those behaviors can be understood in terms of operant conditioning principles, in particular when the notions of modeling, vicarious reinforcement and anticipatory reinforcement by way of fantasy are added (Bandura 1977). These are the principles used, in fact, to explain instrumental aggression (Bandura 1973), the surmised reinforcement of infant crying and the like. The expressive behaviors have been loosened from the emotional tendencies from which they originally sprang, as is the case with the smile of politeness or other social facial gestures.

However, this is only part of the story: it applies to only a part of the interactional production or enhancement of expression. Most of the examples involve more, namely, the production or enhancement of emotions as true and honest sources of the behavior concerned. The infant which manipulates his mother by crying not only cries but is really upset, and may become more so until the crying achieves its end. The phobic husband is really in a state of anxiety, or in a more violent state of anxiety when his wife is not there. The bullying father or sergeant may be truly angry even though his anger-fits may disappear when nobody pays any attention. The helpless partner in a relationship may be really depressed although his depression must be understood, at least in part, as the application of the coercive method of the weak – of one of the strategies of conflict (Schelling 1963).

It is not that behaviors are produced because of their effects, but that emotions underlying these behaviors are. The persons concerned perceive and appraise the situations as angering, frustrating, devoid of support, saddening, or whatever corresponds to the given emotion. These appraisals give rise to the relevant autonomic reactions, and to the tendencies for change in the situation which define 'emotion'. I think, at least, that these attributes of emotion are present in the situations outlined, and that such presence gives rise to the fairly general endorsement by clinicians of the assertion under discussion. All this implies that much of emotion, and expression of emotion, in human interaction is playacting in which all players believe. The subject is both sincere and insincere. He is sincere in indeed undergoing the emotion he manifests; he is insincere in that the emotion may not be as necessary or as unavoidable as he thinks and professes.

The emergence of emotions out of their anticipated and interactional effects may not be as odd as it seems if it is realized that a negative emotion is a product of, on the one hand, an event which hurts or threatens some interest, need, or value which is important to the subject, and, on the other hand, of the context of that event, from which it derives much of its meaning. A physical threat or a moral prohibition may constitute a frustration; such a frustration gives rise primarily to fear if it is viewed as threatening general well-being; to sadness if it is considered as possessing finality, and therefore constituting a loss; to anger if it is attributed to a responsible and, in principle, mutable agent.

Cognitive processes are involved in appraising an event in terms of its impact for one's needs or values. Cognitive processes are also involved in interpreting what I call here the context of an emotional event, and it is particularly this interpretation of context which determines the nature of the emotion involved. A cat being hypothalmically stimulated manifests fear – he flees – if he sees an escape route; he gets into a rage – he attacks – when such a route is absent but a possible agent is in view (Hess 1962); and Hess gives a reasoned argument that here, too, emotion is involved and not just behavior.

Obviously, interests and other purposes may influence appraisals and interpretations, and thereby the nature of emotion. Interpretation penetrates emotion deeply. Anger results, as I said, when the frustration is attributed to an, in principle, mutable agent. Perceived mutability of an agent quite likely is a joint function of the power relationship between the subject and his opponent – again as seen by the subject: lack of 'competence' or self-confidence is generally supposed to predispose for fear, and competence or self-confidence (in some sense) for anger. The perceived mutability is, thus, in part determined by the knowledge of one's own possibilities for action and their effects (cf. Lazarus et al. 1970). Similarly with sadness.

The perceived finality of a frustrating event is a function of the subject's estimated helplessness. The appeal of the helplessness features of the situation are considered to be enhanced by the appeal of the effects of the corresponding actions (or rather, nonactions), and, in particular, of the childish dependent position into which the helplessness fits, which it evokes, and from which position help and assistance may be rightfully expected or demanded. Generally speaking, once an event has laid the groundwork for an emotion, the expected benefits of one's own behavior are among the factors determining the interpretation of context, and thereby the nature of the resulting emotion.

The same explanation may be couched in terms closer to attribution theory. If the subject uses a certain mode of behavior, or feels impelled to do so, he may consider himself to be in the corresponding emotional state; that is, he may transform his appraisals accordingly by shifting some emphases here and there, and so create the impulse behind the behavior.

Other, simpler mechanisms can be hypothesized, by which the expected impact upon others influences emotional behavior; one of these may utilize the flexibility of emotional control. Emotional intensity is not a natural event, for still other reasons than those outlined before. It is also a function of the subjects' estimate of the justifiability of a serious reaction and of the corresponding permissiveness of the situation, with respect to being upset. Frustrations of one's deeper or higher values justify more anger or woundedness, in our culture, than frustrations of amour propre. And here again, there is leeway for interpretation and appraisal, which processes can be bribed as well as any other appraising activity. The bribes consist in more advantages and more subtle advantages than only those of directly influencing other people's behavior. He or she who sorrows not only obtains more consideration, but also deserves more. There is more he or she can be excused for, or from, and there is more he or she is entitled to. to indulgences, to being served, to tasks taken over by others, tasks for which the subject is, alas, for the moment unfit.

Expressive behavior as discussed in this section is utilized in a secondary fashion. In its primary function it implements the emotional tendency, or translates the state of emotional tendency as such. In secondary application its occurrence and intensity is regulated by its anticipated effects, either directly, or indirectly by way of the emotion.

It is clear that the definitions of primary and secondary functioning are not mutually exclusive, and in fact spontaneous, natural expression and the manipulating kind blend over into each other, to the point of realizing that any honest man or woman may rightly doubt his or her own sincerity.

Clearly, also, the secondary functioning is closely related to primary functioning and springs from it. For one thing, secondary functioning is modeled after the interactional expressions. It extends the anticipation of expressive impact beyond those expressions which are, evolutionarily, made for the impact. Moreover, it shares with all other expressions their 'magical' qualities. Expression, in none of its forms, fulfills its functions by way of modifying the external world. Dangers are not lessened by protective movements; only their effects are, possibly, and that only by the subject modifying himself. Similarly with interactive expression and secondary functioning. In fact the entire notion of 'magic' (or, at least, of magical thought, in the sense of Freud's 'omnipotence of thought') may well derive from the experience that my feeling here, or my distressed convulsions here, suddenly result in succoring behavior over there. The notion of emotion as magical activity, of course, is most clearly expressed by Sartre (1934), in manners not very far removed from the considerations presented here.

For another thing, expression, in its secondary functioning, does implement an emotional tendency, just as in primary functioning. If grief is an undesirable state of loss or deprivation, then any action toward ending this state is functional, in the sense discussed earlier – although in simpler situations the grief only translates the absence of possible ways to obliterate the loss or deprivation. Even the form the entire emotion takes – the nature of the tendency, plus its implementation – becomes the means to find a way out of the frustrating situation, so that manipulating grief emerges where otherwise sad resignation might have occurred.

CONCLUSIONS

Bühler (1934) distinguished three functions of language: the expressive, instigating and descriptive (*Ausdruck, Appell* and *Darstellung*). One may apply the three possible functions to communications generally, and in this case to the interpersonal operation of emotional expression (the reader should be careful with the double use of the word 'expressive', referring to either a function or a class of behavior).

Emotional expression may be said to manifest a descriptive function, in that it may transmit information about a person's – or animal's – emotional state per se. The preceding paragraphs have tried to make clear that expression is used in this descriptive fashion primarily by the receiver. But even the receiver does so only occasionally, and it does not appear to be his major concern with the other person's expression. As for the sender, he may come to use his expressive behavior descriptively – to tell the others his anger, his helplessness, distress, or whatever. The direct appeal of violent or powerless behavior, in secondary expressive functioning, may blend over into a signal value, equivalent to the verbal statement 'you made me sad'. The descriptive function is obviously employed on stage and in the many stagings of daily life. The descriptive function does not seem to be the original function of emotional expression however; it does not appear to be the formative influence phylogenetically, or the reason for most of the occurrences in emotional situations. Nor is the content of the messages concerned with such a descriptive nature.

The expressive function may here be understood to involve the fact that expressive behavior, as I phrased it, implements the emotional impulse or is its translation into action. Expressive behavior is not expressive in the sense that language may be, or that art may be; it does not express something having an independent existence previous to its expression. It 'expresses' only insofar as the execution of a plan may be considered the expression of that plan; and that a plan aims at its execution and tends to oppose resistance to its execution. This execution is, largely, not for the sake of its being observed and understood but contains its own purposes.

The true and proper function of emotional expression – that is, the function which presumably governed its evolutionary development and its shaping in actual situations – falls outside Bühler's tripartite scheme, insofar as it is relational behavior, or the manifestation of the state of behavioral activation. In part this true and proper function, however, belongs in Bühler's category of *Appell*, of instigation. This concerns the behaviors termed 'interactional expressions' geared to modifying other peoples', or animals', behavior. This behavior modifies the behavior of others not primarily because it consists of a set of signals, but rather because the behavior is directly significant for others, in the sense of frightening or annoying them, or drawing their attention, or evoking their sympathy or sympathetic distress. For the receiver of communication, the instigation function extends much further. This serves as a source for reinforcement of expressive behavior or even emotion, which thereby, for the sender also, obtains an important instigation function.

Emotional expression contributes to nonverbal communication because observers may read the relational impulses in the corresponding behaviors, and because they may make inferences concerning the events which may have elicited such impulses. This concerns 'communication' in the wide sense – in the sense that the activity of one animal influences the activity of another animal, irrespective of the intentions or purposes involved.

Emotional expression also contributes to communication in that 'interactional expressions' are developed and manifested in order to influence the other animals' behavior. Again, communication is used here in a rather wide sense, namely that of the activity of one animal geared at influencing the activity of another animal. However, rather than considering such expressions as contributing to communication, they should be considered forms of communication: they constitute interactive behavior.

Emotional expression may also be explicitly communicative or interactional when its manifestation is regulated by the other animal's actual or expected response; and to the extent that emotion itself becomes an interactional phenomenon, a sort of transaction. Such transactional functioning of expression, and of emotion, builds upon the feedback from the impact which any expressive behavior may produce.

Finally emotional expression may 'transmit messages' in an explicit sense, meant to convey information concerning emotional states. It is the end-point of a series of increasingly communicative phenomena, with increasingly complex cognitive conditions and, in particular, an increasing dissociation between events and emotions, and between emotions and expressive behavior.

FERNANDO POYATOS

New Perspectives for an Integrative Research of Nonverbal Systems[1]

In an attempt to best complement the other contributions in this section, this paper outlines the integrative, interdisciplinary approach to nonverbal communication, both theoretical and methodological, which has been developing in the course of my work in this area. The various aspects presented here are all essential components, often mutually generated and always revealing new perspectives within seemingly unrelated fields. Given the steady growth of nonverbal communication studies as a rich and unique field in itself, the fact that specific systems and situations are being carefully analyzed, but rather independently of other co-occurrent, contextual or conditioning activities, seems to amply justify this approach, which I have always sought since I was first confronted with verbal language as a communicative tool. For I very soon realized that although words and their closest modifying features formed the core of most human communication situations, the total message was actually conveyed through their co-structuration with systems other than verbal. The resulting revision of the very concept of language – differing at any rate among disciplines – revealed such a complex mesh of consciously or unconsciously displayed systems that an orderly, progressive analysis of the communication situation appeared to be mandatory if a systematic, exhaustive and, ultimately, realistic view of it was to be attained.

1. THE SEMIOTIC APPROACH TO HUMAN INTERACTION

1.1. The researcher who resorts to a semiotic understanding of human interaction, which invariably involves verbal but above all nonverbal systems, finds that a fragment of an interactive encounter contains such an elaborate exchange of signs that his study can be truly systematic and exhaustive only when going through at least an initial phase of semiotic analysis of signs, as signs are what he is actually dealing with. Since verbal language cannot be studied in isolation, as has been done, the realistic point of departure in nonverbal communication studies is the integration of human signalling systems whereby message-conveying activities are assumed to be co-structured in a number of universal, culture-specific, or individual patterns.

Sensorially and intelligibly perceived in both space and time – and always against a cultural background – the channels seen in Figure 1 develop between two human bodies engaged in interaction, the receiver directly perceiving that activity (e.g. kinesics, visually) or assuming it through a secondary channel (e.g. perspiration, visually).

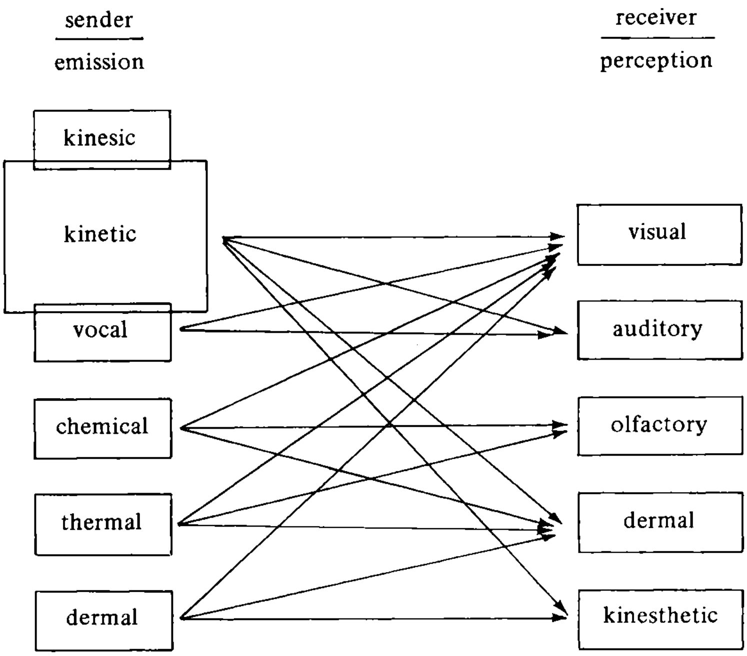

Figure 1.

The *kinetic* activity produces both kinesics (perceived visually, audibly, dermally, and kinesthetically) and sound (language and paralanguage, audibly perceived, but also visually interpreted through lip reading and co-occurring gesturing, though imperfectly); *chemical-glandular* activities are perceived olfactorily (perspiration, tears, natural body odor), visually (perspiration, tears, saliva), dermally (perspiration, tears) and gustatorily (perspiration, tears), all as primary perceiving systems, although odor and taste can be visually assumed as well; *thermal* reactions are sensed dermally (body temperature, perspiration, blushing) and olfactorily (through perspiration), but they can be visually interpreted too (through perspiration, tears, blushing); and *dermal* signs are perceived visually (pigmentation, blushing, scars, blemishes, goose flesh) and kinesthetically (inflammations, warts). They constitute, therefore, 8 ways of consciously or unconsciously emitting signs, which are consciously or unconsciously perceived by a receiver, eliciting or not eliciting specific behaviors on his or her part. These exchanges result in various somatic *systems*, namely verbal language, paralanguage and kinesics, plus proxemics, and those for which labels have not been established yet, although they even function in equally ritualized patterns, such as: the dermal-visual system (e.g. the elicitation of blushing and the various interactive behaviors attached to it), the thermal-dermal one (e.g. the sexual physical intimacy expressed through signs and signals of dual bodily temperature rises), or the chemical-olfactory one (e.g. the rejected or desired olfactory perception of certain natural [glandular] and artificial [manufactured body-adaptors, like cosmetics] chemical compounds). *Subsystems* are the needed distinction between, for instance, gestures, manners, and postures within kinesics, while *categories* and *subcategories* can identify, in kinesics, free (without contact with oneself or other bodies or objects) and bound (with contact) gestures, manners, and postures; or inarticulated paralinguistic alternants (a subsystem) within the system of paralanguage; and further distinctions, such as self-adaptors (rubbing hands) and alter-adaptors (hugging) in kinesics. Pursuing further this semiotic analysis reveals the different *forms* (e.g. a wink) and *types* (e.g. a slow wink), and even *subtypes*, which a systematic investigation brings forth when studying somatic systems (Poyatos in press).

1.2. As for the *coding process* whereby the somatic activities thus generated are transmitted as tools of social interaction, one must acknowledge the following factors. (a) That the receiver is usually more conscious of the emitter's nonverbal behaviors than the emitter himself because of their often unconscious nature. (b) The sign-meaning relationship, as signs can be arbitrary, imitative (either iconic, like a threatening gesture, or audibly perceived as echoic, as with onomatopoeias) or intrinsic (an actual movement of aggression); while meaning itself can be shared or only idiosyncratic and understood by the sender, or it can be encoded but never decoded (which suggests cross-cultural studies of verbal and nonverbal signs, the coding process of blind, deaf or traumatized interactants, the different decoding capacity of socio-economically and educationally lower persons, which behaviors are more affected between speaker and listener in emotional states, etc.). (c) That the verbal messages, therefore, are fully decoded in natural conversation only when words are perceived and decoded along with their complementary nonverbal behaviors. (d) The interrelationships of verbal and nonverbal systems, that is: as modifiers of one's own behavior or our co-interactant's, by affecting the meaning of the message (supporting, emphasizing or contradicting it with, for instance, certain paralinguistic features), the form of the message (preserving the meaning, but modifying, for instance, those paralinguistic features), or the type of behavior (e.g. my blushing can elicit either a verbal or a nonverbal behavior on my part or that of my co-interactant's); or simply as contextual behaviors, affecting perhaps the form of the behavior or the type of behavior, but not the meaning. (e) The basic functions of each activity in relation to each other and to the co-interactants, that is, a self-regulatory one among the behaviors themselves (proxemics affects paralanguage, language affects kinesics, kinesics affects paralanguage, etc.), and an interactional one between the participants (my kinesics affects her kinesics, my proxemics affects his paralanguage, etc.).

2. SOMATIC AND EXTRASOMATIC SYSTEMS, CULTURAL ANALYSIS, AND THE SPATIAL AND TEMPORAL STUDY OF NONVERBAL BEHAVIORS

2.1. Since signs are what culture is made up of, a study of the signs exchanged in social interaction must seek their somatic intersystem co-structuration, e.g. proxemic signs (behavior) in a lower-class woman's greetings must be related to language, paralanguage, kinesics, etc. But it must also go beyond the boundaries of somatic activities, if a full understanding of sign constructs is sought, and assume their co-structuration with extrasomatic cultural signs, such as low-class greeting patterns in general, clothing, the specific setting (whether it takes place in the home, the street, etc.), and the contextual situation. Furthermore, what I have always dealt with as *External Somatic Communication* (Poyatos 1980, with a detailed chart) as a basic tool for the study of nonverbal communication, subsuming all the sensible systems outlined above as complementary to verbal language and to each other, must be seen as co-structured with the other sensible, but extrasomatic, systems and with the intelligible ones which, though apprehended also through sensible signs, form the 'thought of' aspects of a culture. This is represented by the chart (see Figure 2) 'Sensible and intelligible systems in a culture'. This chart depicts actually the elements that constitute the area I have been trying to develop lately as 'literary anthropology' (Poyatos 1978), which serves to prove how the study of nonverbal communication is inherent in the study of culture. Culture is formed mostly of systems that, getting farther and farther apart from the human body, that is, from language, paralanguage and kinesics and the other somatic modes of conveying messages, are nonverbal in nature and mutually related, a fact which prompts in turn the investigation of those relationships as a way to probe into the deepest layers of human communication behavior.

As I believe this table to be clear enough to suffice as a descriptive outline, I should perhaps point out some of the system interrelationships indicated by the lines joining the various systems, and differentiate between direct and indirect or complementary relationships. We know that the interrelationships

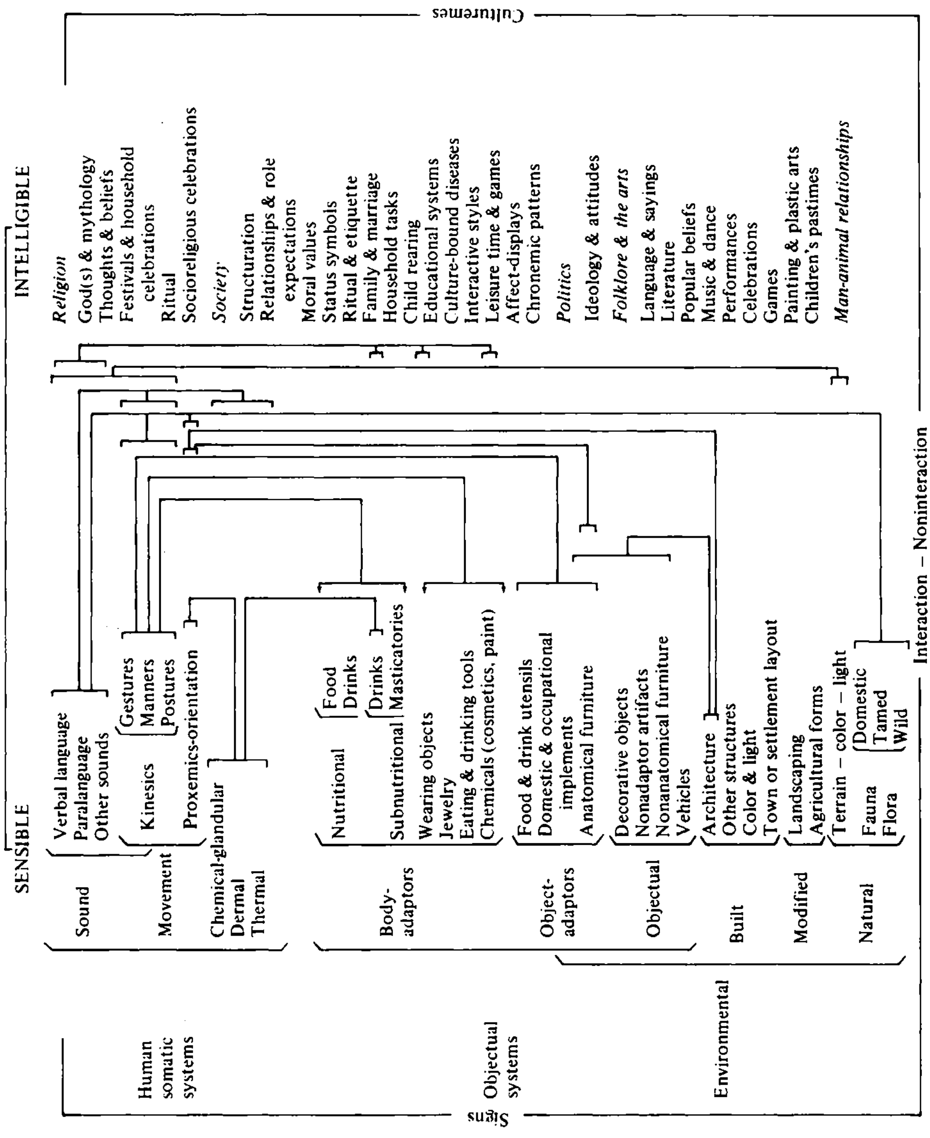

Figure 2. *Sensible and intelligible systems in a culture*

between intimate proxemic behavior and the resulting intimate verbal, paralinguistic and kinesic attitudes are direct ones, but, beyond that, proxemic behavior can be conditioned by furniture arrangement, in turn depending upon architectural spaces. Therefore, through proxemic behavior, we find a morphological and functional relationship between any of the components of the Basic Triple Structure (language-paralanguage-kinesics) and architecture, or between them and furniture. These are obvious relationships among sensible systems, but prayer, for instance, is also related to paralanguage, which is in turn related to proxemics, which is related to architectural spaces, for which reason the intimate experience of communicating with God is directly related to, thus not totally detached from, interior spaces, as it can be to light, sounds, silence, and the general environmental elements. A third example may further prove the need for nonverbal communication researchers to seek the co-structuration of all cultural systems. Clothes have always conditioned kinesic behavior, mainly manners and postures, in both men and women, while furniture has also conditioned postural habits; therefore we clearly see a rather direct association between furniture and dress style. Furthermore, both dress and furniture – witness an ordinary man-woman encounter across a small table in a bar or restaurant – may condition intimate language and paralanguage; cosmetics (olfactorily perceived as a chemical system) may determine language, paralanguage, and kinesics, while being related also to proxemics in that type of situation; in addition, all three systems plus proxemic, dermal (like blushing) and thermal (rise in body temperature) signs are conditioned by alcohol consumption, in turn partly influenced in this context by the intimacy elicited by low lighting perhaps, which is a conditioning factor for paralinguistics (e.g. low pitch, breathy voice), kinesics (e.g. contact of hands and faces) and proxemics (intimate distance) behaviors.

One could keep enumerating the relationships of sensible systems in a particular situation, and then we would have to carry it further, as these very relationships would reveal their own associations with certain intelligible systems as well, such as role expectations, moral values, leisure behavior, etc., thus disclosing certain patterns peculiar to a particular culture, along with some universal ones. In the end we would have established an intricate mesh of sensible and intelligible system interrelationships which would afford an exhaustive microanalysis of human behavior in interaction.

2.2. As a perfectly workable complement to the semiotic approach suggested earlier, and according to the definition of the cultural unit I have called *cultureme* (Poyatos 1976a) – any portion of cultural activity sensorially or intelligibly perceived which can be divided up into smaller similar units or amalgamated into larger ones – the systematic and progressive analysis of culturemes turns out to be a sensible method for studying communication systems, as it prevents us from overlooking the various levels between the broader aspects of a cultural system and its most minute features. If we set out to observe, for instance, the kinesic behaviors typical of a western culture we would first distinguish four basic frames of reference: urban-rural and interior-exterior (open places versus enclosed ones), and then the different settings (the home, the church, the restaurant, etc.), at which point sensible and intelligible systems, as well as geographical and socioeconomic subcultures, become discernible. From there on the kinesicist can deal with culturemes derived from the previous ones, e.g. kinesics at the table in the home, kinesic turn-markers in middle-class interaction, upper-class eye contact behavior, and so on; and by regrouping, for instance, table manners across a whole culture, we can build up a separate cultureme. In addition, the relationships among different systems, say between kinesic and proxemic behaviors in a low-class situation of bereavement, can now be analyzed in detail with a solid background in the kinesics of the culture.

2.3. Both the semiotic and the cultureme approaches, or their combination, are in great need in all disciplines dealing with human behavior of *diachronic* and *synchronic* investigations. Nonverbal communication studies in particular have much to gain from a realistic view of the origin, development, propagation, co-structuration, and possibly disappearance of many interactive and noninteractive behaviors, as their coding in the daily social exchanges depends on the receiver's and/or the emitter's spatial (geographical) and temporal (historical) circumstances. Some behaviors have endured the passing of centuries, though modified by changes in the built environment, in moral values or social relationships, while others are being generated by the advancing sophistication of social life, and still others have disappeared from our repertoires, such as the many kinesic acts conditioned by clothes and furniture. Even a written word that evoked a specific concept two centuries ago, or a paralinguistic construct recorded now on film, may be differently understood by emitter and receiver as time goes by, even perhaps under identical circumstances.

2.4. I should point out that what I mentioned earlier as 'literary anthropology', whose subject is depicted in Figure 2, not only would bridge the existing gap between the study of literature and the other sciences dealing with human behavior, but constitutes, mainly in its narrative form, the richest source for the study of somatic and extrasomatic systems. For the kinetic cultural repertoires revealed or depicted by painting and sculpture, for instance, and even film, lack the author's description of their co-occurrent verbal, paralinguistic and, in general, contextual elements, such as dress and furniture, as well as the emotional factors involved (e.g. situations of happiness or bereavement, proxemic attitudes, interactive patterns). Narrative literature, from the early epic poems to contemporary novels, 'speaks about', and not just describes, many of the behaviors we want to investigate in nonverbal communication studies.

3. THE 'BASIC TRIPLE STRUCTURE' AS THE UNIQUE FOUNDATION OF HUMAN COMMUNICATION STUDIES

3.1. The investigation of human interactive systems in the progressive, virtually exhaustive, way afforded by the semiotic-cultural approach soon proves beyond doubt that language just cannot be studied in isolation any more, since words, whether arbitrary (house) or echoic (swish), lack the capacity for carrying the whole weight of a conversation because they always co-occur with at least paralinguistic and, if visually perceived, kinesic constructs. This unquestionable yet neglected principle made what I have been calling the Basic Triple Structure of human communication the main foundation of any study of interaction, as the unique anthroposemiotic and anthropomorphic complex which shows the analysis of any one system by itself as totally shortsighted. This can be demonstrated by the following:

(a) An exploratory *semantic progression* in which, vertically, one writes an unpunctuated sentence to which one adds on successive lines the appropriate punctuation (already suggesting paralanguage), the various paralinguistic categories, kinesic behavior, and any other systems worth recording, while horizontally we can itemize the pertinent factors from the Total Conditioning Background (outlined in Section 6); but above all, a *triple transcription* which shows the co-structuration of the three basic systems by annotating in a musical-score fashion: phonemic transcription, the four paralinguistic categories, the orthographic transcript, and a three-level kinetic notation (head and face, arms and hands, and trunk and legs), plus a description of the proxemic attitudes, the setting, and any other contextual elements.

(b) A logically derived and more correct view of the dichotomy *segmental* (i.e., words, paralinguistic alternants, silences, kinesic constructs, and still positions) *versus nonsegmental* (i.e. intonational features, paralinguistic primary qualities, qualifiers and differentiators, and parakinesic qualities).

(c) A needed revision of the very concept of language through a very appropriate application of Hockett's design-feature scheme to paralanguage and kinesics besides language, modifying three of his features: the vocal-auditory channel is identified as kinetically based; 'imitative' is added to arbitrariness and conventionality, since we produce echoic sounds and iconic gestures; and 'semanticity' is applied to the Basic Triple Structure; and adding seven more: inheritance, shared idiosyncratic nature, interactionality, graphic representability, verbalization *versus* nonverbalization of thoughts, co-structuration with preceding or succeeding silence and stillness, and intraspecific encoding and decoding and interspecific decoding.

3.2. The three perspectives just mentioned prove the *lexicality* of the three co-systems, language-paralanguage-kinesics, and their possible mutual substitution within a preserved syntactical order even in a single sentence, since both paralanguage (a click, a moaning sound of anticipated pleasure) and kinesics (a gesture of dismissal, a pronominal pointer) can function as grammatically as words. In turn, the *kinetic base* of verbal language, paralanguage, and kinesics suggests a protolinguistic double structure (vocal/narial phonetic movements plus external kinesics) from the early stages of anatomical and cognitive development, although kinesics could have lost status as the vocal-tract repertoire increased. The Basic Triple Structure also suggests *a common historical and adaptive development* and cognitive sophistication affecting language, paralanguage and kinesics, that is, from rougher, broader forms to more subtle ones in each system.

In addition, the obvious co-structuration of the three systems prompts the revision of two traditional concepts. One is *fluency*, which must be understood as both verbal and nonverbal and as a developmental characteristic from childhood, two obvious facts that need no elaboration at this point. Furthermore, one must seek two types of fluencies associated with personal interaction. (a) The *cultural fluency* that ought to be sought during the acculturation process inherent in an observational study in a culture other than one's own; which includes many 'fluencies', as a culture is made up of the many communicative systems already discussed, and which cannot be replaced by the sort of linguistic (actually verbal) fluency with which many believe to be prepared to communicate properly, without even seeking paralinguistic and kinesic fluency. (b) *Interactional fluency*, not only from our own point of view but according to the socioeducational status of our co-interactants (perhaps lower, but certainly possessing its own norms and, for instance, its own etiquette patterns and ritualized forms, of which we must be aware), and as regards the perceptual capabilities of impaired persons (which systems they do or do not perceive), so that we, as their co-interactants, may duly compensate for their deficiencies.

The other concept which needs to be revised is that of *redundancy*, since the various behaviors involved in communication can be either truly redundant or complementary (supporting, emphasizing, or contradicting) to each other, and because even while being redundant they may produce a personal or cultural style. On the other hand, we must differentiate between primary communicative systems (not necessarily verbal language) and secondary systems within a general hierarchization of behaviors in each particular situation, subject to the intensity of each behavior in comparison with the others and to its location in the behavioral stream.

4. PARALANGUAGE AND KINESICS: SOUND AND MOVEMENT VS. SILENCE AND STILLNESS

4.1. Besides integrating *paralanguage* into the Basic Triple Structure within different disciplines, I have attempted – inspired by, but drastically enlarging upon, some pioneering papers – to provide an exhaustive categorization of features from morphological, functional, and representational points of view (Poyatos 1976b, 1979).

(a) *Primary qualities*, fundamental constituents of human speech, which basically differentiate one person from the others (timbre, resonance, volume, tempo, pitch register, pitch interval, pitch range, syllabic duration, intonation range, and rhythm), conditioned by four main factors: biological, that is, purely somatic (such as sex and age, determining timbre); physiological, thus variable, whether due to temporary malfunctions or to traumatized states (nasal resonance due to catarrh, improper timing in diphasias); cultural (the higher volume of Latins and Arabs); and social, such as status (the slow tempo of superiority), occupation (the orality of a preacher), or certain functions (baby talk, story telling).

(b) *Qualifiers*, which can also appear as permanent characteristics, that is, primary qualities (respiratory, glottis, laryngeal, velar, pharyngeal, articulatory, labial, and maxillary controls, and articulatory tension), each one ideally analyzed in terms of: anatomical and physiological configuration, auditory effect (e.g. nasal twang), voice type it produces (creaky, breathy), co-occurrent verbal and nonverbal behaviors (pursed lips + lowered brows + irritated 'Oh, let me alone!'), phonological use (Bushman clicks), paralinguistic use (turn-claiming apicoalveolar click when the listener wishes to speak), abnormal occurrences (hoarse voice of trachyphonia), and notation for phonetic purposes and because the core of the message may sometimes be carried by a qualifier.

(c) *Differentiators*, which characterize physiological and psychological states and appear closely co-structured with kinesic behavior (laughing, crying, coughing, degrees of loud voice and whisper, sneezing, belching, yawning, hiccoughing, and snorting), while they modify words; laughter, for instance, requires more in-depth studies in terms of: biological foundation; influence of the psychological configuration on its frequency of occurrence; duration, acoustic characteristics, and eliciting factors, as well as temporary emotional states and their relation to cultural norms about them; pathological varieties; social implications of laughter display with respect to the same or different states and their contextual situation; the hidden or explicit etiquette norms about it; the phonetic variants of laughter according to the socioeducational and cultural characteristics of the person; its simultaneous or alternating co-structuration with verbal language and with kinesics (as in smiling) and the basic cross-cultural differences; its co-structuration with proxemics as well as with chemical (e.g. tears) and dermal (e.g. blushing) systems; and the study of definitory references and descriptions of laughter in the narrative literature of the various cultures.

(d) *Alternants* (Poyatos 1975a), independent segmental constructs that prove the weakness of the term 'paralinguistic', as they function in each language, that is, in each culture as lexically as dictionary items in social interaction, therefore deserving a much higher status in linguistics (impressionistically describable as clicks, sighs, throat clearings, pharyngeal or narial ingressions and egressions, hissing sounds with different articulations and functions, moaning sounds, closed- or open-lip sounds, meaningful silences, etc.), and much research, considering: their important roles in the mechanism of interaction; that they form, more than words, the greater part of the communicative repertoire each culture utilizes for the interaction of humans with domestic animals; that their articulatory peculiarities should be given serious thought in glottogenetic studies and with respect to the phylogeny of the Basic Triple Structure; and that we need to largely increase the present limited repertoire of phonetic symbols, labels (i.e. verbs and nouns, just as we have *to hiss* and *a hiss*) and written forms (as we have for a few, like *H'm*, *Psst*, *Er*, etc.).

4.2. One of the many research perspectives opened up by nonverbal communication studies concerns the various aspects and problems of *punctuation* in writing (Poyatos 1981), again of an interdisciplinary nature, since it falls under: semiotics because of the forms contained in and symbolized by punctuation; anthropology because it deals with the development of writing, man's greatest communicative achievement; and linguistics and phonetics because of the interrelationships among verbal language, semantics, grammar, and punctuation. But, above all, it is nonverbal communication that people have historically striven to represent, therefore acknowledging its use as an essential part of the human message-conveying activities of speech and movement. Although punctuation reveals a conscious effort to symbolize speech for the better evocation of its semantic variations and the avoidance of too conspicuous ambiguities, it simultaneously, and quite unwittingly too, evokes and marks the co-occurrent body movements and still positions that are an integral part of the kinetic-acoustic continuum of human and animal communication. In sum, punctuation attempts to convey as closely as possible the structural-semantic forms of the Basic Triple Structure, language-paralanguage-kinesics, and a nonverbal approach can do much to improve the present system, which is historically so limited.

4.3. As for *kinesics*, the other inherent part of the triple structure, perceived either visually (a beckoning gesture), audiovisually (finger snapping), audiovisually-tactually (a slap on someone's back), visually-tactually (a hug), or just tactually and auditorily (in the dark or as perceived by the blind), appears in three different but complementary ways in human interaction: *independently*, as in a single OK gesture or a facial expression of distress, or in interaction limited by distance, interfering noise or imposed silence; *simultaneously* with the linguistic-paralinguistic co-structures; and *as a syntactical replacement* for verbal language in parts of the same sentence (which again suggests the perceptual limitations of the blind and, consequently, the different types of interactive fluency required, as discussed above).

Apart from Birdwhistell's work, which has helped many, if controversially, the interdisciplinary integrative approach to communication I always sought prompted me to explore other areas still badly in need of kinesic research (Poyatos 1977a), which I will merely mention here.

(a) The *phylogenetic development* and the origin of human 'communication', and not just of 'language', since a cognitive kinesic lexicon must have evolved along with onomatopoeic sounds and other paralinguistic forms, consisting mainly of gestures; the repertoire of manners gradually growing to accommodate new relationships of authority-subordination, love-hatred, etc., and the handling of man-made objects; while postures were conditioned by anatomy, terrain, nutritional habits, and probably by a growing social life requiring an increasing number of situational body positions.

(b) The *ontogenetic maturational curve* of gestures, manners, and postures within the Basic Triple Structure, as the child gradually develops the three systems to a not always clearly mature adult repertoire.

(c) The *cultural historical development*, not only through the evolution of the dwellings, of furniture, utensils, clothes, etc. (which also betrays the progress of social and intellectual life), but across the various socioeconomic and educational levels; from an interactional point of view, the triple repertoire of the rural class, for instance, is more limited than that of the higher-up people in vocabulary, in the more subtle types of laughter, of narial aggressions or closed-lip nasal sounds, and in gestures, manners, and postures.

(d) The *intercultural borrowings*, not only in verbal language, but in kinesics, particularly gestures, as well as certain paralinguistic expressions.

(e) The elaboration of *kinesic atlases*, which would often have to record not only isolated kinesic features but linguistic-kinesic, or paralinguistic-kinesic, or linguistic-paralinguistic-kinesic constructs that occur always like that, and which would also have to show the geographic distribution of basic gestures, manners, and postures as well as some of the functional categories mentioned below; and, among still other research areas generated by kinesics.

(f) The elaboration of *kinesic inventories*, whether cultural or subcultural, in a systematic way that must take into account (Poyatos 1975b): the sources, the interactive or noninteractive types of live first-hand observation, the illustration of the inventory (sketches, still photographs, film), and the presentation of the material (classification, distribution, labelling, and description), avoiding the more common deficiencies and pitfalls one can observe in some existing inventories (e.g. ambiguity of usage, incomplete kinemorphemic or kinesyntactic constructs) and seeking the cultural and situational context, the frequency of occurrence, and the co-structuration with language and other nonverbal systems.

Basic to kinesic studies is a clear *morphological classification* of kinesic behaviors which allows for a systematic and exhaustive treatment in whatever discipline. The chart in Figure 3 should provide a clear statement of the categories involved. Beyond the indispensable differentiation of gestures, manners, and postures because of their specific morphological, cultural, and interactive characteristics and the distinct research topics they suggest (e.g. emblematic gestures across society or cross-culturally, manners in greetings and leave-takings, posture and manners in backward cultures, kinesic display of happiness and grief), a second distinction must be made between *free* and *bound* movements and positions, the latter when holding oneself or in contact with others (so important across cultures) or objects. A further distinction of behaviors according to established categories and interactive or noninteractive situations allows for a critical investigation, acknowledging the perceptual modes of hindered and impaired interactants as well as indirect perception of movement and sound through sound and movement respectively.

As for the *functional classification* of kinesic activities, the categories we can distinguish for any interactive or cultural study are valid also for paralanguage (the first four for verbal language as well): conversational, ritualistic, occupational, task-performing (mostly with object-adaptors in noninteractive situations, or alter-adaptors, i.e. in contact with someone else), and somatic and random acts, aimed at relieving physiological needs, or with no particular goals or reference to others.

Constructuration with: Verbal language-Paralanguage (& silence)-Kinesics (& stillness) Proxemics, Chemical, Dermal, Thermal systems, Chronemics

Parakinesic qualities: Intensity – Range – Velocity

Biophysicopsychological – Cultural – Socioeconomic conditioning background

		INTERACTIVE: FULL	INTERACTIVE: REDUCED – Audible (unseen)	INTERACTIVE: REDUCED – Visual (unheard)	NONINTERACTIVE
GESTURES	Free	Head, hair Face: eyes, eye-contact, brows, nares, mouth, lips, tongue, verbal & paralinguistic movements Shoulders, arms Hands, fingers Trunk, legs, feet	Verbal & paralinguistic production movements Assumption of others by association with verbal & paralinguistic signs	Head, hair Face: eyes, eye-contact, brows, nares, mouth, lips, tongue, verbal & paralinguistic movements Shoulders, arms Hands, fingers Trunk, legs, feet Assumption of sound through vision	Random acts Imagined (monologic) inter-action Mental activities
GESTURES	Bound	Self-adaptors: hand(s)-to-body Object-adaptors: gesturing with cultural or pancultural con-versational props (pipes, cigarettes, glasses, canes, sticks, tools, hats, gloves, pencils, eating & drinking tools)	Self-adaptors: finger-snapping, clapping & slapping gestures Object-adaptors: hitting cul-tural or pancultural con-versational props against self, objects, or ground	Self-adaptors: hand(s)-to-body Object-adaptors: gesturing with cultural or pancultural con-versational props Assumption of sound through visual signs	Random acts Imagined (monologic) interaction Mental activities
MANNERS	Free	Affect-displays: face, arms, etc. Greetings & goodbyes Eating & drinking (chewing, swallowing), masticatories Gait, dancing, acrobatics, sports Physiological: sneezing, belching, stretching, spitting Posture-forming manners	Eating & drinking (chewing, swallowing) Physiological: sneezing, belching, spitting, coughing, throat-clearing	Affect-displays Greetings & goodbyes Eating, drinking, masticatories Gait, dancing, acrobatics, sports Physiological, posture-forming Assumption of sound through visual signs	Affect-displays: unconscious, imagined (monologic) interaction Eating, drinking, masticatories Gait, solo dancing Physiological Posture-forming

Figure 3. *Morphological classification of anthropokinesics*

Biophysicopsychological – Cultural – Socioeconomic conditioning background

		INTERACTIVE			NONINTERACTIVE
		FULL	REDUCED: Audible (unseen)	REDUCED: Visual (unheard)	
MANNERS	Bound	Self-adaptors: affect-displays, applauding, grooming, preening, scratching, picking, rubbing, clasping, slapping, hitting Body-adaptors: clothes, jewelry, food, drink, eating & drinking tools, pipes, glasses, hats Object-adaptors: tools, furniture Alter-adaptors: affect-displays, sexual behaviors, aggression, protection	Self-adaptors: applauding, slapping Body-adaptors: jewelry, eating & drinking tools Object-adaptors: tools, knocking against objects, contact with furniture Alter-adaptors: kissing, clapping, handshakes, patting, aggression	Affect-displays Greetings & goodbyes Eating & drinking, masticatories Gait, dancing, acrobatics, sports Physiological, posture-forming Assumption of sound through visual signs	Self-adaptors: mental activities Body-adaptors Object-adaptors Alter-adaptors: imagined interaction
POSTURES	Free	Ground-based: standing, squatting, sitting, kneeling Air-based: jumping, acrobatics, sports Water-based: swimming	Assumption of some through associated sounds as secondary sign systems	Self-adaptors Body-adaptors Object-adaptors Alter-adaptors Assumption of sound through visual signs	Ground-based Air-based Water-based
	Bound	Self-adaptors: clasping, crossed arms & legs Object-adaptors: with furniture, objects, built or modified environment, implements, vehicles Alter-adaptors: affect-displays, sexual behaviors, aggression	Assumption of some through associated sounds as secondary sign systems	Self-adaptors Body-adaptors Object-adaptors Alter-adaptors Assumption of sound through visual signs	Self-adaptors: random, mental activities Body-adaptors Object-adaptors Alter-adaptors: imagined interaction

Parakinesic qualities: Intensity – Range – Velocity

Constructuration with: Verbal language-Paralanguage (& silence)-Kinesics (& stillness) Proxemics, Chemical, Dermal, Thermal systems, Chronemics

Figure 3. *(continued)*.

4.4. Lately I have been elaborating on *silence* and *stillness* (Poyatos in press) in human interaction, never sufficiently recognized in communication studies as the segmental (from the point of view of linguistics) nonactivities opposed but complementary to sound and movement within the Basic Triple Structure, that is, in communication, and as systems in their own right. For, if sound and movement are the basis of our communication, silence and stillness are also part of it. Structurally, noncommunicative silences and still positions occur only between and after speaker-listener encounters, otherwise breaks are always linguistic, paralinguistic, or kinesic true pauses within or between speaker and listener 'turns', because when one of the activities is interrupted the other two, or at least one, will fill that gap (hence the important semantic and structural interrelationships within the triple structure). From a semiotic-communicative point of view, silence and stillness in social interaction act as *signs proper*, not necessarily as substitutes for verbal or nonverbal expressions, as *zero signs* which signify by the very absence of sound or movement (e.g. the witting silence with which we avoid saying something) and, what needs perhaps the most research, as *carriers* of the activity just heard or seen, as they re-echo it, thus enlarging it and making it more conspicuous (e.g. silence immediately after shouted words, stillness following a tragic gesture).

4.5. It is unquestionable then that the disassociation between traditional linguistics and the nonverbal systems, as still maintained by many, is totally unrealistic, and that the interrelationships of both, too complex to discuss here, are quite obvious in interaction. But one must also integrate in the study of nonverbal systems the two basic dimensions of any human activity, time and space, as proxemic and chronemic behaviors. *Chronemics*, as analogous to proxemics, is the research area I have suggested (Poyatos in press, 1976b, and earlier) as dealing with our conceptualization, structuration and handling of time as a biopsychological and cultural element that lends specific characteristics to social relationships and to a culture in general, including the many events within the communication situation and the duration of the various activities involved.

5. INTERACTION AND THE STUDY OF THE MECHANISM OF CONVERSATION

5.1. As the integrative and interdisciplinary approach to nonverbal communication builds up, what can be thought of as the 'anatomy of conversation' soon becomes one of the researcher's main interests. The researcher may want to analyze a *brief encounter*, actually a short, generally dyadic encounter, as when ordering food, purchasing a ticket, or asking for directions, which contains a series of patterned verbal and nonverbal behaviors subject to different cultural, individual, and situational variables; or a truly *topical conversation*, that is, the average living-room or business encounter centering around at least one topic which is developed at some length.

Although most of us deal with *natural conversation*, the spontaneous communicative exchange of verbal and nonverbal signs between at least two human beings, certain fields, such as drama and film-making, rely entirely on what should be studied as *contrived conversation*, best exemplified by the theatrical performance. In a performance of any kind verbal and nonverbal activities are not always properly co-structured and, at their worst, we speak of lack of naturalness: intonation patterns do not always correspond to the memorized verbal constructs as they would in a natural situation, paralinguistic features such as rhythm, glottalic control, specific types of laughter, etc. do not seem to agree with the type being portrayed, the situational context and the cultural setting.

On the other hand, we cannot think of natural conversation as only *full unhindered interaction*, that is, under normal circumstances among fully equipped participants, for there is also a *reduced interaction* which is badly in need of research in different disciplines, since we are all exposed to it. Reduced interaction results from: (a) a linguistic-cultural barrier, when other vocal or nonvocal behaviors are often stepped up with relative success; (b) blindness, which blocks off kinesics, except audible and contactual (alter-adaptors) movements; (c) a sound-carrying opaque obstacle, which renders interactants blind for communication purposes; (d) deafness, which blocks off language and paralanguage; (e) a soundproof transparent obstacle, which makes interactants deaf in that situation; (f) excessive distance, which has the same effect and compels interactants to use their kinesic repertoires only (but, curiously enough, often muttering verbal language as they gesture); and (g) a telephonic conversation, in itself a technologically-imposed 'invisible dyad' in which we still emphasize, support, or contradict our verbal and paralinguistic signals with our kinesic behavior.

5.2. Acknowledging the preponderance of the Basic Triple Structure in conversation, the observational analysis of interactants both in real life and in filmed situations prompted me to elaborate a scheme based on Starkey Duncan's *turn* analysis, but further classifying the activities that take place in the course of a conversation (Poyatos 1975c, 1976b).

(a) *Turn rules and counterrules*: turn claiming, yielding, and taking, or turn suppressing (by the speaker or by any of the auditors toward the claiming listener), and turn holding (by the speaker).

(b) *Simultaneous behaviors*: simultaneous turns (culturally, situationally, and individually conditioned), conclusions (silence follows), turn claimings, and yieldings.

(c) *Receiver's within-turn behaviors*: feedback, request for clarification, request for higher volume, verbatim repetition of the speaker's last statement, re-statement (of the speaker's preceding thought), simultaneous conclusion, and prompting signals (by any listener toward the speaker, with different purposes).

(d) *Sender's within-turn behaviors*: counterfeedback (to the receiver's feedback, as used by comedians), turn opening (after the previous speaker's yielding), turn preclosing, turn closing, and claim suppressing.

(e) *Interactive pauses*: due to: failed turn claiming or turn taking (by all), turn opening (before speaking), turn ending (before turn closing), hesitation, and feedback or counterfeedback-seeking pause.

6. THE 'TOTAL CONDITIONING BACKGROUND' OF HUMAN COMMUNICATION

What appears just indicated in Figures 2 and 3 as 'conditioning background' is an indispensable frame of reference against which one must view any of the systems or single activities mentioned in this paper at one point or another in nonverbal communication research. The conditioning factors are always among: biophysicopsychological (biological configuration, sex, age, physiological state, medical state, nutritional habits, psychological configuration, emotional states); environmental (natural, built or modified, socioeconomic, and objectual environments); degree of sharing (performer/public figure-spectator borrowing, couple, nuclear/extended family, social/occupational group, geographical/subcultural variety); cultural patterns (religious and moral values, relationships and role expectations, etiquette norms, esthetic values); and according to the type of culture (primitive, advanced), socio-educational types (superrefined, average educated, average middle-income employee, low-income worker, pseudoeducated, rustic/illiterate).

NOTE

1. Given the nature of this report-like treatment of the development and principal aspects of a personal research, I am citing references from my own work only. A proper reference list would have included, among others: M. Argyle, R. Birdwhistell, D. Crystal, S. Duncan, I. Eibl-Eibesfeldt, D. Efron, P. Ekman, P. Lieberman, M. Key, E. Hall, G. Hewes, A. Kendon, J. Laver, K. Pike, A. Scheflen, T. Sebeok, G. Trager.

YAU SHUN-CHIU

Constraints on Basic Sign Order and Word Order Universals[1]

Sign order in gestural languages and word order in oral languages have a common origin which has been subject to extralinguistic constraints. Given that its modality is spatiotemporal, a gestural language will preserve both the characteristics of the temporal and the spatial registers. In oral languages, though they are linear by nature, we observe that the two major word orders, NRN′ (SVO) and NN′R (SOV), preserve some traces of the spatial register and of the temporal register respectively – the RNN′ (VSO) is considered a derived order. Only those basic declarative sequences from both gestural and oral languages containing three elements. i.e. N, N′ and R (V, +sensory, +intrinsic directional, such as 'bite'. 'hit', 'catch', 'sit', etc.) are taken into consideration.

1. THE PROBLEM

On reading Greenberg (1963) 'Some universals of grammar with particular reference to the order of meaningful elements' we are tempted to ask two questions. (i) Is there a traceable common source to the three word orders listed by Greenberg? (ii) Greenberg's findings cover only oral languages and we know that both oral and gestural languages are languages of different modalities and therefore a straightforward comparison between their orderings is apparently illegitimate. However, if ever there is a positive answer to our first question, then would there be an immediate linkage between these two types of element orderings? Should it be the case that there is such a common source, what would the theoretical consequences be? Thanks to advances made in the last two decades in linguistics, both in oral and in gestural languages, we are able to attempt an answer to the above tantalizing questions.

2. THE ACQUISITION OF DATA AND THE PRESUMED BASIC SIGN ORDER

Exact data on basic sign order in deaf sign languages and other gestural languages similar to those provided by Greenberg for oral languages are not yet available. However, scattered information suggests that if R (relator) is +sensory and +intrinsic directional, NN'R (SOV) is probably the predominant order in various deaf sign languages.[2] To supplement these scattered data, we filmed a gestural interpretation, by ten Chinese adult deaf, of some 30 short cartoon drawings, each containing four to eight pictures. The signers used their various native sign dialects, including dialects of Shanghai, Canton, Hong Kong, Nanking, Peking, and Taiwan. The reason for trying an interpretation of the drawings in various Chinese sign dialects is to see whether our data are strictly dialectal (if the basic sign orders in the respective dialects are different) or whether they are uniform among the Chinese sign languages, which is actually the case. Short cartoons instead of written texts were used so as to reduce as much as possible the immediate influence of the written Chinese – the basic word order of which is the same as that in spoken Chinese, i.e. NRN' (SVO). We did not ask our informants to make spontaneous monologues or dialogues for fear that such a corpus would be too 'rich' and too complex for a specific analysis. Data obtained from various informants without any control on their semantic contents would not be directly comparable; any conclusion on sign ordering in gestural sequences performed by various informants could be more easily arrived at if these sequences were similar.[3]

The sign order of a basic declarative gestural sequence in our corpus is $\overline{\text{N}}/\underline{\text{N}}'\text{R}$ (i.e. NN'R or N'NR), for example:

(1) MAN$_x$ MAN$_y$ HIT (meaning MAN$_x$ hits MAN$_y$ – if action of HIT is from MAN$_x$ to MAN$_y$); (meaning MAN$_y$ hits MAN$_x$ – if action of HIT is from MAN$_y$ to MAN$_x$)
(2) MOUSE DOG BITE (meaning MOUSE bites DOG – if action of BIT is from MOUSE to DOG); (meaning DOG bites MOUSE – if action of BIT is from DOG to MOUSE).

Further, we find in our corpus that if a gestural sequence contains two nouns, one as the logical subject, the other marked as the locative, and an R, then the order will be $\overline{\text{N}}/\underline{\text{Nloc}}\text{R}$, for example:

(3) WOMAN CHAIR SIT (meaning WOMAN SITS [on] CHAIR)
(4) BOY BOX COIN/PUT (N Nloc N'R, COIN and PUT incorporated) (meaning BOY PUTS COIN [into] BOX).

Though there are differences in detail between the ordering of (1) (2) and (3) (4), the principle of the basic sign order is maintained, i.e. all N, whether they function as logical subject, object complement, or marked as locative, are all posed before the realization of R (verb). As far as our corpus is concerned, there is no exception to the ordering pattern illustrated in the examples above. (There are a few false but interesting counter-examples, however. For the discussion, see Section 4.) We had also organized a screening test for the examples cited in the present paper with our American, French, and Japanese deaf. The result was in accordance with our Chinese data.[4] Our data thus confirm the basic sign order suggested by examples given in literature on various deaf sign languages as well as the gestural language of the hearing North American Indians.[5] Hence we consider that $\overline{N}/\underline{N}'R$ (i.e. NN'R or N'NR) is the universal sign order for basic declarative sequences, and we can even extend this basic sign order to NNNR (i.e. N'NlocNR, NNlocN'R, etc.) if the sequence contains an Nloc (for supplementary constraint on Nloc, see next section).

3. SIGN ORDERING AND ITS SCHEMATIC PRESENTATION

The modality of a gestural language (including both sign language of the deaf and the hearing) is spatiotemporal. Its ordering, therefore, ought to be represented on two registers, the temporal and the spatial. It would cause distortion if the schema used by Greenberg for oral languages is adopted for presentation without discrimination. When a deaf signs a basic declarative sequence such as MOUSE BITE DOG, he poses one N on one side and the other N′ on the other (in some cases both N and N′ are posed at the same time), and then performs the action of the relator (verb) in between the two N, or more exactly between the two points previously marked in the space by the two N. By order of appearance of these three signs, we obtain $\overline{N}/\underline{N}'R$ (temporal). However, in terms of their spatial positioning and from a static point of view, the R is in fact performed between the two points previously marked by the two N. Therefore on the spatial register, the three signs will be located as NRN′ (spatial). This observation was made independently. However, Valade was the first who took note of this characteristic in French sign language when he wrote:

> 'The cat watches the mouse'. If we ask a deaf-mute to translate this sentence by signs, we will see that he places the mouse and the cat at a small distance from one another, then he himself substitutes the cat and makes the sign 'watch' in the direction of the mouse. The order of succession will be then: 'Mouse cat watches'. But if we consider the order in which the signs are posited, we will know that this is exactly the word order in the French sentence. 'cat watches mouse'. (Valade 1854) [Translation by Yau]

The significance of such a distinction, spatial versus temporal, will become evident in the course of our discussion (see Figure 1).

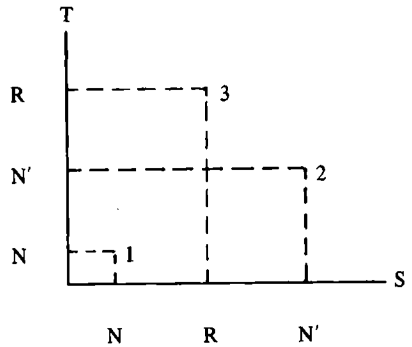

Figure 1. *Graphic representation of the three elements, N, N', and R, on the two registers, T (temporal) and S (spatial)*

4. N PRECEEDING R AND EXTRALINGUISTIC CONSTRAINT

We argue that element ordering in a basic declarative gestural sequence is subject to an extralinguistic constraint, i.e. the basic sign order in such a sequence follows the spatiotemporal development of a visual event. The fact that the N, N', or Nloc in a basic declarative gestural sequence must be performed before (temporal) or at least simultaneously with the relator (verb) demonstrates such a constraint. In (2) MOUSE BITE DOG, MOUSE and DOG must precede the action of BITE, otherwise we are describing an extremely unusual situation such as 'a mouse is biting, and then a dog presents itself to be bitten'. Or in (3) if CHAIR appears after the realization of SIT, the sequence will be understood as 'a woman sits down, or rather makes a sitting posture, then someone slips a chair under her bottom'. Since the basic sign order is conditioned by an extra-linguistic constraint we are obliged to avoid in the arguments within this section the use of those notions which might have too strong a linguistic implication. Mallery (1881, cf. note 5) explained this basic sign order in terms of commonplace expressions as we do although he probably did not restrain himself as we do. He wrote:

> Inversion, by which the object is placed before the action, is a striking feature of the language of deaf-mutes, and it appears to follow the natural method by which objects and actions enter into the mental conception. In striking a rock the natural conception is not first of the abstract idea of striking or of sending a stroke into vacancy, seeing nothing and having no intention of striking anything in particular, when suddenly a rock rises up to the mental vision and receives the blow; the order is that the man sees the rock, has the intention to strike it, and does so; therefore he gestures, 'I rock strike'.[6]

The same constraint applies to example (4) BOY BOX COIN/PUT (in). Imagine if the Nloc (BOX marked locative by the direction of PUT) appears after the relator (verb), the meaning of the sequence if not too marginal, at least not in the sense intended, will at best mean that 'the boy wants to put a coin somewhere and then he himself or someone else raises a box so as to receive the coin'. The same constraint on element ordering will extend to those sequences containing more than one Nloc. Hence for interpreting a situation where a man is sitting against a tree on a beach, a deaf person will sign: (5) BEACH TREE MAN/SIT (i.e. the two signs MAN and SIT incorporated in each other). The reason why BEACH preceeds TREE is analogical to BOX and COIN in (4) or CHAIR and SIT in (3). The order ought to be '(on) BEACH TREE' instead of 'TREE (suspended in the air), BEACH underneath'. We observe a similar feature in oral languages. Perceiving a car in a street and being entirely unfamiliar with the street and the car, we nevertheless would say 'there is *a* car in *the* street'. Following the constraint observed in gestural languages, we argue that the article 'the' attributed to 'street' (but not to 'car') indicates that 'street' must be conceived on the cognitoperceptual level before 'car'. 'Street' is labeled with 'the' when it is later referred to during the formation of the prepositional phrase 'in the street'. The use of 'the' in this case is a priori not for a definite-indefinite contrast. It seems that in 'there is a car in the street' as in example (5) the ordering on the cognitoperceptual level is decided according to the relative degree of mobility or immobility of the nominal elements, or by a constraint which we call the 'preëminency principle' in another study: base first, peripheral second. When we draw, we draw the head before the ear; when we speak, we pose 'street' before 'car'; when we sign, we sign the 'beach' before the 'man' (example 5).[7] Other things being equal, the immobile preceeds the less immobile or the mobile. Since 'man' is the most mobile among the three N in example (5), it comes last. Examples discussed so far illustrate that the question of interest in the study of word order universals is not what a word order in a language should be but what makes it be so.

Several types of gestural sequences are found in our corpus which might at first sight constitute exceptions to the basic order $\bar{N}/\underline{N}'R$ (temporal). These sequences are ultimately rejected as false counter-examples. They are as follows:

(i) sequences containing relators (verbs) such as INFLATE, CONSTRUCT which take a resultative complement:

(6) GIRL INFLATE BALLOON (temporal, meaning 'the girl inflates a balloon')

(7) HE CONSTRUCT HOUSE (temporal, meaning 'he constructs a house');

(ii) sequences containing SEE and 'SEE':

(8a) FISH CAT SEE (temporal, meaning 'the cat sees a fish')
(8b) DOG 'SEE' HOLE (temporal, meaning 'the dog "sees" a hole');

(iii) sequences containing relators (verbs) of mental activities, such as THINK, DREAM:

(9a) GIRL THINK (it) CAR (temporal)
(9b) GIRL CAR THINK (it) (temporal)
(both 9a, b, meaning 'the girl thinks it is a car')
(10a) HE DREAM HORSE-RIDING (temporal)
(10b) HE HORSE-RIDING DREAM (temporal)
(both 10a, b, meaning 'he dreamed that he was riding a horse').

The apparent sign orders (temporal) are: in group (i) NRN′, in group (ii) and (iii) both $\overline{N}/\underline{N}'R$ and NRN′. We argue that (6), (7) and (8b) in group (i) and (ii) are complex sequences consisting of two consecutive units, including a resultative, and therefore they should be dismissed as exceptions. The relator (verb) INFLATE is in fact composed of an action of putting two joined cupped hands in front of the mouth and the action of blowing. The sequence GIRL INFLATE BALLOON should be transcribed as GIRL 'SOMETHING' (the not-yet-inflated balloon) + the resultative BALLOON (fully inflated). This sequence will be read as NN′R plus a single sign sequence which can be interpreted as 'then there is the fully inflated balloon'. Example (7) will be dismissed too when we know that CONSTRUCT is the same sign for BRICK LAYING in Chinese sign language. The sequence of (7) will then be transcribed as HE BRICK/LAY (incorporated) + the resultative HOUSE which is a single sign sequence, interpretable as 'then there is the house'.

The cases of (8a) and (8b) are much more subtle. In the course of deciphering the film we were ready to admit (8b) as an exception. However further checking of the filmed data led us to distinguish the sign SEE in (8a) and the 'SEE' in (8b). The sign SEE in (8a) is simultaneously accompanied by a sudden increase of intensity in the eye expression of the signer telling that the cat sees a fish. In (8b), such an increase of intensity in the eye expression occurs only at the moment when HOLE is signed, but after a lapse significantly long enough to detach this intensity in the eye expression from the sign 'SEE' i.e. DOG 'SEE' + (sight intensity) HOLE. In other words, nothing is perceived by the dog when the 'SEE' is signed. We therefore interpret this 'SEE' as SEARCH and the sign HOLE constitutes a single sign sequence apart signifying '(suddenly the dog discovers) a hole'. We conclude that the order of (8b) is NR (without object complement) + the resultative N, whereas (8a) remains $\overline{N}/\underline{N}'R$.

In the previous paragraphs we stated that the presumed basic sign order only applies to those sequences containing either an R demanding an object complement or a locative complement. The relators in group (iii), THINK and DREAM are not R of such type (physically visible) but R of mental activities. When expressed in gestures, they have to be 'visualized' and no similiar extra-linguistic constraint known to the basic sign order will be imposed, and as a result there is a priori no extra-linguistic constraint that would give a hint that such a relator should be before or after the object complement (on the temporal register). Nevertheless the fact that half of the cases in the type of group (iii) having the object complement posed before the relator (on the temporal register) indicates that there exists an influence of the basic sign order on these sequences if we know that our informants are exposed to a written language (Chinese) which is basically NRN'.

In current grammatical theories, basic word orders in oral languages are either taken for granted as universals as in the case of Greenberg's three basic orders, or as a particularity (nonuniversal) to be acquired on the level of performance for those who work(ed) within the framework of transformational grammar. The question on the 'raison d'être' of the basic word order has seldom been asked (see Yau 1978).[8] Although such a question cannot be given a fully satisfactory answer, it can nevertheless be explained to a certain extent by a visual cognitive capacity which is not subject to any cultural differentiation. Such an argument will account for the homogeneity of the basic sign order $\bar{N}/\underline{N}'R$ (temporal) among gestural languages in different cultural communities, separated in space and in time.[9] Furthermore, when hearing people sign or mime they observe the same order, e.g. the hearing Indians of the Great Plains in North America. We have tried example (4) BOY PUTS COIN (into) BOX (but we changed 'BOY' to 'I' to facilitate the miming) with hearing children and adults. They mimed the sentence, after some 'rehearsals', in the same order as our deaf, i.e. 'I BOX COIN PUT' or 'I BOX COIN/PUT (incorporated)' (both temporal) or 'I – COIN – PUT – BOX' and 'I – COIN/PUT (incorporated) – BOX' (both spatial).

5. RE-INTERPRETATION OF GREENBERG'S FINDINGS

According to Greenberg (1963) there are two principal word orders in oral languages, NRN' (SVO) and NN'R (SOV), plus a third RNN' (VSO) which is statistically less significant and which might ultimately be interpreted as derived from one of the other orders.[10] In the way they are presented by Greenberg, these orders, which are linear by nature, are not comparable to the basic sign order of the deaf which is spatiotemporal. However, given that in general both the hearing and the deaf are seeing beings, it is probable that oral languages at a certain phase might also be subject to the same extra-linguistic constraint known to the basic sign order of the deaf. To our knowledge, there is no evidence that there exists any difference between the visual perception of a deaf and a hearing person towards an image, for instance, when they looked at pictures showing a person hitting another person or someone putting a coin into a box. The existence of NRN′ (SVO) side by side with NN′R (SOV) as dominant orders in oral languages can reasonably be interpreted as the natural outcome of the application of this constraint. As has already been said, oral languages are linear by nature; the vocal realization of the elements in various word orders, including NRN′ (SVO), is basically temporal. However, from a static point of view, NRN′ (SVO) in oral languages can be regarded as an order modeled on the positioning of the elements in space in gestural languages, and NN′R (SOV) in both oral and gestural languages as following the temporal order of appearance of the elements in the development of a visual event. Following again our hypothesis an oral language of the type NRN′ would reflect some features characteristic of the spatial register while an oral language of the type $\bar{N}/\underline{N}'R$ would reflect some of those of the temporal.

We state that the grammatical relationship of the two N on the spatial register is marked by the position and the orientation of the relator (verb). If an oral language adopts the spatial register by modeling on the positioning of the elements in the space, it will obtain NRN′. The grammatical relationship of the two N from a spatial point of view will still be directly established by the relator (verb), and the indication of such a relationship in this case is much less dependent on extra markers than in cases where R (the verb) is displaced elsewhere.[11] On the other hand if an oral language adopts the temporal register it will obtain $\bar{N}/\underline{N}'R$, and from the spatial point of view, R (the verb) is dislocated. The grammatical relationship between the N will no longer be directly marked by the relator (verb), and as a result some markers are required as indicators. Such markers are expected in NN′R languages such as Japanese. Compare the following examples:

(11a) The woman hits her husband (marked by R)
(11b) La femme frappe son homme (French, marked by R)
(11c) Nage nüren da tade nanren (Chinese, marked by R)
that – woman – hit – his – man
(11d) Tsuma ga otto o naguru (Japanese, indicated by markers 'ga' and 'o')
woman – GA – man – O – hit

In Japanese we might have the markers 'ga', 'o', etc. omitted; e.g. 'Soitsu sensei nagutta yo' (guy – master – hit 'perfective' – particle). The utterance by itself, however, is ambiguous with respect to the interpretation of 'soitsu' and 'sensei' as N and N′. Such ambiguity can be avoided either by reintroducing the markers, or if the distinction of N and N′ is contextually evident, e.g.: 'Yamada pan katta kara, ii wa yo' (Yamada – bread – buy – because – OK – particle – interjection), meaning 'Since Yamada has bought the bread, it's OK, I don't need anything'. In this example, N (Yamada) and N′ (pan) are not reversible.

In the case of French, it is interesting to note that if ever the N′ (object complement) is shifted to the position before R (but after the subject N) becoming NN′R, it has to be pronominalized, in other words the dislocation of the R is compensated by the marked form of the pronoun:

(11a) La femme frappe son homme
(11e) La fémme le frappe
(11f) *La femme son homme frappe.

Similar compensations of marking are observed in Chinese and Spanish where word order NN′R coexists with the basic order NRN′:

(11g) un soldado mata (a) un hombre (marker 'a' optional) a – soldier – kill – A – man ı
(11h) un soldado a un hombre mata (marker 'a' compulsory)
(11i) mata un soldado a un hombre (marker 'a' compulsory)
(all three meaning 'a soldier kills a man').

In (11g) the marker 'a' is optional probably because the grammatical relationship between the N is established directly by MATA 'kill'. But in (11h) and (11i) where the R is outside the two N, the marker 'a' is compulsory. In modern Chinese (Mandarin) when the R in NRN′ is shifted to the right outside the two N, the marker BA is introduced to mark the object complement: N′.

(12a) nage nüren BA tade nanren da le (NN′R with marker BA)
that – woman – BA – her – man – hit – ASP
(12b) nage nüren da le tade nanren (NRN′ without marker)
that – woman – hit – ASP – her – man
(both meaning: 'that woman hit her husband').

The order NRN′ (SVO) in French, Chinese, or English might lead us to consider that the relationship between N and N′ are marked by the order as a whole and not by having R as the link between N and N′. The fact that the same relationship in NN′R (SOV) languages is not marked solely by the order itself but rather relies heavily on additional morphological markers eliminates such an argument. Mixtepec Zapotec (of RNN′ and not NN′R), an American Indian language spoken in Oaxaca State, Mexico, is the only language to our knowledge in which the relationship between N and N′ is marked neither by R nor by any additional markers, but solely by its rigid order as a whole. Since this language is RNN′ and has prepositions, we suggest that the RNN′ order of Mixtepec Zapotec is derived from an anterior NRN′ (SVO) order.

Another fact supporting our argument is the co-occurrence of prepositions and postpositions with the respective NRN′ and NN′R word orders. These co-occurrences are found to be most constant and uniform among Greenberg's proposed implicational universals. According to our hypothesis, an oral language like French or English having an order based on the spatial register is expected to have prepositions to mark the locative relationship between the two N. In contrast, an oral language like Japanese having an order based on the temporal register will have postpositions as locative markers. In a gestural sequence like example (3), if read on the temporal register, it will be:

(3a) WOMAN CHAIR SIT.

How the locative is indicated in (3a) is not manifest. It will become evident only when the sequence is read on a spatial register where CHAIR will be marked as locative by the orientation of the action of SIT which links WOMAN with CHAIR:

(3b) WOMAN SIT (action on to) CHAIR.

Once the event is expressed in the linear form of an oral language the orientation of the verb towards the Nloc has to be morphologically represented. We will see that it is the logical consequence to have prepositions in NRN′ languages, and postpositions in NN′R languages. Hence the former for English and French, and the latter for Japanese:

(3c) The woman is sitting ON the chair
(3d) La femme est assise SUR une chaise
(3e) Onna ga isu NI suwatte iru.

Since the locative is indicated on the spatial order by the orientation of the action of R, the locative marker ought to be a preposition in NRN′ languages in order to preserve its spatial register positioning: NR prep Nloc. However, what remains to be explained is that the preposition is located after the relator (verb) and not before it. On the spatial register the R and its orientation constitute a single movement. There is no indication that the orientation of the action when separately represented by a marker (preposition) ought to be placed after R and not before it. (In French, we do find examples like 'survoler' with the preposition 'sur' prefixing 'voler'.) In English, French and Japanese too (see further on), the tendency is to place the preposition or postposition between R and the object complement of the locative marker, and this might explain the preference for the postverbal position for the prepositions.

Now let us turn to an expanded sequence like example (4) containing a locative and complement object of R (verb):

(4a) BOY – COIN/PUT (incorporated, action towards/into) – BOX (spatial register)
(4b) BOY BOX – COIN/PUT (incorporated, action towards/into) (temporal register).

The directionality 'towards/into (the box)' of PUT has to be represented morphologically in an oral language. Thus a preposition (in English or French) indicates the direction which the object of the R (verb) is heading for (in the case of a gestural language, the object COIN is incorporated into the action PUT):

(4c) the BOY PUTs a COIN INTO the BOX
(4d) le GARÇON DEPOSE une PIECE DANS la BOITE.

In Japanese, though the R is at the end of the sentence, the directionality is successfully indicated with the help of a postposition (where a preposition would fail):

(4e) Shoonen ga kooka o hako ni iremasu
Boy – GA – coin – O – box – NI – put
(The boy puts a coin into the box).

Since the R is placed finally, it plays no more role in indicating the direction in which the object complement is heading. The establishment of the locative relationship between N and Nloc depends entirely on the postposition 'ni' and the object complement marker 'o' suffixed to BOX and COIN respectively. And for this reason we can have the object complement COIN placed immediately in front of PUT without any modification in the reading of the sentence (according to our definition, the preposition NI is part of R, cf. Note 2).

(4f) Shoonen ga hako ni kooka o iremasu[12]
Boy – GA – box – NI – coin – O – put
(The boy puts a coin into the box).

6. IMPLICATIONS AND LIMITATIONS OF OUR HYPOTHESIS

Greenberg's findings on word orders are statistical (and also implicational) universals. By means of the present hypothesis we hope to capture the anterior universal of his data on the cognitive level. We suggest that the two major word orders in oral languages, NN'R and NRN', are the consequences of two successive extralinguistic contraints imposed on oral expressions[13]: (i) the visual-perceptive constraint and (ii) the constraint of linearization that demands a choice of strategy between the temporal and the spatial registers. So far in our discussions, references have only been made to human languages. The constraints in question, however, are not limited to our languages. They are also at work when primates start learning signing. According to what has been reported, the chimpanzee, Washoe, first used the sign order NN'R (SOV, temporal register) as did our deaf signers, and it was only at a later stage that she was trained to adopt the signed English sign order NRN' (SVO, temporal register). Linden (1974: 103) wrote: 'At the beginning of the test period, Washoe put subject before object, although she put both before the verb; at the end she was using traditional subject-verb-object word order'.[14] The relatively casual tone in which Linden related this observation makes the description of this critical event all the more faithful and convincing. If only Washoe had been trained by a deaf signer!

Our findings thus justify Osgood's notion (see Osgood 1979) on the general theory of cognizing and sentencing, i. e. 'both in the evolution of the species and in the development of the individual human, the cognitive structures which interpret sentences received and initiate sentences produced are established in prelinguistic experience, via the acquisition of adaptive behaviors to entities perceived in diverse action and stative relations'. This statement of his later becomes one of the key notes in his article on the abstract performance grammar, stating that 'the structures developed and utilized in prelinguistic cognizing determine the basic ('natural') cognitive structures underlying sentence understanding and creating'.[15]

The visual perceptive constraint applies to the prototype of basic declarative sentences (i. e. before they are uttered) containing R of visual action type such as HIT, BITE, etc. These prototype basic sentences, as witnessed in gestural languages, preserve features of both the temporal and the spatial registers, and it is only after the application of the second extralinguistic constraint, the linearization process, that a preference has to be made between the two registers. Once the basic order is adopted by an oral language, then that order will henceforth be generalized and become the habitual order covering all other basic declarative sentences, disregarding the diversity in its verbal constituents, whether they are relators signifying mental activity or relators demanding a resultative complement.[16] However, it is not excluded that an oral language which preferred in principle the spatial register, for instance, might retain in some of its particular structures certain features characteristic of the temporal register. Chinese and Huauhtla Nahuatl are cases in point. The basic order in modern Chinese (in the absence of an aspect or modal marker, or a locative phrase) is NRN′ (SVO). However, there is evidence showing that the word order in archaic Chinese was once NN′R.[17] Postpositions which coexist with prepositions in modern Chinese might be eventually explained in terms of a carry-over of the former which is a feature of NN′R in archaic Chinese. The incompatibility between the use of postpositions and the order of NRN′ (SVO) in Huauhtla Nahuatl can be understood as a result of a shift of word order from NN′R to NRN′ (SOV to SVO). The postpositions, probably more resistant to modification than the word order itself, survive and are sustained in the new word order despite the incompatibility.[18]

We arrive consequently at a conclusion that argues against the assumption that a system of universal grammar ought to be unordered (cf. Staal 1967, see Note 10). It has to be ordered. The basic word order or sign order of any oral or gestural language has to be perceptually or even cognito-perceptually based. We admit, of course, that there are divergent arrangements of words or signs in different types of languages, and even within a single language. The scope of our hypothesis is restricted. This hypothesis deals mainly with the link between the word/sign orderings in basic declarative sentences/sequences. How much more scope this hypothesis will cover depends on how much of the order chosen for basic declarative sentences/sequences in a language is retained among other types of sentences/sequences within that language. We at the present have no intention of making a greater claim. Therefore our hypothesis as it is formulated will not explain the subsequent diversity in word/sign ordering of a language, both oral and gestural.[19] Subsequent ordering such as inversion in questions, topicalization, passivation, emphasis marking, the placement of negatives, numerals, time adverbials, modal auxilaries, etc., are beyond our coverage. Other arguments have to be formulated to answer that need.

NOTES

1. This paper was first presented in December 1976 at the Neuropsychology and Neurolinguistic Seminar, Laboratoire de Pathologie du Langage (INSERM/EHESS), Paris, and later at the Visiting Scholar Lecture Series, McGill University, summer 1977. A discussion session on the paper was also held in early March 1977 at the Department of Linguistics, University of Paris IV. Copies of the original version, in English and in French, were mailed to fellow researchers, destined to solicit their opinion. We owe very much to those who have kindly given us their comments. Our

gratitude first goes to C. Osgood and A. Rygaloff, whose remarks helped us overcome certain hesitations in the postulation of our hypothesis. Our warmest thanks are due to those who offered us hour-long helpful discussions (or by correspondence), in particular, F. Bresson, A. Cartier, J.-C. Chevalier, F. Dell, M. Deuchar, D. C. Ellis, S. Fisher, J.-J. Franckel, P. Friedrich, A.-J. Greimas, H. Hecaen, C. Henry, J. Kawaguchi, H. Kremin, W. Lehmann, P. Le Nestour, P. Oléron, C. Padden, M. Paradis, M.-C. Pouder, R. Reeck, F. Renaud, I. M. Schlesinger, S. N. Sridhar, W. Stokoe, I. Tamba, C. Vogt. Warmest thanks are also extended to our friends, both deaf and hearing, who generously provided us with a grand array of raw data. For the recent development of the hypothesis presented in this article, cf. Yau (1978a, 1979).

2. To avoid involvement in the subject-object controversy over certain languages, we prefer the schema NN'R to SOV, or NRN' to SVO although in most cases N and N' correspond to S and O. The term 'relator', abreviated as R, is also preferable to the traditional term 'verb' (V) in that the former reflects directly its actual function, relating any two N, e.g. N and N' or N/N' and Nloc. In the case of sign languages, elements which are rendered by prepositions or postpositions in oral languages, e.g. 'on' in 'the book is on the table', or 'at' in 'he is aiming his gun at the target' will then be appropriately labeled as R or part of R. Certain linguists, notably Lehmann (1972), study word orders in terms of the alternate positions between V (R) and O (N'). We feel however that an omission of the S (N) in our analysis would make it impossible to account for the difference between word/sign orders in certain languages, such as RN'N (VOS, Malagasy) compared with RNN' (VSO, Tagalog), N'RN (OVS, Hixkaryana) and NRN' (SVO, English), or N'NR (OSV, American sign language, temporal register) and NN'R (SOV, French sign language, temporal register). For 'temporal register', see Sections 2 and 3.
3. Our informants are all adults and have learned and used their dialects throughout their adolescence within their respective deaf communities. For a brief discussion on dialects in Chinese sign language, cf. Yau (1978b). During the film session, only one informant at a time was present in our studio so as to avoid mutual influence among our deaf informants. The deaf person was shown one cartoon (containing several pictures) at a time and filming started after the cartoon was put aside.
4. All are in accordance with the Chinese except in the case of the French where our informants signed Nloc in sequences of N Nloc R with a reference hand acting as dummy Nloc instead of signing the required Nloc. After the performance of the dummy form of the Nloc they then signed it in full as posterior reference. Hence for examples such as 'WOMAN SITS (on) TABLE' or 'WOMAN SITS (on) CHAIR', our French deaf informant from Paris signed 'WOMAN dummy Nloc/SIT (incorporated, dummy Nloc represented by the back of a hand held horizontally) TABLE'. In the case of 'CHAIR', it is understood and no full form was signed as posterior reference. Despite this apparent difference we considered that the French examples, from the point of view of sign ordering, are in line with the rest of our data. For example, there is also a dummy Nloc in the examples of the Chinese. The Chinese version of 'WOMAN SITS (on) TABLE' is: 'WOMAN TABLE dummy Nloc/SIT (incorporated, dummy Nloc represented by the palm of a hand held horizontally)'. The only difference here is that in Chinese the dummy Nloc is anaphoric whereas in French it is cataphoric (in other words, the full form was signed as an anterior reference).
5. We have recently discovered and studied two cases of Cree deaf in Canada (one, concerning a single deaf person; the second, three deaf people, two brothers and one sister) who have invented their own sign language without being influenced by

any external existing sign languages. Their basic sign order conforms with our general observation. Reports on the two cases are now in preparation.

In an article by a Taiwanese deaf, the author acknowledges that the deaf in Taiwan sign with the NN'R (SOV, temporal register) which is different from the spoken Chinese NRN' (SVO). Apparently annoyed by this difference, he unnecessarily claims that it is due to the influence of Japanese which is NN'R (SOV).

For the basic sign order in other gestural languages, cf. articles such as Fant (1972), Friedman (1976), Hansen (1975), Mallery (1881). For other observations, cf., for example, Namir and Schlesinger forthcoming.

6. We find that this constraint is not an isolated phenomenon. An analogic constraint is observed in the designation of an orientated straight line in classical mathematics. To determine such a straight line, two points in space are needed. In case only one point is fixed in space, then an infinite number of straight lines might pass through that point. In other words an infinite number of directions are possible. If we make a comparison between the points necessary for the designation of an orientated straight line and the two N necessary for fixing the orientation of the action of a relator (verb), we will find that without the second N', the orientation of the action of a relator (verb) cannot be determined. This orientation of the relator (verb) can also be compared to a vector. In case of $\vec{V}$, N will be the origin (grammatically speaking, the agent) and N' the extremity (grammatically speaking, the acted on or the patient). In case of $-\vec{V}$ the situation is reversed.
7. In this study of the archaic Chinese writing system, Yau (1978a) finds that the two orders, N/N'R (temporal) and NRN' (spatial) observed in gestural languages, are also respected in the composition of the archaic Chinese ideograms.
8. To our knowledge Osgood and his collaborators (Osgood 1979, 1980) are among the few people working on this fundamental question.
9. An interesting similar phenomenon exists among bee dances. Information about a location is given first by signaling the distance then the direction. Such a message provided by the dance is mutually comprehensible to both bees in North America and bees in Australia, cf. Voegelin (1958). We suspect that the order 'distance-direction' is comparable to the positing of two N before orientating the action of a relator (verb) in a gestural sign sequence. If so, it explains the universal comprehensiveness of the dance among bees in various regions separated by long distances.
10. It is generally believed that the RNN' (VSO) type represents roughly 10% of the world's languages, cf. Blansitt (1973) and Sedlak (1975). A language like Sanskrit, basically of NN'R (SOV) order, allows easily the RNN' alternative, e.g. 'ramo govindam apayat' (NN'R) and 'apasyad ramo govindam' (RNN'), both meaning 'Ramá saw Govinda' but with a slight morphological modification on the relator (verb), cf. Staal (1967). It is also noted that a language like classical Aztec where R (verb)-initial order is common but R(verb)-final very uncommon, this language nevertheless retains postpositions which is characteristic of R(verb)-final order, cf. Steele (1976). We are therefore inclined to consider RNN' or RN'N (VSO or VOS) to be derived from the other two major word orders, in particular from NN'R (SOV).
11. It goes without saying that some NRN' languages, in particular those having alternative word orders, e.g., Russian or German (NN'R in subordinate clauses) do maintain a certain morphological distinction between N and N'.
12. There are other possible variant orderings for (4) in Japanese, for instance with the BOX or the COIN placed at the beginning of the sentence. However, in that case they are considered by the native speakers as marked or emphatic forms. For this

reason, their ordering, in our opinion, should be handled by means of a linguistic permutation and is no more within the scope of our extra-linguistic constraints.

13. It seems that what we labeled 'extra-linguistic' is already within the domain of linguistics for certain psycholinguists; for example, Bever (1971) wrote: 'There is a classical conflict within biological fields between analyses in terms of structures and in terms of processes . . . The question we should now ask is something like this: given that we know the nature of linguistic structures, what do they tell us about the linguistic processes, about the processes that result in language behaviour?'.
14. It seems that the 'immobile-mobile' constraint or the 'preeminency principle' (cf. Section 3) is equally at work in Washoe's signing system. According to Fouts (1975) quoted by Peng (1975), we learn that Washoe posed Nloc before N(temporal): 'I often take Washoe for boat rides in a pond surrounding a chimpanzee island at the Institute. The pond is inhabited by two very territorial and nasty swans. Since I do not have a sign for swan I refer to them with the duck sign. Washoe does not have the duck sign in her vocabulary so she refers to the swan as *WATER BIRD*.' (our italics). See also Linden 1974, p. 112.
15. Our arguments confirm also Lashley's idea on the act of language production, but at the same time adding precision to his postulation. He described, according to Blumenthal (1970), 'the act of language production as involving some internal nonlinear (perhaps spatial) representation that was somehow transferred into an external temporal sequence' ('temporal' probably in the sense of from left to right in a linear form and not in our sense of retaining features of the temporal register).
16. As for the generalization process, the one proposed by Braine (1963), the contextual generalization, might be a possible candidate (but only after choosing one of the two registers). This contextual generalization is described by the author as: 'when a subject who has experienced sentences in which a segment (morpheme word or phrase) occurs in a certain position and context, later tends to place this segment in the same position in other contexts, the context of the segment will be said to have generalized, and the subject to have shown contextual generalization'.
17. In archaic and classical Chinese, NN'R (SOV) is compulsory if the sentence is in the negative form and N' is pronominalized: N neg.N'(pron.)R. The arrangement of the same elements in modern Chinese is obligatorily: N neg.RN'(pron.). Contrary to the traditional and current point of view, we interpret this evidence in archaic and classical Chinese neither as an exception nor as an inversion peculiar to the negative construction, but rather as a trace of an older word order. For prepositions and postpositions in Chinese, cf. Hagège (1975).
18. For the use of postpositions in Huauhtla Nahuatl, cf. Merlan (1976). A similar explanation for the unexpected constant use of postpositions in classical Aztec is suggested by Steele (1976).
19. There are languages which make use of word order contrast as a syntactic device. For example, in Moru-Madi, NRN' (SVO) is reserved for 'a verb action which is complete, momentary, "perfect", definite', whereas NN'R (SOV) for 'a verb action incomplete, progressive, "imperfect", indefinite', cf. Tucker (1967).

PART V

Origins and Development of Communicative Behavior

THELMA E. WEEKS

Intonation as an Early Marker of Meaning[1]

As more and more researchers have been examining in detail the behavior of young infants, it has become increasingly evident that we have been underestimating their capabilities. Trevarthen (1974) found that by six weeks of age, infants approach persons and objects quite differently. By two months, they found activity that they maintained could best be called 'prespeech' activities because both the context in which it occurred and its form indicated that it was a rudimentary form of speaking by movements of lips and tongue. Freedle and Lewis (1977) found that by three months, infants and their mothers were taking turns in interacting, much as in conversation, either with vocalizations or movement. Basing their teaching on what their child could comprehend rather than produce, Steinberg and Steinberg (1978) began teaching their son Kimio to read at six months of age. By 12 months he could identify four words on cards, none of which he could say, and by 24 months, he could identify 48 words, phrases and sentences, of which he was able to pronounce only 15. These and many other research findings offer new evidence that children develop a semantic system long before they are producing any 'words' at all.

While we have been underestimating the capabilities of young children in some ways, we have been inclined to overestimate their ability in other ways. The speed with which children acquire the intonation system of language is a case in point. Bever et al. (1971) state 'It is widely accepted in the literature that the child effectively masters the intonation pattern of his language *before he has learned any words at all*'. While it is well known that children *produce* a wide range of intonation patterns in their babbling, it is not the case that children have *mastered* the intonation system. What they apparently do is to note that speakers of the language do not speak in a monotone, but use variations in pitch, duration, stress, rhythm, etc., and they have imitated these patterns for use with their speech sounds. As early as five months, some children babble with sentence-like intonation contours. Of the seven children whose language development I study longitudinally and on which this study is based, Fred produced such babblings at the earliest age while Jennie did not produce them at all. Leopold mentioned (1949: II, 256) that Hildegard did not babble with intonation patterns. This is not unusual, and it should be stressed here that some children do, and some do not, use sentence-like intonation contours for babbling.

Weir (1962) pointed out that from the end of Anthony's first year on, when she asked him to repeat a sentence with a rising intonation, his repetition of the sentence included a rising contour, and if the sentence she gave him had a falling intonation, Anthony repeated it with a falling contour. This was using language, not babbling. Chao (1951: 32) observed that his granddaughter Canta 'acquired tones very early, as most Chinese children do'.

Leopold (1949: II, 254–255) reported that at 1:1, Hildegard tried to imitate *bimmel bammel beier*, something she had heard repeated as an object was swinging on a string, and although she could only pronounce the first two sounds, her pitch and intonation were correct. Karla said the same word at 0:11, but did not reproduce the intonation until 1:1.

Before children are producing any words at all, they can often imitate intonation patterns that are more complex than they will be producing during their early language period. In pretending to read, for example, all of the children I study except Jennie used intonation patterns that far exceeded any sentence they could produce using words.

Jakobson (1968: 43) found that in aphasic patients, sentence intonation is preserved after other aspects of language are lost. He suggests that the reason is that, in contrast to the phoneme, intonation patterns possess a constant meaning, e.g. a falling contour marks the end of a meaningful unit, etc. This 'constant meaning' is universal. Greenberg (1977) has noted that all languages use intonation to mark sentence boundaries; statements usually have a fall in pitch, which is greatest toward the end of the sentence, and questions are generally marked either by a rise in pitch, a specific question word, or a combination of the two. Bolinger (1968: 32) suggests that

> probably all languages use the direction of intonation to show where major divisions of utterances start and stop. One effect that is found everywhere is a running down, a tendency to drift toward a low pitch when the speaker nears the point where he intends to stop. He starts full of energy, but deflates at the end like a bagpipe running out of wind. But, if he is unsatisfied – as he normally would be in asking a question – his pitch goes up. As with excitement and depression these tensions and relaxations may be instinctive, but we seem to have learned to use them intentionally.

We see, then, that the sentence, like the word, is a universal unit, and is marked as such in most languages of the world by intonation.

To say that children perceive and produce intonation patterns at very early ages is not to say that they have 'mastered' intonation. What children have acquired is the comprehension and use of broad, largely universal patterns, not the fine nuances developed by the speakers of each language. For example, I recently called to see if some printing I had ordered was ready. The man answered, 'Oh, yes, the work has been done for weeks'. What made this a pun (referring to a period of time instead of my name, Weeks) was the extra rise and lowering of intonation, plus lengthening, on the word *weeks*. This and many other ways that adults use intonation are beyond young children's comprehension or production. While a child's language is patterned after the adult language, no aspect of the child's language at age one, two, or even three years, matches that of the adult. What is surprising is that there are as many similarities as there are, for we know that children create as they borrow. Children develop their own rule-ordered system of intonation, just as they develop their own systems of phonology, morphology, and syntax, none of which match the adult system at this early age.

MEANING IN INTONATION

Children learn in early infancy that intonation carries meaning and emotion. Key (1975) contends that emotions and attitudes are always projected by nonverbal means, part of which is intonation. Bolinger (1964) compares intonation to the ocean – the ripples, waves, swells, and tides. Or more accurately, he says, 'ripples *on* waves *on* swells *on* tides, because each larger movement carries the smaller ones on its back'. He compares the ripples to the accidental changes in pitch, the irrelevant quavers. The waves are the peaks and valleys that are called accent; the swells are the separations of discourse into larger segments; and the tides are the tides of emotion. Bolinger suggests that the emotion that we either deliberately or involuntarily put into our message and that is respected as a genuine part of it, is an expansion and contraction of the total range of pitch. If the speaker is bored, indifferent or depressed, his pitch range will be shallow, while enthusiasm, anger, surprise, or other emotions tend to prompt pitches well above and below the average pitch. He believes these tides are much the same in all languages. The reason for this is that these variations are physiologically determined, just as nasality in whining and complaining is. We can see an explanation, then, for the fact that language directed to babies usually contains more variation in pitch (is more melodic) than language directed to adults. Babytalk is used to express emotion. Babytalk in American English is also marked with more rising intonations than unmarked speech, because adults ask questions of babies, even though they know the questions will not be answered. Children learn rather young to use this exaggerated intonation. For example, Fred was 3:10 when he said to Leslie (0:6), 'Hi Lesh. How are you? Oh, you're laugh – playing laughing all the time! Why? Why? Why? Can you shake hands? How come you laugh all the time? How come?'. This was all said with a generally high pitch and exaggerated intonation. It was an expression of affection on his part, and she responded by smiling and kicking her feet.

It is apparent that children learn very early that intonation has the capability of expressing meaning, and they use it in this way, though not necessarily in adult-like ways. Often their use of intonation seems quite idiosyncratic. Some of the ways in which children do use intonation are discussed here.

INTONATION PATTERNS USED BY CHILDREN

The particular ways in which children use intonation patterns will be divided into communicative, or socialized, functions, and noncommunicative, or egocentric, functions.

Communicative functions

1. *Lowering pitch.* I have already mentioned that a fall in pitch generally marks the end of a sentence. The basic contour in American English is three-level, 2-3-1: *I know that.*[2] Children begin to use a two-level falling pitch with one-word utterances. There is naturally no confusion in children's use of such a fall in pitch to indicate the end of a sentence. However, a falling pitch is sometimes used for other meanings. For example, Leslie used a falling intonation pattern to indicate negation before she was able to include a negative morpheme. While *no* was one of Leslie's first words, she did not include it in sentences, even as a first morpheme to negate a sentence as many children do. For example, it is common for children to produce such sentences as 'No mommy read', to mean 'Don't read', 'No sit there', to mean 'Don't sit there', etc. From about 2:4 to 3:2, Leslie used anaphoric negation (i.e. I asked her [2:6] 'Can we take turns?' and she answered, 'No. My turn'), but she did not use sentence negation. Her usual marker of negation was a lowering of pitch. She regularly said 'I know', with the *know* slightly lengthened and lowered more than simply for marking the end of a sentence, and it meant, 'I don't know'. I questioned her about it a number of times to be sure. She also used a steadily falling intonation to negate longer sentences. For example, Leslie's mother had told me she could sing 'Twinkle, Twinkle Little Star', and I asked her if she would sing it. She answered:

Leslie: (2:10) /i gi ki gai dor nau/ 'I'm not going to sing "Twinkle Twinkle Little Star" now'. However, I didn't understand her correctly.

Weeks: Are you going to sing it now?

Leslie: No! /ai van gi ki kai gor a mi hom/ 'No! I want to sing "Twinkle Twinkle Little Star" at me (my) home'.

A couple of months later Leslie was looking through two books with pictures of animals in them. She discussed the animals on each page in a similar way:

Leslie: (3:0) /e be . . . i beg hurt me . . . e o mi/ 'Ladybugs won't hurt me. They love me'. (*i beg* was her usual way of saying *ladybug*.)

/e wrn . . . e wrn kɛr mi/ 'The worm doesn't scare me'.

Weeks: Don't worms scare you?

Leslie: /no e o mi/ 'No, they love me'.

/i yiən i gɛr mi/ 'The lion doesn't scare me'.

She continued with other animals, assuring me (or herself) that they were not frightening. The falling intonation in these sentences is different from that used for affirmative statements. In Leslie's negated sentences, the intonation falls steadily, following the subject, if there is one, whereas for affirmative sentences, the drop in pitch is on the final syllable or final word of the sentence.

Many examples could be given of her use of lowering intonation for negation, and I am sure that many other instances went unnoticed, for the pattern is not sufficiently distinctive to always be unmistakable.

It should be mentioned here that in adult English a negative statement often has a different intonation pattern than a similar positive statement, and it is possible that Leslie had noted this.

One example of such a deviant intonation pattern for negative statements is offered by Iannucci (1978). In discussing the acquisition of 'quantifier dialects' by children he offers examples such as:

All the kids aren't asleep.

Characteristically in such a sentence, the stress and high pitch is on *all*, while the intonation is fairly level for the rest of the sentence, except for a slight rise on the final syllable. With this intonation pattern Iannucci has found that adults and children of about age six and older interpret this sentence to mean 'Some of the kids are asleep and some are not', that is, they interpret the sentence as though the quantifier *all* had been negated rather than the verb. Regardless of the intonation pattern used in presenting such sentences to younger children, they interpret it to mean that none of the kids are asleep.

His paper represents another example of a researcher assuming that young children have rather sophisticated capabilities regarding the comprehension, if not production, of intonation. He notes, 'The clear marking of the Neg-Q interpretation by intonation, further, is no trivial matter with regard to consideration of child language acquisition, since we know that children normally latch onto intonation at the very earliest stages of grammatical development. The question now is: how do children handle these quantifier sentences?' Again we see that while children have learned that intonation is meaningful, and they have learned to imitate many patterns and make use of some, they have not at all 'mastered' intonation. As for how children handle these quantifier sentences, they are interpreting them correctly according to the grammatical structure of the sentence, whereas the adults are interpreting the sentences in a nonstandard way. In English it is normal to negate the quantifier, if that is what is meant. It is also usual to move the negative morpheme as far front in the sentence as is possible. Iannucci maintains that the intonation pattern indicated above marks the sentence as meaning that the quantifier is negated, and that adults almost invariably interpret it this way. In an informal survey of my own, I wrote this sentence on the board for my child language acquisition class along with the two possible interpretations: 'None of the kids are asleep', or 'Some of the kids are asleep and some are not'. In spite of the fact that I did not say the sentence aloud at all, my entire class, including an 11-year-old girl who was visiting that day, voted for the second interpretation, 'Some are asleep and some are not'. Since being alerted to this structure by David Iannucci, I have noticed similar sentences, obviously with the negated-quantifier meaning, in the newspapers and popular magazines. While it has become common, and is interpreted in a way that is deviant from the grammatical structure of the sentence, the sentence itself is somewhat deviant – it does not follow the usual rules for negation. As such, it may be expected to be acquired late by children.

2. *Rising pitch.* Knowing that the English language uses rising intonation, question words, or a combination of the two, to formulate questions, one could easily predict that children would find it easier to learn to use rising intonation than to learn the series of English question words plus the sentence transformations required for standard adult questions. Add to this natural simplicity the fact that more rising intonations are directed to young children than to adults, and you add to the probability that English-speaking children will acquire this early.

For example, Leslie began to use rising intonation to ask questions or express uncertainty beginning as soon as she had one-word utterances to which she could attach the intonation. Before she was one year old, Leslie would ask 'Dada?' when she heard a car in the driveway. She continued to look questioningly at me until I told her it either was or was not Daddy. Or if her mother was not in sight, she would look at me and ask 'Mama?' and wait until I explained where her mother was or when she would be back. Such questions are usually interpretable by the context, but not always, and a great deal of frustration often results from adults' inability to correctly interpret questions.

Leopold (1949: II, 355) reported that at 1:3, Hildegard used the 'word' /ʔə/ and *da* with a rising intonation to mean that she was requesting something. However, a high-level tone was an emotionally charged indication of interest, but not a request.

Just as in the adult system, children use rising intonation to see if the listener understands them. For example, one of the Yakima Indian children with whom I work was telling me about a person I didn't know, and he was trying to explain who he was. He said, 'He's one of our brother longs'. It was a statement, but he said it with a rising intonation, to see if I knew what he meant. I didn't, and asked, 'He's what?'. He repeated, again with rising intonation, 'He's one of our brother longs'. I still didn't understand and he became embarrassed.

Rising intonation is also used for attention-getting. At 2:5 Greg said, 'Look! Round round?'. He was playing with some clay, and trying to get my attention, not asking a question. However, this may be thought of as a request in that the child is asking, 'Will you notice me?'. Jennie, Leslie and Hildegard all used /ʔə/ with a rising intonation during their earliest language period to make requests of various kinds.

Greg also used a rising intonation with 'Fine', in response to 'How are you?' at age 2:5. This seems to me to be an acceptable intonation contour even for an adult, even though it may be assumed to be a statement, not a question.[3]

In my own material and that which I have reviewed, I have found one particular exception to the rule of children following general adult patterns with rising intonations. This exception is reported by Lord (1974), who noted that at 2:0, her daughter Jennifer used a rising intonation to indicate negation. For example, 'I wan' put it on!' starts out at a normal pitch and the remainder of the sentence climbs to a higher level, except for a final brief fall at the end. It meant, 'I don't want it on!' 'I want need help!' meant 'I don't want any help!'. This may be an idiosyncratic use of this pattern on Jennifer's part, or she may have heard the pattern used by an older person in conjunction with a negative element. It doesn't seem to me to be an unacceptable pattern for negation even for adults, particularly when the statement is directed to children.

While there is no one intonation contour that is associated with negation in adult English, it does appear that a negative statement often carries a different contour than a positive one, due in part to the different stress usually found in a negative statement.

3. *Contrasting pitch.* I have noted a number of examples of children using contrasting pitch in contiguous phrases to indicate contrasting meaning in nonadult ways. This was another one of Leslie's ways of expressing negation before she was able to include a negative morpheme in a sentence. For example, she was looking at a book that pictured a boy and a dog in bed together:

Leslie: (3:1) Oh oh! Gog feet sticking out! Boy feet sticking out! (The dog's feet are sticking out. The boy's feet are not.)

The fact that the two similar sentences had different intonation patterns would lead one to think that the meaning was also different, but without the pictures it would not have been clear just what she meant.

In the following example, I had asked Leslie if she needed to blow her nose, and she replied:

Leslie: (2:11) I a ikky nothe. Fwe a ikky nothe. (I don't have an ikky nose. Fred has an ikky nose.)

By this, of course, she meant that she did not need to blow her nose, but I should look into the matter of Fred's nose. In this case, the first word of each sentence had stress and high pitch, but the first sentence remained level after that, while the second sentence ended with a rise. In a similar situation, an adult relies on the negative morpheme, so this is a child-like strategy, and I might not have deduced the meaning if the context had not made it clear.

The point I want to make is that Leslie was using a contrasting intonation pattern to express a contrast in meaning, and even though adults do use intonation to express contrasts, her system was her own, not the adult system.

One contrastive adult system which has been examined by Cruttenden (1974) is the contrasting intonation patterns used in reporting football scores in British English, in which the intonation used in announcing the first team and its score anticipates the second score. There is a complex pattern of differences depending on whether the home team or away team wins or loses, or whether it is a draw. He found that 15 adults, chosen for their non-interest in football, were all able to predict the second score correctly, but that 28 boys aged seven to ten were just beginning to acquire the ability to do this. The first pattern to be learned by children, at about age nine, was that of the draw score. Cruttenden says there is a strong relationship between age and the score on this test, and a lesser relationship between football interest and the score. As he points out, children had heard such contrastive patterns as:

John walked slowly, but Bill ran.

A falling-rising pattern (as in *but Bill*) regularly indicates 'new' information. Children have been found to use intonation productively for this purpose during the two-word utterances stage.

Chafe (1970) has brought to our attention the fundamental semantic distinction between the elements in a sentence which convey new information and those which convey old information, and suggested it as a promising area for further study. Wieman (1976) is one who looked at this in a study of the two-word utterances of five children aged 1:9 to 2:5. The tape-recording was done during play sessions. She found, as most child language researchers have, that children have very strong patterns of stress in their speech. In two-word utterances, the stressed word carries the high pitch. She found that out of 28 possessive phrases, the locative element was stressed in every instance; in attributive phrases, stress was usually on the head noun; in verb plus object phrases, it was the object that was stressed. In examining the exceptions to the patterns, the determining factor seemed to be whether or not there was 'new' information included in the phrase. If so, the new information received stress. For example, whereas in a noun-locative phrase, the locative was usually stressed, in the case where the mother asked 'What is in the street?' the child answered, 'Firetruck street'. In another instance the same child's mother asked 'What is on the side of the milk truck?' as she pointed to a letter A on the side of a truck in a book. He answered 'Milk-truck B', again stressing the noun object, which was new information, rather than stressing the location, which was the rule with old information. Sentence position was not the determining factor, as the children produced pairs such as *here goes* and *goes here*, both of which meant, 'it goes here'.

Even the youngest subject, who was 1:9, showed this correspondence between stress and new information. The capability of using this pattern of intonation and stress to express meaning develops during the early language production period. It seems that even in two-word utterances, the child is functioning with some rule that specifies that the more important of the two words should be produced more prominently by means of pitch, volume, duration, etc. The determination as to which word is more important is made on the basis of several factors: new vs. old, location vs. action, possession vs. object possessed, etc. The decision is based on semantics, not on position in the utterance nor on part of speech.

In stages beyond the two-word utterance stage, children are able to suggest more complex contrasts in meaning by means of intonation. Their contrasts do not always fit adult patterns of contrast, but they are meaningful to the child, and this meaning is usually communicated successfully.

Noncommunicative functions of intonation

1. *Melodic contours for 'reading'.* A very commonly reported activity for children who have been read to is for the child to look at a book and pretend to be reading. At early ages, this reading usually involves sentence-like melodies and babbling. Even though children are using some one- or two-word utterances at this time, the intonation contours they use with babbling are too advanced for any meaningful utterances they could possibly produce.

Because the seven children whose language development I study have all been read to a great deal and are very familiar with books, they have all begun to pretend to read at early ages. Jennie, the Korean child who was adopted at age 0:5, was the latest to babble while she looked at books, and was the only one who did not babble with sentence-like melodies. From 1:3 to 1:9 she used a steady repetition of 'dubba dubba dubba dubba dubba dubba' as she turned the pages of the book. At 1:9 she changed to a mid vowel (a), but her reading still sounded more like singing than like English sentences. It should be noted that even though Jennie's reading intonation did not follow anything similar to English intonation patterns, it was different than her usual meaningful speech – she did not use this singsong pattern any time except for reading.

2. *Imitative/expressive.* It is quite a usual occurrence for children to imitate intonation patterns. I have discussed it throughout this paper. However, the kind of imitation I want to mention here is not babbling – it uses real speech and an imitated intonation pattern that does not appear to be productively meaningful to the child. For example, at 2:5, Greg was making cookies out of clay – he told me they were cookies – and I said 'It looks yummy!' and he replied 'Dat good!' Even though he changed the words, the intonation was

almost an exact replica of mine even as to length. And Leslie always said San Diego with the same intonation pattern she heard, even though she didn't pronounce it quite right. She also used an imitated pattern for *hello* when she answered her toy telephone. She said 'ɛo o.' These and many more were cases of using meaningful language with an imitation of the adult intonation system rather than an evolvement of their own system, such as the use of lowering intonation to express negation, such as Leslie did.

3. *Melodic contours for language practice.* It is not my intention here to suggest that practice is necessary in the acquisition of language, but it is nevertheless the case that many children *do* engage in activity that sounds like practice. This is as true of intonation as it is of lexicon, morphology, or syntax. Jennie was a particularly good example. She had done virtually no babbling during her prespeech period, and as mentioned earlier, even her 'pretend reading' used a singsong rather than sentence-like intonation pattern. But at 2:3, when Jennie was producing mostly one-word utterances in real speech, she began her first practice with sentence intonation patterns. She seemed to be using Greg as a model; she stood beside him as he talked to their mother. Jennie gave the impression she was trying to say what he was saying, repeating it about a syllable behind him. When Greg paused, she paused. When he laughed, she laughed, and when he resumed talking, she resumed her babbling. She did this repeatedly until her mother asked her to stop because it made it impossible to understand what Greg was saying. Jennie's meaningful speech was somewhat less fluent than that of the other children. There was a pause between every word, as though she were considering what to say next. Her imitation of Greg, who was 4:7, was her first attempt at a normal speech sound. Many times after this, for a period of several months, as I walked down the hall past her room, I could hear her practicing.

Jennie was a somewhat unusual case in that she spent the first five months of her life in Korea, but many other children are reported practicing intonation patterns in much the same way even after they are producing some meaningful language.

4. *Level intonation.* I have many examples of utterances that exhibit a virtually level intonation pattern. For example, at 2:5 Greg said 'apple juice', and 'Talk mike phone', with no discernible stress or change in pitch. I have the impression in most of these cases that the child is concentrating on pronouncing the words – he is reaching the limit of his production capability – and the result is a nonfluent utterance. A flat intonation pattern in an adult might indicate boredom or some similar emotion, or lack of emotion, but in a child who is not yet an accomplished speaker, it may simply indicate

that he cannot concentrate on everything at once. While he can produce many sentence melodies easily with babbling, they disappear when he is concentrating on lexicon and syntax.

SUMMARY

One of the most remarkable aspects of the babbling of some (not all) babies is that it is produced with intonation contours that sound very much like adult sentence melodies. The fact that babies are able to imitate intonation so well has led some observers to conclude that children have acquired the adult system at a very early age. Such is not the case. Children do, however, appear to note that adult speech makes use of variation in pitch, duration, stress, and pauses, and they learn to do the same with their babbling. Children also learn that intonation carries meaning, and they use intonation to express meaning from the earliest language period on. They use rising pitch, lowering pitch, and contrasting patterns to express particular meanings in communication with others. Children also use intonation in noncommunicative, but meaningful, ways, such as for language practice or for their own entertainment. However, the ways they use intonation do not necessarily coincide with the adult system; children develop their own rule-ordered intonation system that differs from the adult system, just as their morphological or syntactic systems differ from the adult language.

NOTES

1. Paper presented at the First International Congress for the Study of Child Language, Tokyo, Japan, August 10, 1978. I wish to thank Dwight Bolinger and Martin Montgomery for their helpful comments on the draft of this manuscript. The weaknesses that remain in the paper are my own.
2. British and American English intonation patterns are not the same.
3. Dwight Bolinger (personal communication) suggests that in using such an intonation, an adult probably has in mind going on to ask 'And how are you?'. In such a case, the rising intonation signals incompletion (as it does, by definition, in any question).

BEATRICE BEEBE

Micro-Timing in Mother-Infant Communication[1]

This article describes a method of microanalysis of mother-infant nonverbal interaction during face-to-face naturalistic play. Several case studies of three- to four-month-old infants are presented to illustrate the rapid and subtle communicative events identified with this method, and how these communicative events are organized in time.

Some of the most important mother-infant nonverbal communicative events occur in less than a second, and are often lost with usual observation methods. The method of microanalysis of film to be described below is designed to capture these fleeting events; it allows us to discern their communicative significance. Furthermore, whereas other naturalistic methods time-sample, or prejudge the appropriate unit of time, losing the actual duration of events in their natural sequence, the precision of microanalysis is ideally suited to the question of how mother and infant coordinate their joint action exchanges in time. It is increasingly agreed (Ashton 1976; Sander 1977; Stern 1977) that one of the most important early developmental tasks of infants is to integrate their own self-generated timing systems with those of the environment.

I. EARLY CAPACITIES

Research in the last decade has revolutionized our understanding of the capacities of the human infant in the early months of life. Contrary to traditional notions of a helpless, passive, fairly undifferentiated organism at birth, the infant is increasingly seen as innately structured, active, and stimulus-seeking, continuing to organize itself around incoming information, which is in part structured by the infant's own congenital capacities (Stechler and Carpenter 1967; Ainsworth 1969; Lewis and Brooks 1975; Fantz et al. 1975; Wolff 1967). Although a review of this literature is beyond the scope of this article, some early capacities relevant to early social communication will be briefly highlighted.

At birth the infant has available a large repoertoire of stimulus-seeking behaviors. These include rooting, sucking, molding to the contour of mother's body, orienting; the ability to visually scan, alert to, and focus on an object, and to follow or track it in a horizontal plane. In addition, the infant can indicate responsivity to a visual target by widening and brightening of the eyes, many fine nuances of changes in facial expression (Beebe and Bennett 1975), changes in respiration, and a decrease in random movements (Stechler and Carpenter 1967; Brazelton 1974). These innately organized patterns of behavior equip the infant to engage in a primary relatedness with the human other.

Als (1977) has demonstrated that alertness in the neonate elicits 'affection' behaviors in the mother, and it is the infant who leads in getting the mother to react. Not only can infants indicate their alert availability for information intake and for interaction with their caretaker, but they can also regulate their own state in the face of aversive conditions, with self-quieting measures such as finger or tongue sucking, by partially inhibiting their responsiveness, or by habituation to a disturbing stimulus (Brazelton 1974). They are thus born with capacities both to seek and initiate social interaction and to modulate or regulate their social stimulation.

From birth, infants can discriminate between linguistically relevant sounds like 'pah' and 'bah' (Eimas et al. 1971), and they can 'track' the sound segments of adult speech with precisely synchronized simultaneous body movements (Condon and Sander 1974). As Wolff (1976) suggests, infants behave as if they are born with feature detectors for analyzing the sound pattern of language. Although these findings are in the auditory realm, it seems not unreasonable to assume, and the following research suggests, that infants might have similar mechanisms for analyzing the kinesic patterns of human movement.

Infant attention from birth is quite selective, as shown by visual 'preferences', such as looking longer at patterned as opposed to nonpatterned configurations (Fantz et al. 1975; Fantz and Nevis 1967). If we examine the exact parameters of stimulation for which the infant shows preferences, namely pattern, movement, contrast, contour (Lewis and Brooks 1975; Ainsworth 1973), it is clear that these exactly match the perceptual features contained in the human face. The social implications of early selectivity of attention are shown in the findings that at two weeks infants in an alert state spend more time looking at mother's face than a stranger's face (Carpenter and Stechler 1967; Carpenter 1974). From four days infants show a preference for a regular schematic drawing of the human face over a scrambled drawing of the face (Fantz and Nevis 1967; Fantz et al. 1975). It seems that there is a biologically-ensured fascination of the infant for the human face. This fascination for the face constitutes one central root of the human social bond.

The object-seeking behaviors, discriminations, and preferences cited above are predicated upon a highly functional visual system, in which at birth most visual capacities are present in immature form, particularly fixation and pursuit. Development thereafter progresses rapidly such that by approximately three months, the infant's visual accomodative capacity achieves adult status (White et al. 1964). The capacity for sustained mutual visual regard, present by approximately the second month, is considered to be a fundamental paradigm of communication, and central to the developing attachment between mother and infant (Walters and Parke 1965; Rheingold 1961; Robson 1967; Stern 1971, 1974). Moreover, as Stern (1971: 502) points out, by the third month visual behaviors of gazing at, or gazing away with head turning away, and eye closure, are 'uniquely qualified to perform subtle instant-by-instant regulation of social contact', and constitute the only motor system (besides sucking) over which the infant has voluntary control. The infant's capacity at three months to use head and gaze behaviors to regulate the initiation, maintenance, and termination of social visual contact has been elegantly demonstrated by Stern (1971), who first introduced the method of microanalysis of film in the study of mother-infant interaction. Stern has shown that the mother tends to be the steady gazing partner of the infant, who controls periods of looking at mother and looking away.

With the exception of the work of Stern, the studies mentioned above do not attempt to analyze the structure or rules of the interactive process between mother and infant. The work which comes closest to the studies to be described below is that of Tronick et al. (1975, 1979, 1980) and Brazelton et al. (1975).

Tronick et al. (1979, 1980) code a 'dynamic second' of videotape, during which a second of real time is slowed down to last seven seconds. Each dynamic second is categorized into 'monadic phases' (of attention and affect) of the interactions which are determined on the basis of the presence of specific behaviors. In this way they have been able to show a rule-governed system in which mother and infant's transitions through the monadic phases parallel each other in a mutually regulated system. They find an orderly stepwise sequence of changes from one monadic phase to the next, in a predictable sequential order, which constitutes a syntax, or set of ordering rules, which enable joint regulations to occur (Tronick et al. 1975).

In Tronick's analysis of the 'dynamic second', the appropriate unit of time is prejudged, and the actual duration of events is lost. Frame-by-frame analysis, by contrast, allows the data to determine the unit of time, and preserves the durations of events necessary for the study of subtle timing issues.

II. METHOD OF MICROANALYSIS

This method owes much to the ethological approach to the study of behavior. It shares the careful description of observable features of behavior in the natural habitat, detailing the form, sequence, and organizational features of behavior. It also shares the belief that careful description is an absolute prerequisite to an analysis of the signal value of behavior in the social interaction (Eibl-Eibesfeldt 1970; Hinde 1966; Jones 1972b; Brannigan and Humphries 1972).

Birdwhistell (1952, 1970) has influenced research in his approach to the definition of units of behavior in the study of kinesics, or communicative body motion (Birdwhistell 1970). His analogy between kinesic structure and linguistic structure has also been influential. He conceptualizes body motion as an ordered system of a limited set of isolable elements, combinable by rules, within a particular context, that organizes the interactive flow of human behavior.

Three normal mother-infant pairs comprised the subjects of the case studies reported below. The infants were three to four months old, of normal developmental course. Mothers were of upper middle-class background, recruited as volunteers through word of mouth. They were videotaped either in the home with one camera (Beebe 1973), or, for the remaining studies, they were videotaped with two cameras in a laboratory room with no distracting objects. One camera focused on the mother's face and upper torso, and one on the infant's face and upper torso, with the pair seated opposite each other in the same plane, with the infant usually in an infant seat. The resulting picture is a split-screen, with the behavior of the two partners synchronized in time. The pairs were familiarized with the experimenter beforehand, and the instructions to the mother were to play with the baby as she would normally at home, in an effort to create as natural a situation as possible. Mother and infant were then left alone in the room to interact. The purpose of the studies is to define the structure or rules of organization of the interactive flow of behaviors under the circumstances studied and in the particular sample of time analyzed. No claim is made that the filmed interaction is representative of the ongoing relationship. The presence of an observer, or even of recording equipment with the observer absent, presumably affects the interaction in some way. The position taken here, however, is that for the most part the behaviors studied are out of the mother's conscious control. Even if she experiences the filming situation as pressure to perform, one can conceptualize the situation as 'experimentally induced anxiety', and the resulting interaction can be taken to be an example of how the pair might interact when the mother is anxious.

For purposes of analysis, videotapes were kinescoped into 16mm film, 24 frames per second, with consecutive numbers printed on each frame. The method was frame-by-frame analysis (Birdwhistell 1970; Condon 1970; Stern 1971). The films were viewed on a hand-crank Craig Projecto-Editor movie viewer, which allowed the experimenter to go back and forth over any number of frames, in slow motion, to determine the exact frame in which a movement began, and the exact frame in which a movement stopped. Units of behavior were defined as movements in process of transformation from the beginning to the end of ongoing action. When a steady posture was held, the behavior was defined as having ceased. The process of the head moving up, for example, was defined as a unit of behavior, with its boundaries delimited by the exact beginning and ending of the movement, to the nearest 1/24th of a second. Once the head was held in a steady 'up position', it was not scored as a behavior. The steady state was conceived as a behavioral 'silence' or 'hold'. A movement and its ensuing hold comprise a 'movement-hold cycle'. Both the degree of displacement (or excursion) in space of any particular movement can be gauged, as well as the rate at which the movement was performed.

The following kinesic behaviors of mother and infant were scored: (1) head movements in the directions of vertical: up-down; sagittal: forward-back; and horizontal: side to side; (2) body movements in the horizontal and sagittal directions; (3) hand and arm movements; (4) facial movements of mouth opening-closing, mouth widening-narrowing, grimace, frown. The 'mock surprise' (Stern 1977) expression of the mother was scored in addition, as well as the maternal repositioning of the infant by picking him up and putting him down on her lap. Reliability between trained coders was 0.92 as to presence versus absence of events within two frames of onset or termination of behavior.

With this method, the 'stream' of events constituting the interaction can be followed moment-by-moment in its natural sequence; behavioral units appropriate to the infant organism can be identified; the film can be viewed and re-viewed sufficiently slowly to identify the fleeting, 'micromomentary' (Haggard and Isaacs 1966) events which have fundamental significance in the interaction; the analysis of events can be sufficiently detailed to capture the subtlety and complexity of these fleeting phenomena; and the behavioral events so procured can be subjected to statistical procedures in order to determine their functional significance in the interaction.

In the remainder of this chapter, a number of case studies will be described, in order to illustrate the kinds of interactive phenomena, their communicative significance and temporal coordination, that would go unnoticed without this (or some very similar) method. In each case study, a very small amount of consecutive time is analyzed, usually approximately two to four minutes, due to the time-consuming nature of this method. This is one of its primary limitations. Nevertheless, this method yields a dense and rich population of events for each case study, such that the number of events in each category described above tends to be substantial, yielding no difficulty in utilizing statistical procedures. The studies reported below are based on three babies, with the exception of one study (Stern et al. 1975), where eight infants were studied by combined film and videotape analysis.

III. THE SPLIT-SECOND WORLD

This method of microanalysis has revealed that mother and infant live in a 'split-second' world, where events with demonstrable significance in the interaction last approximately one-third to one-half second (Stern 1971; Beebe 1973; Beebe and Stern 1977; Beebe et al. 1979; Beebe et al. in press; see Table 1). The documentation of functional significance will be discussed in detail in the studies below. The mother's behavior generally lasts closer to one-half second and the infant's closer to one-third second. These events are so fleeting that many behaviors detected with this method go unnoticed in normal observation procedures or upon viewing the film at regular speed.

Table 1. *Average duration of events* in the 'split-second world'*

Mother duration	Infant age (months)	Infant duration	Type of sequence	Study	Subject
	3½	0.25 sec.	Infant-Mother Mother-Infant	Stern 1971*	1
	2½ 3½	0.370 sec. 0.305 sec.	Infant alone	Beebe 1973	2
0.489 sec.	4	0.347 sec.	Mother-Infant Infant-Mother	Beebe and Stern 1977	3
0.494 sec.	4	0.363 sec.	Mother-Infant	Beebe et al. 1979	3
0.343 sec.	4	0.440 sec.	Infant-Mother	Beebe et al. in press	3

* *Note*: Events include all behaviors described as coded in the Method section, with the exception of Stern (1971), which is based on head turns only.

Furthermore, both mother and infant are capable (for stretches) of a 'split-second' or 'micromomentary' reactivity, in which both can be remarkably sensitive to, and capable of rapidly readjusting to, the other's behavioral adjustments (Stern 1971; Beebe and Stern 1977; Beebe et al. 1979). Some mother-infant or infant-mother sequences occur almost synchronously, others overlap, in the sense that one begins to behave before the preceding behavior of the partner is completed, and in other cases there is a short 'lapse' between the end of one partner's behavior and the beginning of the other's 'response'.

For example, Stern (1971) found that in one mother-infant pair, the mother moved toward the infant as the infant moved away, and the infant moved toward the mother as the mother moved away. Maximum correlation occurred at the simultaneous pairing of mother and infant behavior, and when mother led by 1/4 second.

Beebe and Stern (1977) found in another mother-infant pair, in which a major portion of the interaction involved complex sequences of mother 'chasing' and baby 'dodging' (described in detail below), that each partner reacted to the other on an exquisitely tuned, micromomentary basis, within under half a second (0.38 second for contingent sets of mother-infant sequences, and 0.31 seconds for contingent sets of infant-mother sequences).

In both these studies, this micromomentary responsivity did not require that the infant be looking *en face* (with foveal vision) at mother, and much of the time this reactivity was based on the infant's peripheral visual monitoring of the mother.

These split-second reciprocal responsivities between mother and infant occur so quickly that one cannot grasp them with the naked eye. Their rapidity suggests that, at least for the mother, these events occur partially or fully out-of-awareness or conscious control. It is proposed that in this interlocking responsivity of the movements of one to the other, with which the infant gets extensive experience, the infant is learning a basic microstructure of being with another human being, or learning a crucial feature of the class of animate events (see Spitz 1963).

IV. THE INFANT'S ENGAGEMENT-DISENGAGEMENT SPECTRUM

The face-to-face naturalistic 'play' encounter between mother and infant can be seen as having a number of degrees of animation of engagement, and various kinds of disruption of engagement. In order to differentiate these modes of interpersonal relatedness available by three to four months, 'levels' of an 'engagement-disengagement spectrum' will be described. The levels of the engagement spectrum are defined by particular coordinations of orientation, visual attention, facial expressivity, and type of temporal reactivity (Beebe and Stern 1977; Beebe and Gerstman 1980). The ordering of the levels is a heuristic model and shows what 'compromises' the infant makes with respect to information intake, or what aspects of functioning drop out, as the infant progresses the spectrum from an oriented, looking, smiling engagement to a complete disruption of the face-to-face encounter (see Table 2).

'Facing and looking' holds constant face-to-face orientation and gaze at mother. Variations in degree and quality of animation are determined by sight head movements (within the face-to-face position) and by rather fine facial expression changes, from 'negative' (frown, grimace), to 'neutral' and then through degrees of the smile display, to the height of positive engagement in the fully open-mouthed 'gape-smile', with head straining up toward mother (Beebe 1973; Beebe in preparation).

The next major 'level' in the spectrum is 'side looking or visual checking', in which the infant orients his head away from mother in the horizontal plane, from 5 to 30 degrees, and either looks at her out of the corner of his eye ('side looking') or alternately visually 'checks' in and out of a foveal visual engagement. Facial expressiveness in this mode potentially retains almost the full range of expressiveness, although the most common expressiveness is neutral, negative, or slight positive; and the possibility of building to a full crescendo of the 'gape smile' (Beebe 1973) is lost.

In the next level of 'dodge', the infant maintains acute vigilance (through peripheral vision) and 'microresponsivity' to maternal 'chase' movements, while at the same time posturally and visually continuing to turn away, or 'dodge'.

In the mode or level of 'inhibition of responsivity', the infant suddenly becomes motionless, either limp or rigid, with an abrupt cessation of 'microresponsivity'.

'Dodging', and 'inhibition of responsivity' will now be illustrated by a four-minute frame-by-frame analysis of a normal mother and her four-month-old infant. This stretch of film of this particular pair illustrates especially well the mid-range of the spectrum, between the more obvious extremes of face-to-face foveal visual attention, and the complete disruption of the play encounter by 'fuss/cry' or 'turn completely away to environment' (see Table 2). In this pair one can see in high relief the complex and subtle compromises between 'engagement' and 'disengagement'. For full details of procedure and statistical analysis see Beebe and Stern (1977).

Table 2. *Infant engagement-disengagement spectrum*

Gradations of the engagement-disengagement spectrum	Visual attention			Orientation					Reactivity to mother			Direction of movement			Facial expressions		
	Foveal image	Peripheral	None	Center vis-à-vis	5°-30° paracentral zone	30°-60° near peripheral zone	60°-90° far peripheral zone	> 90° out of vision	micro-momentary	Inhibited	Unrelated	Approach	Withdraw	None	Positive	Negative	Neutral
Facing and looking	X			X					X			X			X	X	X
Side looking	X				X				X			X	X		X	X	X
Visual checking				X ←→	X												
	X ←→	X		X ←→		X			X			X	X		X	X	X
Dodging		X			X →	X →	X										
									X				X			X	X
Inhibition of responsivity		X	X	X	X	X	X			X				X			X
Fuss/cry			X	X	X	X	X				X	X	X			X	
Turn to environment			X					X			X		X		X	X	X

Reproduced with permission from Beebe and Stern 1977.

Chase and dodge

The compelling clinical impression of this pair (statistically documented in Table 3) was that mother and infant were involved in complex sequences of mother 'chasing' and infant 'dodging', with each reacting to the other on an exquisitely tuned micromomentary basis, within half a second from the onset of the partner's previous behavior. To every maternal overture the infant could move back, duck his head down, turn away, or pull his hand out of her grasp, exercising virtual 'veto power' over the mother's efforts to engage him in a face-to-face encounter.

Once this baby was facing and looking, the mother typically began a sequence of stimulation with a 'mock surprise' expression (Stern 1974b) and a 'loom' of her head close into the infant's face, to which the infant predictably reacted by moving his head back and then away, losing face-to-face orienta-

Table 3. *Summary of significant interactions, by chi-square test*

'Stimulus'*		'Response'
Dodging		
(a) Mother loom (head-forward-and down-and-lean-in)	----→	Infant (head back) head away $\chi^2 = 17.7$, $p < 0.001$ $N = 249$
(b) Infant dodge (head away, head through)	----→	Mother chase (pull, follow with head or body) $\chi^2 = 8.6$, $p < 0.01$ $N = 108$
(c) Mother chase (pull, follow, tickle)	----→	Infant dodge (head away, head through, body back or side-away) $\chi^2 = 19.8$, $p < 0.001$ $N = 214$
(d) and (e) 'refusing a reorientation'		
Mother pick up	----→	Infant head center, eyes closed $\chi^2 = 26.3$, $p < 0.001$ $N = 346$
and put on lap	----→	Infant head away $\chi^2 = 33.1$, $p < 0.001$ $N = 346$

* *Note*: A 'response' is defined as occurring in the range of 0.25 seconds to 0.75 seconds after the 'stimulus' onset. Reproduced with permission from Beebe and Stern 1977.

tion and looking away. The infant's head away reaction began before the mother's head movement was even completed, beginning on average 0.41 seconds after the onset of the mother's loom and 0.08 seconds prior to the termination of the loom.

The mother's predictable reaction to the infant's head turn away with loss of gaze was to 'chase' by following with her head and body in the direction of the infant's head turn, by pulling infant's arm, seemingly in an effort to bring him back to a face-to-face posture, or by picking the infant up to re-orient him toward her.

The mother's chase movements predictably were followed, within one-third second of the onset of mother's movement, by still further 'dodges' by the infant: further head movements away which frequently reached the remarkable 90 degree aversion from center midline; large head movements swinging an arc from one side off center, through the center *en face* position, and out to the other side, with eyes simultaneously squeezed shut, and often an accompanying grimace. If the mother 'chased' by pulling the infant's arm, the infant was likely to pull his arm or hand right out of hers, often with such force that he nearly fell out of his infant seat. Frequently the mother attempted to re-orient the infant by picking him up and repositioning him on her lap in an *en face* position. However, as the mother picked the infant up, his head re-oriented to an *en face* position (seemingly reflexively), but with eyes squeezed shut; and as the mother put the infant down into her lap, his head and gaze simultaneously moved away again.

The mother reacted to the infant's various avoidance maneuvers with fleeting but marked signs of negative affect: sobering, grimacing, biting her lip, jutting out her jaw, and a few instances of roughly thrusting the infant away from her.

In a comparison interaction with the experimenter immediately following, the infant was able to maintain an oriented, face-to-face, predominantly expressively positive encounter, revealing that the infant's dodging in this particular stretch with the mother was due neither to incapacity nor fatigue. Later on in the filming session, the mother was able briefly to engage the infant in an expressively positive face-to-face encounter by introducing rhythmic 'handgames', to be described below.

Most striking in the chase and dodge interaction was the infant's ability to modulate or regulate incoming stimulation, in a situation which can be considered 'overstimulating', through acute vigilance, receptivity, and continued responsivity (in a withdrawal mode). This finding corroborates Stern (1971). Rather than 'tuning out', which has been seen traditionally as the infant's primary mode of coping with overstimulation, the infant remained exquisitely sensitive to the mother's slightest movements (primarily head and body movements). Through primarily peripheral visual monitoring, the infant was capable of changing his orientation, posture, and gaze, from moment to moment, so as to maintain a certain postural and visual 'distance' from the mother.

V. INHIBITION OF RESPONSIVITY

In comparing the first two and the last two minutes of the interaction, clinically the 'chase and dodge' increasingly resembled a 'fight', with the mother making significantly more use of arm pulling, and the infant beginning to pull his arm right out of her grasp. Interspersed with these 'pulling-pulling away' sequences, the infant increasingly in the last two minutes suddenly lapsed into brief stretches of 'passive resistance', or 'active nonresponsiveness', which we have termed 'inhibition of responsivity'. No matter how vigorously the mother bounced, poked, or pulled the infant, he would remain motionless, with head either limply hanging on his chest, eyes cast down; or head rigidly held in an averted position, not looking at mother. The impression was of a profound refusal to engage.

Although the 'chase and dodge' and 'inhibition of responsivity' are examples of the mid-range of the spectrum, daily fluctuations in the state of either partner will usually result in a full use of the entire engagement-disengagement spectrum, giving the infant a large range of different interpersonal experiences.

VI. THE RELATION OF MATERNAL MICRORHYTHMS TO INFANT ENGAGEMENT

This case study at four months demonstrates that the hierarchy of various maternal rhythmic conditions of 'handgames' systematically covaries with the hierarchy of this same infant's engagement levels (described in the previous section).

Although numerous recent studies have focused on the importance of maternal rhythms in the organization of the mother-infant interaction (Brazelton et al. 1974; Stern 1974a, 1974b; Stern et al. 1977; Sander 1977; Stern and Gibbon 1978), in much of the work done (Brazelton et al. 1974; Stern 1974a, 1974b) the maternal rhythm itself was not examined. Where the maternal rhythm has actually been measured (Stern et al. 1977; Stern and Gibbon 1978), the specific impact of various maternal rhythms on the infant have not been demonstrated. Stern (1974a, 1974b, 1977) has hypothesized, but never actually shown, that the mother can use changes in the content or tempo of her rhythm to 'fine-tune' her behavior in order to maintain an optimal level of attention, arousal, and positive affect in the infant.

In order to show such a functional relation between maternal rhythms and infant attention and affect, a measure is needed to assess the influence of maternal rhythmicity. A modified version of the infant engagement level scale described above, and a similar scale for maternal 'engagement levels' were devised (Beebe and Gerstman 1980). Both scales are photographically illustrated in Figure 1, with behavioral criteria of the engagement levels defined in Tables 4 and 5. Using these scales, we ask the question: how will

Table 4. *Infant engagement level scale*

Level	Attention	Orientation	Facial expressivity		
			Degree mouth open (M.O.)	Degree mouth widen (M.W.)	Other
90 High positive	Look	Vis-à-vis	M.O. 4	Bowing	
85 Medium high positive	Look	Vis-à-vis	M.O. 3	Bowing	
80 Medium positive	Look	Vis-à-vis	M.O. 2	M.W. 2 or 1	
70 Low positive	Look	Vis-à-vis	(a) M.O. 1 or (b) M.O. 0	M.W. 1 M.W. 1 or 2	
60 Positive attention	Look	Vis-à-vis	(a) M.O. 1 or 2 or (b) M.O. 0	M.W. 0 M.W. slight	
50 Neutral	Look	Vis-à-vis	M.O. 0	M.W. 0	
40 Negative attention	Look	Vis-à-vis			grimace or line mouth or frown
30 Oriented, not look	Look away	Vis-à-vis	M.O. 0	M.W. 0	*or* Negative
20 Avert	Look away	Orient away	M.O. 0	M.W. 0	*or* Negative
10 Inhibition of responsivity	Look away or eyes closed	Vis-a-vis or away: body limp	M.O. 0	M.W. 0	

Reproduced with permission from Beebe and Gerstman, 1980.

Infant Engagement Scale

Infant level | | (Mother level)

90  (85)

High positive

85  (85)

Medium
high positive

80  (70)

Medium
positive

70  (90)

Low positive

60  (40)

Maternal Engagement Scale

(Infant level) | | Mother level

(70)  90

Mock
surprise

(85)  85

Smile 3

(85)  80

Smile 2

(80)  70

Smile 1

(50)  60

Positive

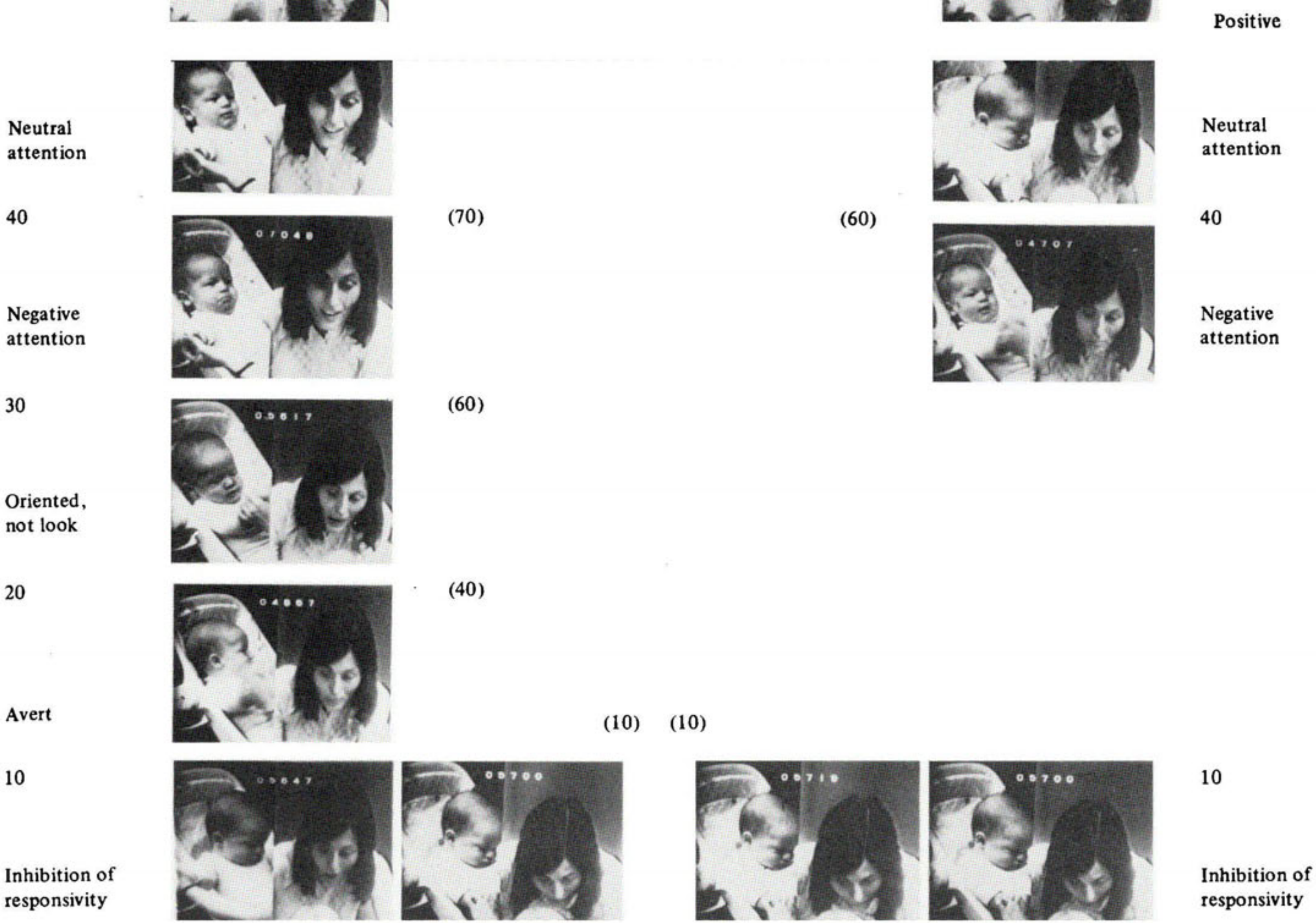

Figure 1. *Photographic illustrations of infant and maternal engagement scales.* (Reproduced with permission from Beebe and Gerstman, 1980).

Table 5. *Maternal engagement level scale*

Level	Atten-tion	Orientation	Facial expressivity: Degree mouth open (M.O.)	Facial expressivity: Degree mouth widen (M.W.)	Other
90 Mock surprise	Look	Vis-à-vis head up	M.O. 3 or 4	M.W. 0 or 1	eyes wide eyebrows up
85 Smile 3	Look	Vis-à-vis	M.O. 3 or 4	Bowing or M.W. 2	
80 Smile 2	Look	Vis-à-vis	M.O. 2	M.W. 2	
70 Smile 1	Look	Vis-à-vis	M.O. 1 or 2	M.W. 1	
60 Positive attention	Look	Vis-à-vis	(a) M.O. 1 or (b) M.O. 0	M.W. 0 / M.W. 1	kiss face
50 Neutral	Look	Vis-à-vis	M.O. 0	M.W. 0	
40 Negative attention	Look	Vis-à-vis			grimace or frown or line mouth
30 No comparable category					
20 Avert	Look away	Orient away			neutral or negative
10 Inhibition of responsivity	Look away or down	Vis-à-vis: head down, body limp	M.O. 0	M.W. 0	

Reproduced with permission from Beebe and Gerstman, 1980.

the introduction of a particular rhythm, at a particular tempo, influence the interactive flow, or 'dyadic fit', as defined by the engagement levels of both mother and infant.

The infant of this case study was the same infant described in the immediately previous case illustration, where mother and infant were locked into a 'chase and dodge' struggle. After about 20 minutes of interaction similar to that described in the chase and dodge interaction, the tenor of the interaction changed dramatically, as the mother introduced rhythmic 'handgames', grasping the infant's hands in her own and swinging them back and forth in a horizontal plane. For the first time the mother was able to engage her infant in the 'positive' realm of 'facing and looking', as photographically illustrated in Figure 2.

Frame	Time (Sec.)		
4179	– 4.54	*20*	*50*
4193	– 3.96	*20*	*70*
4288 Initiation of maternal hand rhythm Start game 1	0.1		
4293	0.21	*30*	*60*
4310	0.92	*50*	*60*
4328	1.67	*70*	*60*
4343	2.29	*80*	*70*
4356	2.83	*80*	*70*

Figure 2. *Effect of maternal initiation of rhythm on infant engagement level.* (Reproduced with permission from Beebe and Gerstman, 1980).

Criteria of maternal rhythmicity

The mother operated in three modes: temporally and kinesically regular repetitions of hand swings, defined as 'games'; temporally and kinesically irregular occurrences of hand swings, defined as 'transitions'; and 'hand pauses', where the mother's hands were at rest. The period of handgames lasted approximately two minutes, which provided the data base of this study.

The criterion for a 'game' was four or more repeating movement-hold cycles of hand swings of identical kinesic pattern of excursions in space. The mother used three different kinesic patterns of excursions in space during games, each with characteristic mean movement-hold cycle durations and variances. 'Full-out' games swing the infant's hands out from midline to a full horizontal excursion, with 0.64 sec. mean cycle duration (S.D. 0.20 sec.). 'Half-out' games swing the infant's hands halfway out, with 0.28 sec. mean cycle (S.D. 11 sec.). 'Short-out' games swing the infant's hands out to a very short excursion, with 0.15 sec. mean cycle (S.D. 0.02 sec.). 'Transitions' were defined as two or fewer movement-hold cycles of identical kinesics, or kinesically varied cycles of any number. 'Games', 'transitions', and 'hand pauses' comprised 53%, 31%, and 15% of the data, respectively.

Relation of maternal rhythm to infant and maternal engagement level

Significant differences (for statistical analysis of all significant findings reported here, see Beebe and Gerstman 1980) were found among the conditions of maternal rhythmicity (games, transitions, hand pauses), and for each paired comparison, in relation to median engagement level for both mother and infant. As can be seen in Table 6, for both mother and infant, median engagement levels are organized in a hierarchical relation, with the highest median engagement levels in full-out (2/3 second mean cycle) and half-out (1/4 second mean cycle) games, significantly lesser engagement levels in transitions, and lowest engagement levels in both hand pauses and short-out (1/8 second mean cycle) games. Thus the mother's rhythm covaries with her engagement changes, presenting the infant with changing facial-rhythmic constellations, with which the infant's engagement levels systematically covary.

The infant shows positive engagement (in the realm of 70 or higher) only during the conditions of full-out and half-out rhythmic games. Further, mother and infant match engagement level closely only during these two kinds of rhythmic games. The matching of emotional tone is one primitive basis of empathy and can be considered an important contributor to the 'bonding' process between mother and infant.

As mother moves to the irregularity of transitions, she retains positive expressiveness, but the infant retains only very slight 'positive attention'. During hand pauses, mother retains low positive engagement, whereas the infant undergoes a further disengagement to an expressively neutral attentiveness. Mother's short-out games are equivalent to hand pauses in the infant's associated median engagement of neutral attention. Short-out games differ from half-out or full-out games in their more rapid tempo (1/8 second mean cycle) and their significantly lesser degree of variance. Either one or both of these variables may account for the lowered infant engagement.

Whereas previously the functional importance of mother's rhythm has only been hypothesized, this study demonstrates that the presence and degree of maternal rhythmicity, together with her covarying engagement levels, are functional in influencing infant levels of engagement. That is, games, transitions, and hand pauses occur at very different moments in the dyad, associated with very different levels of engagement.

Table 6. *Median engagement levels for five kinesic-rhythm conditions*

Condition	Number of frames	Maternal engagement level	Infant engagement level
Full-out games	707	80	80
Half-out games	473	75	78
Transitions	548	75	60
Hand-pauses	300	68	50
Short-out games	192	60	52

Note: Braces connect nondiscriminable conditions. Otherwise adjacent conditions significantly differ, $p < 0.001$.
Reproduced with permission from Beebe and Gerstman, 1980.

Importance of rate in rhythmicity

Wolff (1967) has emphasized the need for careful quantitative analysis of rhythms in a developmental context, and in his own work has measured high frequency 'microrhythms' of three-quarters of a second and one-quarter of a second cycles in neonatal crying and sucking, respectively. Wolff posits that these neonatal microrhythms will be entrained onto external pacemakers, but he states that it is difficult to conceive of external 'clocks' for entrainment that would have the appropriate frequencies for these microrhythms. I propose that the mother is precisely such an external pacemaker. She provides the infant with the exactly appropriate range of high frequency rhythms onto which to entrain its own endogenous microrhythms.

There may be clinical implication to the findings of this study. In this particular pair, the potency of introducing regular rhythmic stimulation in changing the tenor of the interaction from an aversive 'chase and dodge' to a much more positive encounter is dramatic. In addition, if an optimal range of rhythmic tempo could be demonstrated, in pairs experiencing difficulties, mothers may be taught to alter the tempo of their rhythms (Beebe et al. in press; Bebe and Sloate in preparation).

Importance of rhythm for the interrelation of cognition and affect

Repetition and rhythm are a chief means by which the infant acquires cognitive expectancies and creates order and predictability in his world (Lewis and Goldberg 1969; Stern et al. 1977; Stern and Gibbon 1978). This study demonstrates that the same rhythmic events also influence the infant's affective level of engagement. Within the structure that rhythm provides, aspects of both affect and cognition are simultaneously organized.

VII. COACTIVE AND NONCOACTIVE INTEGRATIONS

It is clear that the mother and infant must be conceptualized as a system in which both are actively generating behavior. Furthermore, it is increasingly accepted that it is a system in which both bring a 'readiness' or a 'reactivity', wherein the behaviors of each may become synchronized or entrained in time, in either simultaneous or alternating fashion, especially in the realm of high frequency events (Condon and Sander 1974; Stern 1971; Brazelton et al. 1974; Sander 1977). Thus, one partner is not necessarily 'activated' by the other, or 'responding' to the other, but rather both together generate organized sequences of joint action.

The issue addressed in the following two studies is the description of the temporal organization of these coordinated or regulated joint action exchanges between mother and infant. We are again here concerned with the 'micro' level of the moment, for it is only at this level of detail within the limits of one second that we can understand the synchronization of these high-frequency events. In a social interaction between mother and infant, for both, these high-frequency events are largely under the instant-by-instant feedback control from the other partner (Stern 1971).

Coactive and noncoactive vocal integrations

The first study concerns the joint coordination of exchanges in the vocal realm (Stern et al. 1975), in contrast to the work described above which focused exclusively on the kinesic modality. However, infant vocalizations at this age are prelinguistic and tend to occur in a cohesive constellation with other kinesic behaviors. Eight three- to four-month-old infants were studied during social play with their mothers, by a combined method of videotape analysis by an event-recorder, and frame-by-frame microanalysis of film (for details of method and statistical analysis see Stern et al. 1975). Mother and infant vocalizing either in unison, or in alternation, are described as two modes of communication which differ both structurally and functionally. Although both the unison and alternation modes were used by all mother-infant dyads, there was a surprising degree of simultaneous vocalization, at an order of magnitude 40 times greater than that found in polite adult conversation (Jaffe and Feldstein 1970). On the basis of the eight dyads pooled, the constraint toward unison or a 'coaction' model was significant at the 0.001 level. In addition, the mother contributed to the pattern of coaction by prolonging the duration of her vocalization while the infant was vocalizing.

To test the clinical impression that coactional vocalization occurs primarily during higher levels of positive infant affect or arousal, for one infant (Beebe 1973), mother and infant vocalizations were superimposed on a frame-by-frame transcription of behaviors which had been made without sound. Levels of intensity of positive infant affect (from neutral to the 'gape-smile': Beebe 1973), were examined in relation to the vocalizing categories of either partner vocalizing alone; either partner vocalizing in alternation with the other (following within one second the termination of the partner's vocalization); and coactional vocalization, defined as simultaneous vocalization. Coactional vocalization was heavily concentrated (60%) at the highest level of infant positive affect or arousal. Alternating vocalizations of both mother and infant occurred throughout the midrange of the positive affect scale, with the heaviest concentration at level medium positive (see Figure 3).

Coaction and alternation vocalization modes are seen not only as two different temporal structures of the integration of joint actions, but they are also seen as functionally different. We suggest that coactional vocalization is not simply later transformed into the alternating pattern of conversational dialogue, but that coaction per se is an enduring mode of human communication throughout life that is similar to the kinesic systems of mutual gaze (Stern 1974a), posture sharing, and rhythm sharing (Byers 1976). Further, each is more likely to occur under different conditions of affective arousal, with coactive vocalization predominant at high positive infant affect, and alternation predominant at midrange levels of infant positive affect. (The relation of coactive versus alternating vocalization to infant levels of negative arousal, or distress, has not been examined.) Coactive vocalization occurs not only at the highest moments of positive infant affect, but also during mutual gaze. These are special moments for the dyad, and we propose that they may be considered an early attachment behavior which contributes to the 'bonding' between the two.

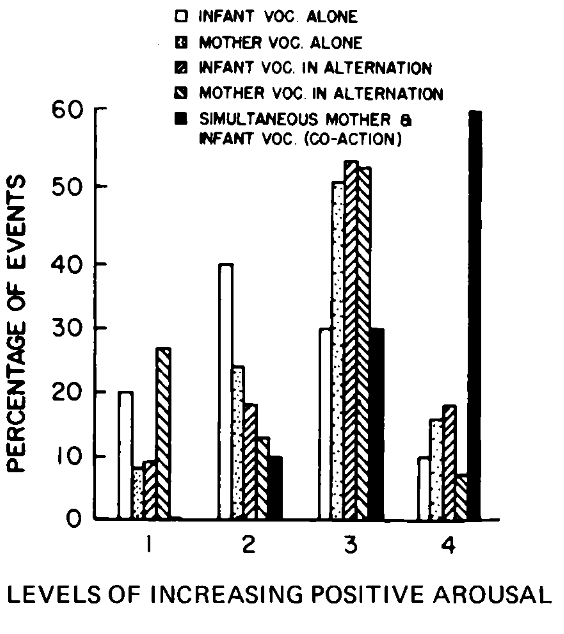

Figure 3. *The relative occurrence of different types of vocalizations at different levels of affectively positive arousal*
Infant vocalize alone, N = 10; mother vocalize alone, N = 37; infant vocalize in alternation, N = 11; mother vocalize in alternation, N = 15; coaction vocalizations, N = 20.)
Reproduced with permission from Stern et al. 1975

Coactive and noncoactive kinesic integrations

In this second case study at four months, the temporal patterns of coactive and noncoactive integrations found for vocalization were also found in the purely kinesic modality, by frame-by-frame analysis (Beebe et al. 1979). Furthermore, as in the vocal modality, coaction is the predominant pattern kinesically as well for this infant at this age. We tend not to think of vocal and kinesic acts as similar, but they do share the common features of repetitive 'runs', with a 'burst-pause' or 'movement-hold' form; and the durations of the bursts and pauses are roughly similar (Stern et al. 1977). On the basis of this case study, the vocal and kinesic modalities seem to share coactive and noncoactive temporal structures as well.

In this study (see Beebe et al. 1979 for full statistical analysis) one-step sequences of mother behavior followed by infant behavior, and vice versa, were examined with respect to duration and onset-to-onset times (hereafter referred to as 'onset time'), to see what set of temporal patterns they covered. Since onset times frequently approach or become even smaller than some minimal reaction time, the concepts of 'latency' and 'response' become increasingly questionable, hence our use of the more neutral term onset time. (Woodworth and Schlosberg [1956] report that adult reaction times in the laboratory setting average two-tenths to four-tenths second if the subject is 'set' to monitor the event).

The one-step sequences examined in this study were a further analysis of those described above as having functional significance in the case illustration of 'chase and dodge'. Although two seconds was chosen as an arbitrary cutoff point to define onset times (from the onset of one partner's behavior to the onset of the other partner's behavior), frequency distributions revealed that onset times never exceeded one second for either mother or infant.

The temporal pattern of kinesic coaction

Coaction is defined as an overlap between acts, during which mother and infant are behaving simultaneously. Of the 170 one-step sequences investigated, coaction was the predominant pattern, comprising 65% of the sequences. In the mother-initiated sequences, the incidence of coaction was twice as frequent as noncoaction. The mean coaction onset times for both mother and infant are on the order of one-quarter second and are shown in Figures 4 and 5, and the mean duration of a behavior for both partners is slightly less than one-half second. At least for the infant, and probably for the mother, these onset times are too fast for a stimulus-response explanation. It is proposed that on the basis of the rhythmicity of prior maternal events, the infant has built up a sufficient expectation of when the mother will next behave that he is in a predictive system with her during coactive episodes (Stern 1971; Stern et al. 1977; Stern and Gibbon 1978). These extremely rapid coactive infant onset times are an analogue in the purely

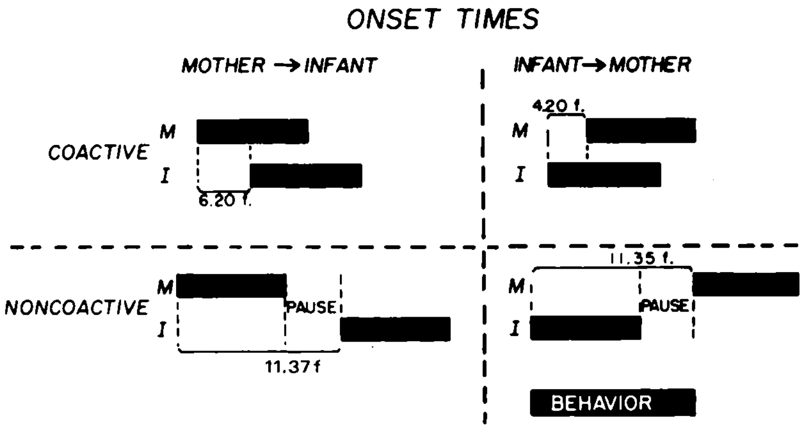

Figure 4. *Coactive and noncoactive onset times for mother and infant*
M = Mother; I = Infant; f = frame; 24 frames = 1 second.
Reproduced with permission from Beebe et al. 1979

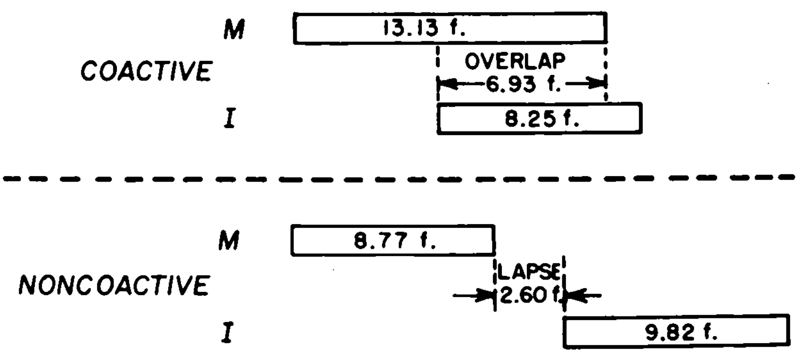

Figure 5. *Durations of maternal and infant behaviors and the overlap and lapse, comparing coactive and noncoactive episodes, respectively, in mother-initiated sequences*
M = Mother; I = Infant; f = frame; 24 frames = 1 second.
Reproduced with permission from Beebe et al. 1979

kinesic realm of Condon and Sander's (1974) finding of neonatal infant kinesic simultaneous 'tracking' or 'entrainment' to the structure of adult speech, as a 'mode of processing which occurs well below the level postulated by the stimulus-response model' (Condon 1977: 163).

The temporal pattern of kinesic noncoaction

Noncoaction is defined as absence of any overlap of action between the two partners. By contrast with coactive episodes which by definition contain no behavioral pauses or holds between behaviors, onset time in noncoactive episodes is composed of a two-part cycle of a movement and a hold. The mean onset time for mother and infant was identical, just short of one-half second as shown in Figure 4. Repetitions of such a cycle of an event plus a hold define a rhythm, and the mean duration of this rhythmic two-part cycle was exquisitely matched in noncoactive episodes in this pair. This finding parallels the rhythmic matching of phrase-pause cycles found in adult conversation (Jaffe et al. 1978). This rhythmic matching indicates that a stimulus-response explanation is again inadequate, suggesting that noncoaction is also a system based on expectancies, in which there is an alternating as opposed to a more literally synchronous entrainment.

An analysis of the duration of events revealed further differences in the coactive versus noncoactive sequences. Whereas the infant's duration of behavior does not differ in the two types of sequences (suggesting an endogenous timing mechanism for infant duration), the duration of the mother's behavior seems to be a sensitive interpersonal indicator. For sequences in which the mother is the initiator, in noncoactive episodes the mother matches the duration of the infant's behavior (see Figure 5), whereas in coactive episodes, the mother significantly prolongs the duration of her behavior. It is as if the infant's coactive 'participation' may be sufficiently reinforcing, facilitating, or arousing for the mother to prolong the period of coaction. This finding is directly analogous to our previous finding with coactive vocalization, when the mother prolonged her vocalization when the infant began to vocalize coactively (Stern et al. 1975).

Temporal structures of functionally significant kinesic interactions were found in this case study to be consistent with those previously demonstrated for vocal interactions at this age. In both the vocal and kinesic modalities, (a) coaction is the predominant pattern; and (b) the mother contributes to coaction by prolonging the duration of her behavior. Furthermore, the less frequent, noncoactive kinesic pattern revealed rhythmic matching that presages the matching found in adult conversation. These parallelisms are common temporal structures which are at the basis of our notion of 'proto-conversation'.

VIII. CONCLUSION

Frame-by-frame microanalysis of film provides a precise measurement tool in which functional relations between mother and infant can be determined, without experimental disruption of the natural flow of communicative events, and without losing the actual duration of behaviors, as do many naturalistic methods.

These studies underscore the importance of temporal organization as key in the coordination of mother-infant nonverbal communication. The finding of the prevalence of the temporal pattern of coaction at both high positive arousal and high aversive arousal of the 'chase and dodge' interaction suggests the intriguing hypothesis that coaction is a basic aspect of mother-infant temporal integration relatively independent of the quality of the affective arousal, whether positive or negative. Coaction may be an index of the intensity of affective arousal, regardless of quality. In other 'slices' of the data, however, as for example in the influence of maternal rhythmic hand games on infant engagement, it is clear that the mother's particular timing can have a dramatic effect on the infant's quality of affect or engagement.

Within one second constitutes a 'magic range' in this data. The mother's duration of behavior closely approximates one-half second; onset-to-onset times in noncoactive rhythmic kinesic matching are one-half second for both mother and infant; and the infant shows highest engagement level during mother's rhythmic games of two-thirds and one-quarter second cycle duration. Presumably we are beginning to tap an optimum information processing constant for the infant. In the study of adult time estimation, one-half second is a critical cut-off point, below which time estimation proceeds by a more 'absolute' mechanism, and above which the time estimation mechanism is 'scalar', following Weber's law (Kristofferson 1976).

Separate measurement of mother or infant behaviors, though occurring within a social context, addresses 'intra-individual' timing; measurement of coactive and noncoactive integrations addresses 'inter-individual' or interpersonal timing. The fact that the one second range spans both these kinds of timing lends support to the hypothesis that this is indeed the time-frame of the infant's social world at this age. If the mother operates outside this timing range, we speculate that the infant's social integration will be disturbed.

This data has relevance for the prelinguistic origins of language. Bruner (1975) argues that linguistic concepts are first realized in action, and that there are prelinguistic rules for regulating joint action and joint attention. The 'structure' and rules of jointly regulated action sequences are proposed by many (Beebe et al. 1979; Bruner 1975; Sander 1977; Condon and Sander 1974; Condon 1977) to have a correspondence with, and to form the basis for, later linguistic ability and the structures of speech. However, the psychophysical details of the definition of these early prelinguistic structures have not been sufficiently described and measured. The quantitative studies reported here document aspects of (a) the temporal, (b) the affective, and (c) the temporal-affective linkage of these early jointly regulated action structures at three to four months which are presumed to be developmental precursors of the pragmatics of later linguistic communication.

NOTE

1. The immense contribution to this work from Daniel Stern M. D., Joseph Jaffe M. D., and Stephen Bennett M. D., is gratefully acknowledged.

KENNETH H. ABRAMS

Coordinated Movement in Children's Faces, and What Parents Know About It[1]

The studies reported here will show that very young children do not make complex facial gestures, and that this inability derives from a general inability to carry out complex action of any sort. Further, the origins of the ability to carry out such complex action lies in an expressive function of the left hemisphere. Suggestive findings in a diverse literature place these tenets in perspective.

Sarles (1973) noted the inexpressive cherubic quality of very young children's faces. This remark upon the relative facial inactivity in young children was made in the context of rising interest in children's nonverbal communication. Van Hooff (1962) sketched the repertoire of facial gestures in apes and Eibl-Eibesfeldt (1972) traced the connection between primate and human expressive facial gesture. Strong parallels were extended to children's gesture by McGrew (1972), Jones (1972a, b, c), and Brannigan and Humphries (1972) among others.

Interestingly the vast majority of the gestures catalogued by these investigators were symmetrical movements of eyebrows, eyes, nose, lips, and jaw associated with the expression of emotion. Only Brannigan and Humphries (1972) made note of the infrequency of asymmetrical gestures of the face. They speculated that asymmetrical gestures were compounds formed by the superimposition of two conflicting constituent gestures. It was variability of interpretation with changing point of view, leading to communicative inefficiency, that Brannigan and Humphries suggested as the origin of the low frequency of such gestures.

Recently other evidence has been collected that suggests that the two halves of the face do not express simple emotions with equal intensity. Sackheim et al. (1978) found that the left half of adult faces was judged to be more intensely expressive than the right half for relatively symmetrical emotional expressions such as disgust. These results suggested that the right hemisphere is the seat of simple emotional expression.

If asymmetrical expressions of more complex emotional states, with major cognitive involvement, such as sarcasm, wryness, and irony, are controlled by the right cerebral hemisphere mechanisms that control the expression of simpler emotions, then a left face half preference would also be found for these more complicated face gestures. If, however, asymmetrical face gestures are more closely associated with mechanisms of the left hemisphere, then a right face half advantage or preference might be expected.

There is some evidence that complex coordinated limb gesture is associated with the intact left hemisphere, while simple static postures don't show this left hemisphere association. Wolff et al. (1977) found more precise right-hand tapping to varying rhythms in normal right- and left-handed adults. They argued that the left hemisphere is superior for serial organization of fine motor movements in difficult or novel tasks.

Ingram (1975) found that three- to five-year-old children showed superior right-hand performance for rapid finger tapping though they also showed a left-hand superiority on static hand postures and finger spacing tasks. Ingram proposed that the left-hand superiority for hand postures derived from a spatial component of the hand posture tasks.

Kimura and Archibald (1974) working with unilaterally brain-injured apraxics found that a left-damaged group had greater difficulty with complex dynamic hand and arm movements for both right and left arm, whereas there were no group differences for static postures. They concluded that there was some capacity for complex limb coordination in adults that is affected by left brain damage. A deaf aphasic as well as deaf controls were tested by Kimura et al. (1976) who found a marked impairment of the aphasic for copying the series of novel dynamic gestures used by Kimura and Archibald, though there was little evidence of impairment in the use of familiar objects.

Mateer and Kimura (1977) found deficits in fluent aphasics for nonverbal multiple oral movements of the tongue, lips, and jaw, while these patients showed no deficit compared to a right-damaged group for single oral movements. The fluent aphasics also showed a striking impairment on repetitions of meaningless multiple phonemes as well as repetitions of words and phrases. Mateer and Kimura found that the bulk of these results could not be attributed to a sensory deficit and that errors produced by the fluent aphasics were not primarily sequencing defects, but rather incorrect movements. They suggested that there were two systems operating in the motor control of speech: (a) one controlling single discrete oral movements and (b) a second controlling transitions from one discrete movement to another.

In an attempt to investigate differential hemispheric capabilities for motor control in young children Experiment 1 was designed to investigate the ability of young children, three to five years old, to copy expressive face gestures, and arm and hand gestures. It was hoped that it would be possible to discover whether there were factors of complex motor control operating either within a single body half or across body halves that emerge with development. Experiment 2 extended the study of children's ability to copy face gestures to elementary school-age children, and Experiment 3 investigated adult knowledge of the mental states in children that are presumed by adults to lie behind complex face expressions.

EXPERIMENT 1:
IMITATION OF FACE AND LIMB GESTURES IN YOUNG CHILDREN

Introduction

This investigation attempted to study the factors of asymmetry and complexity of imitated action. Gestures of the face and arms that were some combination of simple or complex, symmetrical or asymmetrical actions were imitated by children aged 3 to 5½ years.

This paradigm was devised to test for factors of movement control that would be affected only by increasing the complexity of gesture within one half of the body or would be affected by asymmetry as well, as it increased the overall complexity without contributing to the complexity of each body half. The former factor would be a local factor, confined in its effect to a single hemisphere, whereas the latter would be a higher order factor whose influence spans both hemispheres as a general determinant of complex action.

Procedure

Children were run on a FACE GESTURE IMITATION task and a LIMB GESTURE IMITATION task in a single session. They were taken individually from their school room into a nearby testing room. Experimenter and child sat across a table upon which the experimental materials were placed. Video tape recording was made of each session for subsequent analysis. The video camera was positioned so that the field of view was from slightly behind and above the experimenter's shoulder. Thus a child looking at the experimenter appeared in the video recording only a few degrees to one side of a full frontal perspective.

'Face gesture imitation'. The FACE GESTURE IMITATION task was made up of eight face gesture imitation trials in which a child's imitation of a face grimace was elicited by cartoonlike drawings of one of eight faces (Figure 1). The child was instructed to imitate the face with his own face, and to assist him in doing this, the major components of the required gesture, the eye and mouth positions, were pointed out on each trial. No reference was made to

the child's own face, even in response to the child's direct question. Instead, the experimenter would again point out the components of the gesture on the cartoon face to be imitated.

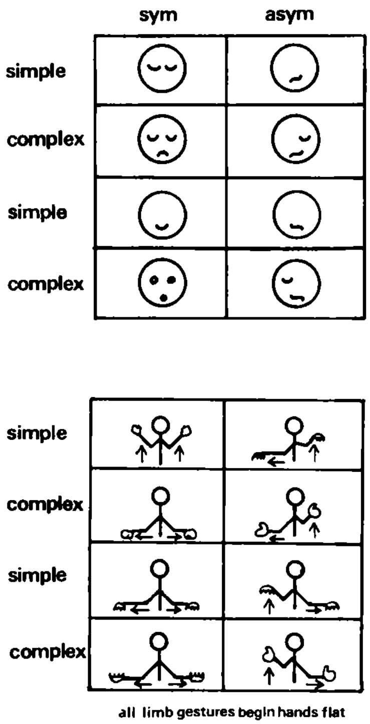

Figure 1. *Face and limb gestures in experiment 1*

'Limb gesture imitation'. Limb gestures were tested following face gestures. The child was instructed to imitate each of eight arm and hand gestures demonstrated in sequence by the experimenter, when she was certain the child was paying attention. Limb gestures are shown in Figure 1.

Four of the face and four of the limb gestures were symmetrical, having equal bilaterally symmetrical movements, while the remaining four face and limb gestures were asymmetrical, requiring movements executed in different directions. Four of the face and limb gestures were simple, having only a single gesture component, i.e. a single movement, such as sliding the hands apart on the table surface, or moving the hands at right angles to one another – one hand sidewards the other upwards. Four of the face and limb gestures were complex, requiring simultaneous independent hand and arm movements, such as forming initially open hands into fists, while simultaneously sliding the hands apart, or clenching open hands into fists with thumb extended, while simultaneously moving one hand sidewards and the other upwards.

Subjects

Twenty middle-class children, 14 boys and 6 girls, from two local day care centers, ranging in age from 3:0 to 5:1 were tested individually.

Hypotheses

It was expected that with increasing age children would show increasing control over their facial musculature with the greatest gains showing in the youngest children. This study was run in the middle of the school year so that any effect of the initial exposure to nursery school or day care would likely be already present.

If one cerebral motor area or the other were better suited for the execution of complex coordinated movement then it might be hypothesized that there would be a preference or superiority in execution to one side for both face gestures and abductive limb gestures, which presumably are under contralateral control (cf. Van der Staak 1975). If execution of complex movement is controlled by some higher order mechanism giving input into the two motor areas equally, as is suggested by the findings of Kimura and Archibald (1974), then no performance laterality effects might be expected.

The execution of coordinated activity was hypothesized to be determined by two possible factors:

A. a *local factor* of information processing capacity within a hemisphere and acting directly upon the motor area of that hemisphere only;

B. a *higher order factor* of information processing capacity devoted to the simultaneous organization of the activities of both motor areas;

then if factor A alone were operating, and complex gesture was organized in its entirely, separately within each of the motor areas, it would be expected that:

I. The complexity of the action within a single body half would be the sole determinant of task difficulty, so that difficulty would not increase with bilateral asymmetry of the task and factor A would be the sole dimension along which development would take place.

Whereas if factor B alone were operating, and the organization of complex gesture for *both* sides of the body was carried out at a single locus, it would be expected that:

II. Both the complexity of the coordinated activity within each individual body half, and the combined total complexity – which would be greatly increased with increased bilateral asymmetry of the action – of the two body halves would be the determinant of difficulty, and factor B would be the dimension along which development would take place.

Coding 'face gesture imitation'

A coding scheme was devised to be applied to each attempted imitation to mark the presence or absence of three posture features described below.

i. WITHIN: two different simultaneous posture components within a right or left half of the face. A posture component is a recognizable movement or tension of the muscles around the eyes, brows, lips, cheeks, and chin.[2]

ii. ACROSS: two different simultaneous posture components such that one component is on the right side of the face and the second is on the left, and neither of the two components is present symmetrically on both sides.

iii. DIRECTION: the direction of the major face movement, the most active side of the face, the side of intended movement determined by a child touching part of his face while trying to move it, or in the case of mouth action on both sides of the face, the side with the mouth going upward.

Some examples of face movements scored +ACROSS are one mouth corner up, the other down; one mouth corner down, the opposite eye closed. A double, or a single eye closure, a right and left mouth corner raise, or a single mouth corner raise are all scored -ACROSS.

Two more features were used to score all imitation attempts.

iv. UNDERUSE: eyes and mouth were scored for the absence of movement when an optimal imitation would require movement of these parts.

v. OVERUSE: eyes, mouth, and head were scored for the presence of movement when an optimal imitation would not include such movement.

As an example of OVERUSE, if a single eye were to be closed, and instead of merely closing the eye, the mouth corner was also raised, then the mouth would be scored +OVERUSE.

These discriminations were fine ones, but they were reliable. Two independent judges agreed on the scoring in 78% of 560 cases. The scoring of the video record of each imitation attempt was done after viewing the record first at normal speed, then in slow motion, and finally in stop frame. Each face gesture was examined for eye, mouth, jaw, and head movement. When a child would make more than one imitation attempt, the most adequate attempt was scored. There were no systematic differences in the number of tries a child made and the child's age.

Coding 'limb gesture imitation'

A coding scheme for limb gestures was devised in a parallel way to the face gesture scheme. The presence or absence of the following features was noted.

i. WITHIN: two different simultaneous movement components of the hands or arms within a single half of the body. A movement component consists of some recognizable portion of the target movement such as a hand slide, arm raise, fist clench, hand roll, or thumb extension.

ii. ACROSS: two different simultaneous movement components of hands or arms each in a different half of the body such that the movement components are executed in different nonsymmetrical directions in the two body halves.

Hereafter responses coded +WITHIN, or +ACROSS, or +OVER-, or +UNDERUSE will be referred to as WITHIN, or ACROSS, or OVER-, or UNDERUSE responses.

Results

'Face gesture imitation'. The scores of each of the 20 children were placed in one of five age groups, Groups 1 to 5 – from 3:0 to 5:6 by 6-month intervals. Group subject means for WITHIN and ACROSS scores for Groups 1–5 are plotted in Figure 2. A one-way fixed effects analysis of variance for mean WITHIN scores for Groups 1–5 did not show a significant age group effect. Inspection of the WITHIN response means revealed that there were moderate levels of WITHIN responses even in the youngest children.

As the face imitation responses were examined and scored from the video record, it became clear that when young children attempted to close one eye there was under most circumstances a sympathetic mouth corner raise on the same side as the attempted eye closure. Thus there was induced an artifactually inflated WITHIN score on those faces that demanded a combined eye closure and mouth corner raise when the child would have produced that combination in *any* case requiring eye closure. Thus the possible conclusion that children as young as 3.0 show moderate levels of complex facial gesture though confined to one side of the face would be erroneous. These gestures are not complex; they are merely overgeneralized global movements.

A one-way fixed effects analysis of variance was carried out on the group means of ACROSS scores for Groups 1–5. There was a significant difference among these means ($F = 3.33$; d.f. = 4,15; $p < 0.05$). A post hoc Tukey test revealed that the mean ACROSS score for Group 5 was significantly different from Groups 1, 2, and 3 (each at $p < 0.05$ respectively). Essentially the same results were found for males alone at the $p < 0.025$ level. As there were so few females in this experimental sample it was impossible to draw any inference about the effects of sex.

There was a distinct laterality to children's face gesture imitations. Though in the experimenter's presentation of each face diagram there was never any reference to the child's own face, seven of the 20 children had a greater number of imitations in which they used the *left* side of their faces rather than the right (sign test, $p < 0.001$). Evidently, children between 3 and 5½ years have a strong tendency to use the left side of their faces for imitation of mouth and eye gestures. This certainly supports the early priority of the right hemisphere for motor control in young children.

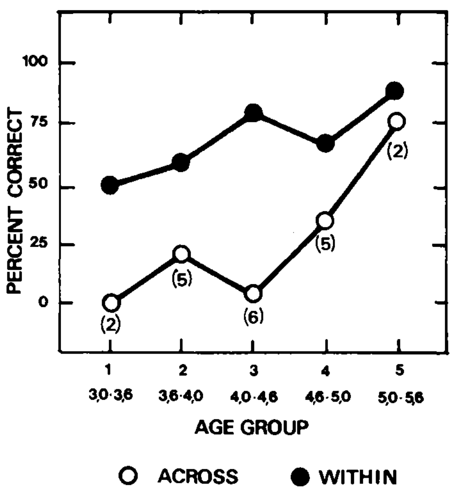

Figure 2. *Mean face gesture imitation in experiment 1*

'Underuse' of the mouth. On imitation trials requiring a lateralized mouth response, the youngest children were unable to move their mouths asymmetrically. When such symmetrical responses were subjected to an analysis of variance of mouth UNDERUSE means, a significant age group effect was found ($F = 3.3$; d.f. = 4,15; $p < 0.05$). This effect derived from the especially large number of symmetrical responses made by the children in Group 1. The number of these symmetrical responses declined significantly for Groups 2 and 3 (Tukey test, $p = 0.06$) and rose slightly for Groups 4 and 5.

Evidently the motor control of the youngest children is not differentiated enough to be capable of vigorously moving just one side of their mouths without the other, and quite incapable of moving each side in a different action simultaneously.

'Limb gesture imitation'. Mean WITHIN and ACROSS scores for Groups 1 to 5 are plotted in Figure 3. A one-way analysis of variance of the group means for ACROSS scores showed significant differences among the age groups ($F = 6.5$; d.f. = 4,15; $p < 0.01$). This overall effect was attributable to the mean ACROSS score of Group 5 being significantly greater than those of Groups 1 to 3 (Tukey test, Group 5 versus 2 $p < 0.01$, versus 1 and 3 $p < 0.05$). This pattern is identical to the pattern of group means of ACROSS scores for FACE GESTURE IMITATION and indicates that the ability to handle action complexity across body halves is an important dimension of

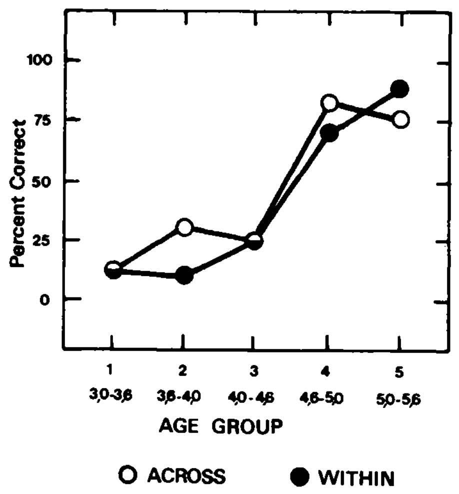

Figure 3. *Mean limb gesture imitation in experiment 1*

development in children beginning at 4½ years. This similarity is brought out even further by a high Pearson sample correlation, r = 0.7435 (t = 4.717, $p < 0.002$) of the mean ACROSS scores for FACE GESTURE IMITATION and LIMB GESTURE IMITATION.

A one-way analysis of variance on the group subject means for WITHIN responses revealed a strong age group effect ($F = 6.28$, d.f. = 4,15; $p < 0.01$) that a post hoc Tukey test showed to derive from the significant differences between the high Group 4 and 5 WITHIN means and the zero mean of Group 1. If we can discount the spurious non-result for WITHIN responses in FACE GESTURE IMITATION, then this is evidence that only by the age of 4½ are children able to carry out complex coordinated movements within a body half and across body halves.

The typical response of the children younger than 4½ to a complex simultaneous movement was to break it into serial components. For example, instead of simultaneously sliding their hands apart while forming them into fists, they would first clench their hands and then slide them apart. If the gesture were asymmetrical, the child would first move one arm and hand, and then the other arm and hand, often in alternation.

The imitations produced by the children were uniformly mirror images of the demonstrated movement so that when the experimenter raised her right hand all of the children raised their left. There was no measurable effect of preferred or superior side of movement.

Discussion

There is strong evidence in the findings of Experiment 1 that children younger than 4:6 are unable to simultaneously move both halves of their faces or move their arms and hands in independent simultaneous gesture. Though children in the FACE GESTURE IMITATION task were able to make grimaces involving both the eye and mouth on one side, it was argued that these grimaces were not decomposable into constituent movements and were therefore not complex facial gestures. Complex single-sided body movements in the LIMB GESTURE IMITATION task showed the same age constraints as complex movements involving both sides of the body. This suggests that there is the development of a higher order factor controlling complex coordinated movements for the entire body that begins to have an effect in the fifth year of life.

This does not mean to say that there is no local factor operating as well. The difficulty that the children in the very youngest groups had moving their mouths asymmetrically, even if only unilaterally, suggests that in early childhood there is also an increase in the local within hemisphere capacity to handle movement complexity.

EXPERIMENT 2: IMITATION OF FACE GESTURES BY ELEMENTARY SCHOOL CHILDREN

Introduction

This second study extends the investigation of Experiment 1 to an older population in order to discover whether the marked gains shown for the children between the ages of 4½ and 5½ were found at any other age as well. Children's ability to imitate eyebrow gestures is also examined.

Procedure

Experiment 2 continued the study of the development of facial motor coordination in a group of older children, ages ranging from 5:8 to 8:11. These children were run individually in a manner similar to that of Experiment 1 by the author. The task the children were given was a slightly longer version of the face task in Experiment 1, the EXPANDED FACE GESTURE IMITATION task. This task was constructed to include the movements of the eyebrows as well as eyes and mouth. In the EXPANDED FACE GESTURE IMITATION task a child was presented with caricatured faces, ten in all, to be imitated as in Experiment 1. Again the critical movement components were pointed out for each child only on the diagram itself. These faces consisted of five symmetrical pairs with critical features as follows (Figure 4):

1. right or left eye closure;
2. right or left eyebrow raise;
3. crooked mouth – up right/down left or up left/down right;
4. right or left eye closure with left or right eyebrow raise;
5. complete asymmetrical grimace – right eye closure, left eyebrow raise, mouth up right/down left or left eye closure, right eyebrow raise, mouth up left/down right.

Immediately following the child's imitations of the ten faces, the child was asked to imitate the experimenter and close each eye in turn; move the mouth to an extreme sidewards position, each side in turn; and imitate a single eyebrow raise. The latter movement was limited to one side only due to the author's inability to raise his right eyebrow alone.

Subjects

Forty-five children were randomly selected, 22 girls and 23 boys, from grade school classes in a local upper middle-class elementary school.

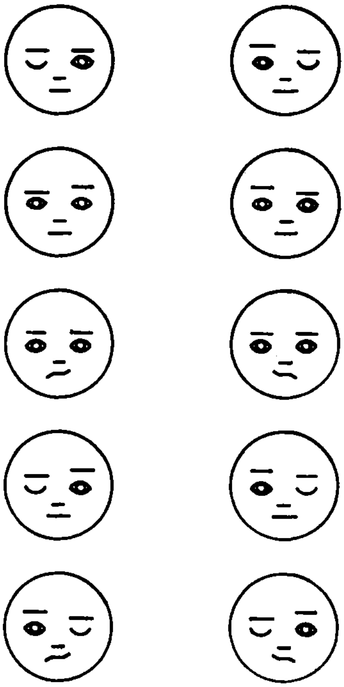

Figure 4. *Ten face gestures in experiment 2*

Coding for 'expanded face gesture imitation'

The coding scheme used was the same as in Experiment 1.

Results

It was found that so few children could move a single eyebrow that no systematic analysis of eyebrow movement by age was possible. Eyebrow movements are therefore not included in the findings reported below.

Subjects were divided into seven age groups, at 6-month intervals from 5:6 to 9:0. Group means for WITHIN and ACROSS scores were calculated for all imitations that would require these features, and plotted in Figure 5.

By inspection, mean WITHIN responses were found to be uniformly high for all groups. This is quite consistent with the finding in Experiment 1 of moderate WITHIN scores for the youngest group, that increased in the older groups.

A one-way fixed effects analysis of variance, run on the mean ACROSS scores for the seven groups was not significant. Inspection of the data revealed that this was due to high variability among males. A one-way analysis of variance run on females alone showed a significant age effect ($F = 3.4$; d.f. = 3,15; $p < 0.025$) and a post hoc Tukey test revealed that this effect

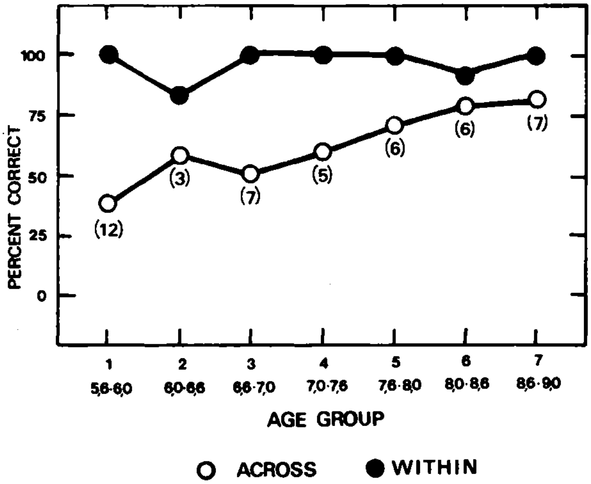

Figure 5. *Mean face gesture imitation in experiment 2*

derived from the differences between the two identical oldest groups which had come to a ceiling, and the four youngest groups. By 8 years, girls are able to produce reliable imitations involving the dynamic movement of both halves of their faces.

The older children of Experiment 2 produced a more consistent mirror image imitation strategy than did the children of Experiment 1, so that it was difficult to discover a directional bias to their imitations. A strong bias to use the left side of the face for imitating was found only in Group 1, 5:6-6:0, in which seven out of ten children with any bias at all chose to move the left side of their faces.

Classifying children by superiority-preference for right or left eye closure and plotting the group frequencies revealed a pattern of left superior closure in the youngest groups that becomes equal in Group 4 and changes to right superior in Groups 5 to 7. If the equal Group 4 is not included, and a chi-square test is performed on the 2 X 2 table of right/left-young/old superior eye closure comparing the three youngest and the three oldest groups, it is determinable at the $p < 0.05$ level that these are independent distributions. The shift from left superior eye closure to right superior eye closure follows the same pattern of middling levels of ACROSS responses in the three youngest groups and high levels in the three oldest groups. Evidently the ability to carry out coordinated simultaneous movements across face halves is strongly related to a shift from predominantly left face action to right face action.

Over- and underuse. There were no significant effects for either OVER- or UNDERUSE of eyes or mouth with age. Notable was the extremely low UNDERUSE score of all groups in Experiment 2. With some exceptions, there was an overall pattern of decreasing OVERUSE of the head.

Head OVERUSE was relatively high among all groups in Experiment 2. Typically head OVERUSE would be found as a counter-clockwise rotation when the right eye was closed, and a clockwise rotation when the left eye was closed. This head rotation was not easily interpreted as showing the closed eye to the experimenter since on those occasions when the experimenter requested a child whose face was so turned so as to be hidden from the video camera to turn forward, the child was able to straighten out only with extreme difficulty.

DISCUSSION OF EXPERIMENTS 1 AND 2

There is in these two experiments a pattern of FACE GESTURE IMITATION findings in the younger children of Experiment 1 on the one hand of:

1. preferred left-sided face action from 3 to 5½ years;
2. an ability to move both halves of the face simultaneously that begins at 4½ and increases to moderate levels at 5½;
3. an ability to move arms and hands simultaneously that, both within and across body halves, emerges at 4½ and follows the same developmental course as the ability of the face to make complex gestures.

In the older children of Experiment 2 on the other hand:

4. left eye closure superiority-preference changing from about 6½ to clear right eye superiority-preference by 8;
5. moderate ability to move halves of the face simultaneously shifting to facility by 8.

WITHIN responses combining different face gestures within a single half of the face do not show a strong developmental emergence within the sample age range, but this, it has been argued, is due to an artifact in Experiment 1.

Certainly by the age of the children in Experiment 2 WITHIN responses are found nearly 100% of the time they are called for. Only two out of 45 children in Experiment 2 did not have a perfect WITHIN score.

In summary, there seems to be both a preference and a superiority for movement in the left half of the face for children up to about 7 years, which shifts to a right preference and superiority at about 8 years. Evidently there is some global ability to coordinate two halves of the body in different movements that emerges at about 4½ years and is fully consolidated by 8 years. This increasing ability corresponds to a change of preference for facial gesture from the left to the right side.

EXPERIMENT 3: WHAT ADULTS KNOW ABOUT CHILDREN'S FACES

Introduction

The several findings of Experiments 1 and 2 outline a picture of a developmental chonology for complex action that is provocatively parallel to that of child language. It is plausible that coordinated action is paced by the functional lateralization of the same higher order capacity that enables the development of syntactically facile language, and perhaps other communicative domains as well.

It may be that complex facial gesture is also communicative, though not necessarily intentionally so. It is more likely a reflection of complex inner states deriving from the simultaneous apprehension of surface forms and other realities that lie behind those forms. It is in these multiplicities that the origins of irony, wistfulness, satire, and prevarication lie. Perhaps it is the higher order factor controlling thought and action that is in the employ of both the complex mental state and the expression it elicits. It follows then, that there may be changes in facial expression that map with some transparency for adult observers increases in cognitive complexity in children.

At this point it seemed appropriate to investigate what adults know about children's faces that shapes their models of child minds.

Procedure

Experiment 3 was an attempt to discover what adults know about children's faces and the kinds of judgments about maturity that they are able to make from them. In particular, the question is asked 'do adults know that complex faces reflect complex minds?'.

To this end, a template was constructed that would guide the drawing of faces with the following features.

i. Eyebrows
   a. up; b. down; c. right up/left down; d. left up/right down;
ii. Eyes
   a. open; b. closed; c. right open/left closed; d. left open/right closed.
iii. Mouth
   a. corners up; b. corners down; c. straight; d. right corner up/left corner down; e. left corner up/right corner down.

Four asymmetrical faces were drawn from the template as follows and as illustrated in Figure 6.

1. One eyebrow down; one eye closed; both corners up.
2. One eyebrow down; one eye closed; one mouth corner up/one down.
3. One eyebrow down; both eyes open; one mouth corner up/one down.
4. Both eyebrows up; both eyes open; one mouth corner up/one down.

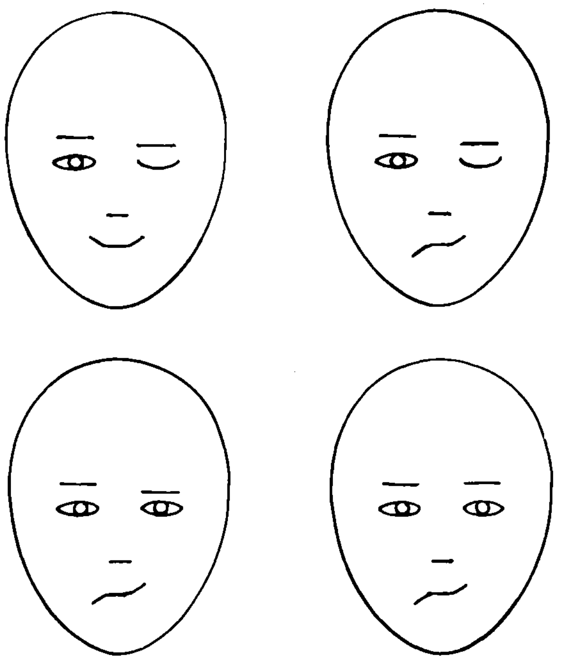

Figure 6. *Four asymmetrical faces in experiment 3*

Each of these was drawn in two mirror-image versions to make eight faces. These eight faces were copied eight times and combined with eight copies of eight symmetrical faces to form 64 pairs of faces. Each pair was arranged on a separate sheet, one face above the other. Half of the pairs had the asymmetrical face at the top, and half had it at the bottom.

These 64 combinations were placed in an ordered series, pseudo-randomized within every eight pairs, and preceded by eight practice pairs with other asymmetrical and symmetrical faces.

Each adult tested was run individually and received instructions to the effect that pairs of drawings of children's faces would be presented a pair at a time to be judged and the face of the older child was to be indicated. The subject flipped through the 72 pairs on individual pages held in a loose-leaf notebook and gave his judgments. At the end of this series, the subject was asked to give the strategy used to make these age judgments, and beginning with the first pair and continuing for some 20 pairs, the subject was asked to give a descriptive label for each face. After labelling each pair, the subject was asked whether he had ever seen this face before (on his own child, or) on any child, and also the age of a child who might make that face. A written record was kept of all of the subject's replies.

Subjects

Thirty-six middle-class adult subjects, 18 males and 18 females, volunteered their participation in this experiment. Each subject was selected to be in one of the following three categories:

1. parents whose oldest child was younger than 4 years (PYC group);
2. parents whose youngest child was older than 9 years (POC group);
3. adult nonparents without recent experience with young children (NP group).

No attempt was made to control for education so that there was some confounding of educational level among the groups. Parents of children under 4 years were mostly parents of children enrolled in a university nursery, while the adults with no children were either university students or college graduates. Parents of older children were more varied, being either university faculty, working professionals with graduate degrees, university secretaries, or businessmen.

One female subject, a parent of a young child, saw all the asymmetrical faces as deformed and distorted, not belonging to a normal child at all. This was the only subject who responded this way. As all of her judgments were based upon the age of a normal and an abnormal, this subject was replaced by another mother of a young child.

Hypotheses

Since in Experiment 1 it was found that only children older than 4½ were able to imitate faces with movements in different halves of the face, it was expected that parents with direct recent experience with young children might be sensitized to the possible complexities of the faces of children around the age when complex asymmetrical gestures might be expected to appear. It was predicted that the parents of young children would show the highest scores for age judgments based on the principles of across face half complexity or asymmetry.

Results

The number of judgments each subject made that was consistent with the hypothesis that the older child had the asymmetrical face was counted for a maximum score of 64.

The scores for the three groups, male and female, are shown in Table 1. A one-way fixed effects analysis of variance carried out on the means of the asymmetrical-equals-older scores for the three groups showed that there were significant differences among the means ($F = 4.38$; d.f. = 2,33; $p < 0.05$). A post hoc Tukey test revealed that the difference between the PYC and the NP groups was significant ($p < 0.05$).

This finding that the PYC group had higher asymmetrical-equals-older scores is supplemented by the further finding that eight of the 12 subjects in the PYC group gave unambiguous complexity or asymmetry arguments with only two subjects failing to mention anything about these. This proportion falls to four to seven for the POC group, and two to ten for the NP group. A

Table 1. *Age judgment scores in experiment 3*

PYC		POC		NP	
F	M	F	M	F	M
64	64	64	33	53	40
64	55	27	18	16	28
64	63	50	33	27	37
16	51	63	39	59	32
50	63	52	57	26	42
55	54	44	28	42	64
55.25		42.33		38.33	

chi-square test of these proportions was significant ($p < 0.01$), supporting the position that these are independent distributions. Two thirds of the PYC group is able to give face complexity as the explicit rationale for making age judgments among children's faces in this task. Evidently recent experience with young children provides important information about the relative difficulty of asymmetrical faces compared to other symmetrical though highly expressive faces.

The average age for the adults in each group was PYC, 31.25; POC, 50.41; NP, 25.66. There was a near zero correlation between age of subject and asymmetric-equals-older score.

Mirror-image pairs of faces quite often do not elicit the same descriptions. In some instances, presented in Table 2, a face labelled 'happy' is in its mirror reversed form labelled 'unhappy' by the same subject. One subject consistently labelled faces grimacing to the right 'sense of humor', 'pondering', 'contented', and 'happy', while the mirror images of these faces were labelled 'sneer', 'disturbed', 'unhappy', and 'turned off' respectively. Two subjects in

Table 2. *Responses to otherwise identical mirror-image faces in experiment 3*

Active side of face: Right	Left
Playful	Unhappy
Winking happily	Making a sour face
Winking	Getting ready to cry
Friendly wink	Wry or sardonic
Sly look	Intense stare
A little sad/giving in	Trying to tease/relaxed, happy
A little happy	Sad
Sad/hopeless	Happy, but ambivalent
Happy, told a joke	Sad
Disgust	No comment
Doubtful	No comment
Congenial	Sly
Happy	Cross
Bland	Wisecracker
Sense of humor	Sneer
Pondering	Disturbed
Contented	Unhappy
Happy	Turned off

the PYC group noticed spontaneously that a face in one orientation looked unnatural, but was acceptable in the reverse orientation. In each of these instances, the more natural orientation was the one with the pictured child's *left* eye closed.

Discussion

Parents of young children know a lot in direct experiential ways about what young children can do with their faces, and in particular, that very young children are unable to produce the asymmetrical faces that are spontaneously labelled as 'sardonic', 'wry', 'ambivalent', 'confused', 'feeling happy and something else', and 'doubtful'.

In light of Experiment 1, in which children younger than 4½ were found to have a sharply limited ability to make complex face gestures, it is not surprising that parents of children younger than 4 are aware of this limitation and attribute to it some significance: the child who is able to make asymmetrical faces is more sophisticated and is dealing with a more complex reality than is the younger child. The handling of a sophisticated child must be presumably adjusted accordingly, to encourage and speak to that sophistication.

DISCUSSION OF EXPERIMENTS 1, 2, AND 3

The shift from left superior to right superior face movement, between the age when the ability to handle complex movement has not yet developed, and the age when it has been consolidated, suggests that there is a locus of motor control shifting from the right to the left hemisphere. Presumably, contralateral superiority accrues from the close proximity to this locus of motor control of first the right, and then the left motor areas. We have noticed the shift of locus of control in the winks and grimaces of Experiments 1 and 2, and tracked its enhanced capabilities in face and limb gesture performance, so it is not unreasonable to look further at related phenomena of coordination for its effects. The left hemispheric locus of higher order control appears to enhance the rest of the contralateral body and is probably the origin of handedness in man. It may well follow that being right-handed is not fortuitously related to being left-brained for language, each being a slightly different employment of a common localized capacity.

Parental judgments of the quality of a child's apprehension of the world are based, in part, upon the child's complex facial gestures. Indeed, as borne out by the findings of Experiments 1 and 2, these complex expressions are, in fact, revealing indicators of a child's current level of maturity.

NOTES

1. The author would like to thank Susan Winograd for testing the children in Experiment 1, Maria Myrink for running the video recorder and helping with data coding, and Lynn Hyman and Beth Bolt for helping with testing in Experiment 3. The cooperation of the children and staff of the State University of New York at Buffalo Early Childhood Center, the Jewish Community Center of Greater Buffalo, and the Maple West Elementary School, Williamsville, was greatly appreciated.
2. Three subjects produced lateral movements of the jaw. It was decided not to score these movements as it was difficult to determine whether they were bi- or unilateral.

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Deaf Children and Chimpanzees: A Comparative Sociolinguistic Investigation

SUMMARY

This study is a sociolinguistic comparison of the signing behavior of deaf children and chimpanzees. Both social setting and dominance were found to be important factors in explaining the variance obtained on the five selected variables. Touching and eye contact behaviors were very similar between species and were explained in terms of dominance. With chimpanzees and humans, one's touching of another depends upon their dominance relationship with the interactant. The less dominant one is, the more one is touched. An opposite effect for dominance was found with regard to eye contact for the two species. Less dominant situations resulted in more eye contact for chimps, but less eye contact for the deaf children. Both species initiated formal conversations through signing. More informal conversations were sign initiated by both species in this study.

There were individual and species specific variations in the average number of signs. The overall trend of the averages, often dependent on dominance and reciprocity, shows that the more formal the setting the fewer the signs. Numbers increased with decreasing formality and reciprocity. The results for variations show that for both species, variations increase as the situation grows more informal. The results are analogous to the sociolinguistic concept of careful speech.

DEAF CHILDREN AND CHIMPANZEES: A COMPARATIVE SOCIOLINGUISTIC INVESTIGATION

The ability to communicate has been classified as a necessary prerequisite for the development and maintenance of stable social systems. Communication has also been defined as the central component of social organizations and relationships (Mehrabian 1968). Communication behavior is the core intrinsic element in the social orders of human society as well as other species. Both human and many of the other animal species have in common the communication imperative. The traditional method used to gain insight into the origins and evolution of human communication behavior is the comparative method. A logical place to begin such an investigation would be in the analysis of two species whose communication behaviors are quite similar. Deaf children and chimpanzees who communicate through American Sign Language (Ameslan) meet this qualification. By looking at those whose primary mode of communication is both gestural (nonvocal) and nonverbal, researchers should be able to see clearly the function of nonverbal communication behaviors in the overall communication process. They should also be able to examine the interaction of nonvocal-nonverbal style and social context, thereby shedding light on cross-species similarities and differences in the communication behavior. Thus, in this research, nonvocal language of chimpanzees and deaf children was examined, with a special emphasis on the role of social context as an intervening force influencing the communicative behavior of both.

Sign language use

Ameslan as a native language for the deaf seems to facilitate one's integration into the deaf and hearing speech communities. Ameslan as a language is acquired in a manner similar to oral English (Schlesinger and Meadow 1972; Bellugi and Klima 1972; and Klima and Bellugi 1972). Social context also plays a vital role in the use and variation of sign language within a given community of users. Such variation can be produced by changing the hand configuration, the sign in relation to the body, or the direction or intensity of the movement associated with the sign. The deaf enjoy a wide assortment of dialects and other sociolinguistic patterns. The signs of certain subgroups of the uses of a language show variation from a given or analytically derived norm in pronunciation, vocabulary and syntax – but the variation does not preclude mutual intelligibility (Stokoe et al. 1965).

Dialects of Ameslan are present in schools and between social, racial, and sex groups. Each generation in a school innovates certain signs; the majority are short-lived. Dialects are present on a regional or state basis, especially in states where frequent interactions between deaf occur. 'The extent of the occurrence of a certain sign for a certain thing is always related to frequency of social contact' (Stokoe et al. 1965: 312). Between men and women there is some evidence to indicate variation, as with the use of a different sign for laugh. Catholic and Protestant deaf typically employ different signs dealing with religious concepts. And some social stratification, the most common sociolinguistic concept, has been observed (Stokoe et al. 1965). This area of sociolinguistics for the deaf community is a relatively unresearched area, but one that offers rich potential.

Variations in the language begin early in the use of Ameslan. Cicourel and Boese (1972) report that three and a half-year-old children develop signs which parents must learn in order to communicate effectively with their child. This coining of new signs allows the child to develop his own distinctive style. School children can even tell jokes with the use of signs that are unintelligible to their teacher. No direct observations have concentrated upon the variations in Ameslan signing behavior due to the receiver and situation. Bellugi (1972) asked a deaf signer to sign to a hearing signer, an intimate friend and a totally deaf person; however, Oral English, Signed English, and Ameslan were also changed with the situations. Differences between the three modes were indicated but sociolinguistic patterns could not be detected.

Schlesinger and Meadow (1972) describe interactions between a mother and a child using Ameslan as the means of communication. These exchanges display 'patterns of reciprocity' that, if not replicated over various situations and different receivers, will illustrate the sociolinguistic variations of Ameslan by its users.

In summary, deaf signers produce a language as rich as Oral English. Despite the protests of researchers, deaf children show consistent linguistic abilities through Ameslan. The evidence seems to indicate some sociolinguistic variations among the sign language users.

Chimpanzees and Ameslan

Various projects are currently conducting research in chimpanzee communication, using various types of language (or communicative symbols) (Fouts and Rigby 1977). Beatrice and R. Allen Gardner at the University of Nevada in 1966 began teaching the chimpanzee Washoe to communicate using Ameslan (Gardner and Gardner 1971, 1974). At the termination of the experiment in 1970, Washoe had acquired over 160 different signs (Fouts 1975). She created her own signs, made novel combinations of signs, signed in strings of three or more, corrected her own mistakes, signed to herself, showed definite grammatical preferences, and in short, acquired a nonverbal sign language (Gardner and Gardner 1974). Roger Fouts at the University of Oklahoma is continuing this research, expanding it to include several chimps (Fouts and Rigby 1977). The results in Oklahoma have continued to confirm the Gardners' original hypothesis that chimpanzees are capable of acquiring and using this nonvocal language.

An area of investigation as yet untouched in the chimpanzee research has to do with the impact of social situations on signing behavior. Stokoe et al. (1965) mention sociolinguistic variations in the signing of deaf humans. Why should not the signing chimpanzees exhibit similar behavior? There should be differences in chimp signing behavior, directly correlated to various signing situations. Fouts and Rigby (1977) note that there were differing sign acquisition rates for the Oklahoma chimps; individual characteristics seem to mediate sign learning. More specifically, Gardner and Gardner (1974) noted that not only does Washoe have a signing accent, but at times she slowed down her rate of signing for new graduate researchers. Thus, there is strong intuitive feeling that sociolinguistic variations would likely occur with the chimps' signing. Social variables are as important in this species as in any other.

Research

Examination of the results of chimpanzee and deaf human signing behavior shows many similarities. Previous comparisons for the chimps and for deaf signers have been drawn from Oral English speaking humans. Yet, Ameslan is a language in its own right (Klima and Bellugi 1972; Stokoe et al. 1965), making the Oral English comparison somewhat faulty, especially in the area of syntax. Comparing the chimps with deaf signers allows for generalizations based on a common language. Along with these studies of acquisition and grammar, the area of sociolinguistic variation offers many possibilities.

Sociolinguistics is the study of language behavior as it is affected by the status of the communicators and the situations. 'A speaker in any language community who enters diverse social situations normally has a repertoire of speech alternatives which shift with situations (Ervin-Tripp 1973: 245). Grimshaw (1973) states that social structure can determine speech behavior and vice versa. The use of address, for example, can define the social relationships, or at least the interactants' perception of them.

The present research is an examination of sociolinguistic variation over situations. Three situations were devised to differ status and interactant possibility: a conversation with a teacher, a conversation with a stranger, and a conversation with an intimate friend. Each deaf child and each chimp participated in each of these situations.

The questions for this research project were based on sociolinguistic variations. The following questions were investigated:

1. What are the species-specific signing variations across situations for chimps and deaf children, and what are the similarities across species?
2. What are the species-specific communication behavior variations (other than signing) across situations for chimps and deaf children, and what are the similarities across species?

Subjects: Three chimps, Booee, Bruno, and Ally, were chosen as subjects from the Primate Research Laboratory at the University of Oklahoma. With permission from their parents and their instructor, Ms. Linda Lebedz, three deaf children were selected from the Special Services School in Moore, Oklahoma, to participate in the study. The children and their hearing losses were: Sharon, profound; Jeff, profound; and Gwen, severe (60 db. loss).

Interestingly, a dominance hierarchy existed as was displayed within each subject group. Booee was the dominant chimp, followed by Bruno, while Ally was submissive toward both of them. Because of her partial hearing, Gwen dominated the other two children; Jeff was next, followed by Sharon who was dominated by both children. The dominance effects seem directly analogous across both species.

Situations: Each subject was videotaped for a minimum of five minutes in each situation. The chimps conversed with their teacher, Roger Fouts, with a stranger, and with each other. The main theme was a food-sharing situation. The deaf children conversed with their teacher, with a stranger, and with each other. The main theme was a ball-playing situation. The stranger was the same individual for both species.

Units of analysis: The researchers chose categories for analysis that reflected the sociolinguistic orientation of the project. The preceeding review of the literature suggested some specific categories and supplied a theoretical basis from which some directional predictions could be made. All other categories consisted of communication behaviors that were possibly affected by the social situation, the dominance or both.

A. *Touching*. Burgoon (1974) indicates that one's touching behavior can be determined, in part, by social relationships. Touching another denotes a certain level of intimacy absent from very formal situations. With this in mind, the researchers examined touching behavior, predicting that, in both species, amounts of touching would increase as social relationships became less formal.

B. *Eye contact.* Among the many types of social relationships that can exist within species, the dominance-submission concept plays an especially important role in social behavior (Schenkel 1967). Amounts of eye contact can suggest one's place on a dominance hierarchy (Burgoon 1974; Schenkel 1967; Knapp 1972). With certain animals, lack of eye contact signals submission (Schenkel 1967). This is also true of some human cultures but does not seem to be the norm in white American society which places a premium on one's ability to look another in the eye (Burgoon 1974; Knapp 1972). On the basis of existent literature, one would predict opposite eye behavior across species according to changes in social settings. For the chimps, one would expect increased eye contact in less formal, less dominant social settings. For white American deaf children one could predict increased eye contact with the formal more dominant settings. As well, decreased eye contact with chimps should occur in formal, dominant settings; with deaf children, decreased eye contact would be found in the more informal social environments. For the present study, with both species, eye contact was operationalized as the subject's looking toward the one with whom he was interacting. More latitude in gaze behavior was allowed the chimps, in order to compensate for their peripheral vision. For purposes of analysis, the authors calculated eye contact to be the percentage of time, over a two-minute segment of tape, that the subject maintained direct eye contact with his interactant.

C. *Initiations.* Grimshaw (1973) notes that the use of various types of address can define social relationships as the interactant perceives them. Bearing in mind this evidence, the researchers noted that the various types of social situations employed in this study should call for different types of conversational initiations as social relationships changed. In this study, initiations were either signed or nonsigned (i. e. tapping a person or clapping the hands). As the social relationships became less formal across situations, there should be an increase in the use of less formal, nonsigned initiations for both species.

D. *Average number of signs per segment.* The researchers felt that the manipulations of social relationships would also affect the number of signs per segment. It would seem that in more exciting, less inhibited situations, the amount of signing would increase. The probability of this occurrence would seem higher where social situations became less formal, and less structured. Hence, it was expected that as social situations became less formal, the number of signs per subject over ten five-second segments would increase. Individual variations and effects of reciprocity, quickness of obtaining the desired response, were also anticipated.

E. *Variations.* According to Labov (1970) formal interviewing situations should exhibit careful speech, with little use of the relaxed speech more apt to occur in less formal settings. Several studies (Stokoe et al. 1965; Cicourel and Boese 1972; Bellugi 1972) suggest that one's signing behavior is as subject to social situations as is the verbal behavior mentioned by Labov. The researchers thus predicted that with both chimpanzees and the deaf, there would be increased variation in signing as contrived social situations varied from more formal to least formal.

To determine the extent of variation across situations, the authors established baselines for signs on an *a priori* basis. For the chimps, a baseline for specific signs was established by determining how those signs were most often made when the chimps signed to humans. Four chimp researchers, agreeing unanimously and independently, designated each chimp's usual sign for food and each chimp's usual sign for his name. These signs served as the baseline for comparison. Any deviation from these signs in terms of the parameters of hand configuration, direction, intensity of movement, or bodily placement, was termed a variation. With the deaf children, a baseline was established by finding the sign each child most often used for *throw*, *me*, *the*, and *ball*, when conversing with his/her teacher. Any deviation from these signs, in terms of the parameters already mentioned, was labeled a variation.

Results and discussion

Touching. Booee, the most dominant chimp, touched the teacher once and the stranger not at all over the two-minute segment. But he touched Bruno, the middle dominant chimp, 14 times and Ally 30 times. Bruno touched the teacher and stranger once each. He touched Booee 16 times and Ally 11 times. Ally, the most submissive, touched the teacher three times, stranger none, Booee none and Bruno once.

For both Booee and Bruno the amount of touching can be directly attributed to the dominance hierarchy. Both of these touched more when they were the dominant member of the communication pair. Ally, the most dominated chimp, touched very little and was more an object of touch. The fact that he touched the teacher more than anyone else might indicate his greater affiliative feeling for his trainer as contrasted to his peers.

All of the touching by deaf children occurred among themselves. Over a two-minute segment, Gwen, the most dominant, touched Jeff once and Sharon four times. Sharon, the most submissive, touched Jeff six times and did not touch Gwen. Jeff, the middle dominant figure, touched neither child in his interactions. None of the children ever touched the teacher or the stranger.

Touching behavior by the deaf is indicative of both a dominance hierarchy and cultural norms regarding respect shown authority. None of the children touched the teacher or the stranger. Being dominant over the other two, Gwen touched both children. Sharon, the least dominant, was touched most of all by Gwen. Sharon respected this dominance and did not touch Gwen, but did touch Jeff who was higher in dominance than she. Possibly, Jeff showed his submission by not touching Gwen, and attempted to assert himself with Sharon and thus did not touch her.

The touching behaviors across social situations was similar across species. As predicted, for both the chimps and the deaf children, social setting and the resultant dominance dictated touching behavior. The more dominant one is, the more formal the setting, the less apt there is to be touching behavior.

Eye contact. In the amount of sustained eye contact over a two-minute segment, Booee, the most dominant, gazed at the teacher 9% of the time, at the stranger 38% of the time, at Bruno 33% of the time and at Ally 49% of the time. Bruno gazed at the teacher for 12.5%, at the stranger for 20%, at Booee 7.5% and at Ally 27.5%. Ally, the most dominated, looked at the teacher 1.6% of the time, at the stranger 2.5% of the time, at Booee 3% of the time and at Bruno for 4% of the time.

With the chimps, an inverse relationship existed between the amount of dominance one possessed and the amount of his eye contact with others. Booee was most dominated by the teacher. Booee's eye contact with the other participants showed that he seemed little overpowered by those he was conversing with. As the dominance decreased, his amount of eye contact increased. Bruno seemed most dominated in his eye contact with Booee whom he looked at the least. His dominance hierarchy then progressed from the teacher, to the stranger, to Ally. Ally's eye behavior fits into the predicted pattern. As the most dominated, Ally had little eye contact with others. His dominance hierarchy seemed gradually to decrease across situations from the teacher, to the stranger, to Booee, and then to Bruno. These results are very similar to the touching behavior in respect to the dominance hierarchy.

The amount of eye contact for the deaf reflected the dominance hierarchy. Gwen, the most dominant, maintained eye contact 89% of the time with the teacher, 90% with the stranger, 79% with Jeff and 75% with Sharon. Jeff looked at the teacher 75% of the time, 69% to the stranger, 68% to Gwen and 42% to Sharon. Sharon, the most dominated, maintained eye contact 87% with the teacher, 75% with the stranger, 90% with Gwen and 42% with Jeff.

With the exception of Sharon's eye contact to Gwen, all the children paid more direct attention to the teacher and the stranger, again indicating the respect for authority figures. Asserting her dominance, Gwen maintained eye contact with both children three-quarters of the time. Jeff looked longer at Gwen than at Sharon, again ignoring Sharon to retain his dominance. Sharon continually looked at Gwen, almost in adoration, suggesting that one looks at but does not touch a dominant figure.

As the literature suggests, the behaviors of the chimps and deaf, reflecting their different norms, vary inversely on this variable. For chimps, high dominance and respect dictate a lack of eye contact. The reverse is true for the white American culture. In this society, eye contact with one higher in position than oneself shows respect for that person's authority and position. Lack of or avoidance of eye contact would indicate a disrespect of authority (Burgoon, 1974).

Initiations. Gauging the percent of signed conversational initiations in a two-minute segment, it was found that Booee's initiations across all four situations were 100% signed. When Bruno initiated, he used 100% signed initiatons with the teacher and Booee, 87% with the stranger and 81.8% with Ally. Ally initiated no conversations.

An interesting finding in this area was the fact that the vast majority of the chimps' conversational initiations were signed. It had been expected that as the situations became less formal, there would be an increase in nonsigned initiations by the chimps. This trend seemed to be evident in Bruno's behavior, but was not strongly confirmed with any of the other chimps. One explanation of this would seem to be that in all signing situations involved in this study the chimps must sign in order to receive their fruit. Hence, one would expect more signed initiations by the chimps, even though the teacher and stranger used only 50% signed initiations communicating with them.

The majority of initiations to the teacher and stranger by the deaf children were accomplished through signs. Jeff, who was the exception, used four nonsigned (100%) initiations with the teacher. Sharon did not initiate with the teacher. With the children, Gwen initiated 66% and 71% with signs to Jeff and Sharon, respectively. Jeff did not initiate with either child. Sharon's initiations were 100% signed with Gwen and 50% signed with Jeff.

As predicted, when interacting with the teacher and stranger, the majority of the children's initiations were accomplished through the use of signs. This may be because initiations by the teacher and stranger were almost totally signed. Initiations between the children were mainly nonsigned. In most instances, these nonsigned initiations occurred when attempting to regain another's attention, through tapping the other or by a loud clapping of the hands.

In contrast, the chimps had more signed initiations. This probably was a demand result produced by the signing situation: the chimps had to sign to receive food from the teacher, or even in the presence of the teacher while communicating with each other. But placed in untutored settings, chimps and deaf children use their natural gestural systems as a primary mode of communication.

Average number of signs. The average number of signs was calculated over ten five-second segments. Booee's average with the teacher was 4.14 signs, with the stranger it was 4.29, with Bruno it was 5.9, and with Ally it was 4.0. Bruno's number with the teacher was 4.14 signs, with the stranger it was 3.0, with Booee it was 4.1 and with Ally it was 1.8. Ally signed 2.6 signs per five seconds with the teacher, 2.14 with the stranger, 2.2 with Booee and 2.1 with Bruno.

Dominance seems to offer the best explanation of the results obtained on this variable. The trend seemed to indicate that the chimps sign differentially with others, according to perceived dominance. As well, the number of signs in a segment was determined by the quickness of response by the receiver. When the dominant chimp requested food from a chimp who was lower on the hierarchy, he received his food quickly. The quickness of one's compliance with a request for food determined the number of signs needed to have a request fulfilled. This perspective explained the inconsistencies in averages. For Booee, signing decreased for the teacher and stranger. His signing increased with Bruno because this chimp was slower in complying with his requests. But Booee's number of signs decreased with Ally as this chimp gave immediate compliance. A similar situation occurred with Bruno. He decreased the number of signs with the stranger and with Ally, because both of these reciprocated quickly. This was not the case with the teacher and Booee. Ally signed few words per session in all the situations. His variations in speed were so insignificant as to make any meaningful inference impossible.

Overall, for the deaf children, the prediction held that the average number of signs would increase as the situations became less formal. Gwen signed 2.56 signs with the teacher, 3.00 with the stranger, 3.57 with Jeff and 3.86 with Sharon. Jeff signed 1.86 signs per five seconds with the teacher, 2.86 with the stranger, 2.71 with Gwen and did not sign to Sharon. Sharon signed 2.2 signs per five seconds with the teacher, 2.71 with the stranger, 2.86 with Gwen and 2.0 with Jeff.

In understanding the deaf children's signing averages, dominance and social setting seem to offer the best explanation. Gwen, the most dominant, signed more in all of the situations. She continually exerted her dominance over the other children and seemed to feel a need to demonstrate her signing competence. Decreases in use of signs by the other children seemed to be a function of the the use of Ameslan to communicate. The child-to-child situations often required prompting to obtain signing. When the researchers put the children into a natural game-playing situation the children worked together, shared toys, and showed each other their projects. In 15 minutes of such activity no signing occurred. The children communicated with each other; reciprocity was evident in these informal situations but signing outside of a natural gestural system was not necessary. The number of signs with the teacher and stranger can be explained as a function of questions asked – the majority required only short answers.

Overall trends in number of signs across the two species seemed reversed. Both species seemed affected by dominance and its consequent reciprocity. Both species exhibited an interesting tendency to move to a natural gestural system, away from Ameslan, when in untutored informal settings.

Variation. Variation in signing was gauged by the amount of usage by the signer of a predetermined baseline of signs. A percentage was calculated to determine how extensively the signer used the expected signs totalled across the settings. For all chimps, signs for their names and food were used. The percentages are listed in Table 1.

Table 1. *Variations for chimpanzees**

Chimp	Setting				
	Teacher	Stranger	Booee	Bruno	Ally
Booee	74	70		65	44
Bruno	85.7	68	66		20.8
Ally	93.75	87.5	50	71	

* All percentages were obtained by dividing the number of obtained expected signs by the total number of signs in each setting

With all of the chimps, the amount of variations increased as the social situations became less formal. For these subjects, the most formal signing settings were to their teacher. One would expect them to use the signs he had taught them to use. As the situations moved in formality away from the teacher and towards informality, an increase in deviation away from the expected signs occurred. The chimps tended to switch signs from setting to setting as they determined the appropriate code for each setting.

For the deaf children, four signs occurred across situations: *throw*, *me*, *the*, and *ball*. There was definite variation as the situations became less formal. The percentages are the number of signs using the expected configuration over the total number of signs for the four words. The results are listed in Table 2.

Table 2. *Variations for children**

Child	Setting				
	Teacher	Stranger	Gwen	Jeff	Sharon
Gwen	100	100		91	91
Jeff	63	53	40		–
Sharon	78.5	57	61	80**	

* All percentages were obtained by dividing the number of obtained expected signs by the total number of signs in each setting

** Based on a total of 5 signs

Gwen varied little in her use of signs across all of the situations. Her preciseness of signing seemed to testify to her dominance and oft-assumed role of teacher for the other deaf children. She displayed this competence to the teacher and stranger by not varying her signs when conversing with them. Jeff varied his signing as the situations became less formal. But he would not sign to Sharon. Sharon's variations fit this same pattern, except for the 85% with Jeff. The validity of this last comparison can be doubted, as it is based only on five signs.

Thus, variations in both species follow the expected sociolinguistic curve. As the formality of situations decreased, the signing variations increased. This is analogous to the use of careful and relaxed speech. Nonprestigious forms are used in informal speech, as with the chimp-to-chimp and child-to-child situations.

Initially, the authors planned to investigate grammatical categories. But the experimental conditions were so contrived as to limit language usage by the subjects. The deaf children tended to respond to questions with one-word answers. The chimps, preoccupied with food, signed only to receive their reward. Nevertheless, several interesting behaviors occurred.

Deaf children did not feel the necessity of using lexical-gestural signs to convey their messages to each other and to the experimenters. They constantly hugged the experimenters, pointed out objects of interest, and showed off their classroom. One child went to each desk and signed the name of its absent occupant. In a game-playing situation, where the children were required to share pieces of toys to accomplish their ends, not one word was signed during the 15-minute period. Yet the children shared the toys and achieved their ends. In yet another sense, the children, although accustomed to videocameras, were excited by the presence of the experimenters. Future research should strive to make the experimental setting less contrived and conspicuous.

The chimpanzees offer rich potential for future investigation. Ally, the small and least dominant chimp, was quite hesitant to sign to Booee, the most dominant chimp. When Ally was hesitant in signing for food, Booee would poke Ally for attention and sign 'you', or 'give me food'. Booee continued this spontaneous signing until Ally signed his necessary signs. When Ally made the appropriate request for food, Booee would cease his prompting and deliver the requested item. Once during a signing session between Bruno and Ally the teacher at one time ran out of food. As an experimenter walked to the barn for more food, Bruno stared, turned to the teacher, signed 'more food', looked towards the returning experimenter and repeated the signs. Each time the sign for food was held for a few seconds, the means of indicating a question in Ameslan.

These results mandate future sociolinguistic research. Studies covering a larger number of signs and social situations over a longer period of time need to be conducted. Studies of the natural gestural systems of the species should also be carried out. In a sense this might qualify as a study of the native language system of the group. Knowledge of this system is essential to the explanation of variations in signing. The learning of a second language (Ameslan) by the groups needs to be compared to the learning of a second verbal language. These are but a few of the several areas demanding further investigation. Essentially, the only bounds for the research in this area seem to be those erected by one's own imagination.

SHEILA J. WHITE

Nonverbal Antecedents to Language Functioning: A Model and its Relevance for the Deaf

If one accepts the premise of our inherent sociality (we *are* mammals, after all), then one can ask how this sociality expresses itself and, indeed, whether attaching the label 'communicative' to any set of behaviors says anything about intentionality. It is certainly possible to transmit information unintentionally. For example, the emission of any noise could, by itself, communicate a certain amount of vital information: where the noise-maker is, possibly who it is, of what sex, of what age, and whether she is angry, contented, frightened, or sexy. Certain nonverbal behaviors, such as blushing, the position of eyes, head, hands, etc., often give away information which we are not necessarily seeking to express. Indeed, often the verbal and nonverbal behaviors give quite conflicting information. So, although an act which is unintentional can transmit information, is it really a *communicative* act? In this article, the use of words such as communicative behavior or communicative functioning will always imply intentionality and, further, will imply *an intention to interact socially.* Individuals in our society who do not conform to this definition are considered bizarre and/or psychotic.

Language functioning is a special subset of communicative functioning, involving the recognition and use of a societally acceptable set of conventions (specific languages) with which to impart and receive information. In humans, the major imparting mode is via speech; this is not, however, a necessary condition for 'language'. When addressing the question of when language function begins, it has always *seemed* obvious to start with the first spoken utterances. Indeed, most linguists dealing with this question begin by recording utterances and noting how they are strung together. While this is certainly a valid area of study, it does not, in reality, address the question of when language functioning begins and in what form it does so. Both linguists and zoologists have argued that man's defining quality, aside from the opposable thumb, is 'language'. We should perhaps amend that to read 'speech'. As I shall argue below, we have, as do other highly social animals, a nonverbal language history, the understanding of which can help us to help those whose verbal functioning is not all that it could be.

THE NONVERBAL BASIS OF LANGUAGE FUNCTIONING

The motif that has run throughout my career as a zoologist is our connectedness with other forms of life. And one of the strands of this connectedness is via language functioning. There are two distinct prerequisites that have to be considered in deciding whether an organism 'has language' or not (social and cognitive), and another area which concerns itself with language expression. We must not confuse whether or not an animal has language with how the language is expressed. An undue concentration on the receptive/expressive components (e.g. hearing and speech) has created a certain amount of confusion (see White 1979).

First, what is language about if not the passing of information from at least one individual to another? Indeed, in humans, if the messages are not in a form which is understood by more than a single individual, we do not consider it to be language. So, the first prerequisite that has to be present when we say that an organism 'has language' is that the organism in question is social. And one can think of looking to the origins of socialization as a framework within which the origins of language would have to fit. I would even go so far as to say that languages (in whatever form) have evolved in parallel with changes in types of social organization that groups can have.

A second prerequisite is that there is some kind of cognitive organization which allows for abstraction and representation of objects and events and their relationships in time and space. This is what frees an organism from the immediately seeable, hearable, touchable, and smellable. Jointly with the evolution of complex social and cognitive functioning lie the origins of what we call 'language', although its modes of expression may differ from species to species. When researchers express interest in the 'Biology of Language', what they should be exploring are the types of social and cognitive organizations necessary to supply the need and the wherewithal for language functioning to exist.

But surely, I hear some of you say, humans are different from other animals! And indeed they are. The difference, however, lies within the final aspect to be noted which concerns itself with how information is received and how it is transmitted. There has to be some kind of perceptual organization (for input) and some kind of motor organization (for output). The ears function as the main reception unit and the vocal apparatus as a unique transmission unit. That is not to say that other modalities are not involved. (Indeed, this whole volume would be completely unnecessary if that were not the case.) In the absence of – or in addition to – the ears as functional units, we may rely on the visual system for input and a gestural or manual system for output. Even with functional ears, the visual modality is used when we read and write or when we attend to body language. When these modalities are not operative, tactile/vibratory systems have been implemented, but with much less success to date (Levitt and Nye 1971; Pickett 1968).

No other animal can speak, which is one reason why many of us have had enormous difficulty in accepting language functioning in other animals. The input and output aspects of our language system are, after all, the most obvious. However, other organisms have their own input-output systems which are put to the service of intentional, repeatable, intraspecific communication. For example, visual input – postural output; tactile input – vibratory output; olfactory or gustatory input – pheromonal output; auditory input – vocal (not speech) output; and various combinations and recombinations of these. Even Hockett's (1958) list of properties of human 'language' is seen as applicable to other species if nonverbal (as well as nonvocal) communicative behaviors are considered. (We will leave bees up in the air for the moment.) In concentrating solely on speech functioning, we are doing animals and, ultimately, ourselves a great disservice. And we are in danger of making the same mistake in dealing with infant language functioning.

The point, then, is that language and speech are not interchangeable terms. Speech is only one aspect of human language, and the confusion which arises from not recognizing this difference (e.g. Lenneberg 1967) has held back remediation efforts for many years (White 1979).

CONCENTRATING ON THE SOCIAL BASIS

In my own work I am concentrating primarily on the social basis of language functioning, exploring the nature of the maternal/young interaction and how the acquisition of language and speech arises from it. What are the effects of disruption at different stages of social development? And what are the unique problems of the deaf in this regard? While it may appear difficult to conceptualize the separation of the social and cognitive aspects of our development, it is, in fact, not all that difficult if one bears in mind that adequate nurturing is what provides the milieu for the experience with the world which is necessary to develop cognitively (e.g. Elkind 1967). The so-called 'institutional child' and, for that matter, the 'wild child' develop deviant and substandard cognitive and linguistic functioning, if at all (Provence and Lipton 1962; Curtiss 1977). What these children are suffering from *primarily* is inadequate nurturance or social stimulation (Rubenstein 1967). The work of Skeels and Dye (1939) is of interest here: they noted the improvement of institutional children who were placed in the care of mentally retarded companions and who, when tested later, showed substantial gains in IQ and verbal performance over their institutional peers who did not have this type of stimulation. One can conclude from this study that substandard cognitive models are not necessarily an obstacle to later functioning, but that the lack of close social ties might be.

Hearing children of deaf parents develop perfectly normal language functioning (Kretschmer and Kretschmer, 1978). In fact, they are sometimes ahead of their peers because they act as go-betweens between their deaf parents and the hearing world; and code switching (between oral and signed modes) has been noted as early as two years of age (Schiff 1976). This effect is analogous with what occurs with other bilingual children. The point is, however, that being a substandard speaking model says nothing about the abilities of deaf adults to supply the nurturing necessary for good social, cognitive, or linguistic performance. Further, the oft-quoted superiority of deaf children of deaf parents over deaf children of hearing parents (many examples are noted in Schlesinger and Meadow 1972) may arise more from an earlier recognition of the problem and an easier acceptance of a deaf child in a deaf family than for any other reasons (e.g. Greenstein et al. 1975; Kretschmer and Kretschmer, 1978).

Let us look at the deaf child of hearing parents for the moment, for there is usually no question about the type of language environment which surrounds him. The deaf child's most basic problem is, of course, having a faulty input channel which is seen as having dire effects on his eventual language functioning. The usual line of reasoning is: because the deaf child lacks experience in hearing the output of others and does not get decipherable feedback from his own utterances, language simply does not develop. If this were the true cause-effect relationship, then the degree of hearing loss should be predictive of the degree of language impairment. This is simply not the case (e.g. Lewis 1968; Schlesinger and Meadow 1972; Fry 1975; Kretschmer and Kretschmer 1978, etc.). Now, if one looks at this effect from a social point of view, then it is not difficult to imagine how mismatches in early interaction patterns could lead a child away from grasping the usual rules of the language game (e.g. Bruner 1975; Nelson 1973). Nelson's work (1973) addresses this effect in hearing children: she found that she was able to categorize the children in her study as operating either within an object-oriented ('referential') or a socially oriented ('expressive') style. The socially oriented children put words together earlier, while the object-oriented children built up single-word lexicons. The point made by Nelson was that the child's language acquisition (in whatever style) could be enhanced by a matching maternal communicative style and retarded by a mismatched one. More importantly, maternal acceptance of the child's output also had an effect on language acquisition. Coupling a mismatch of style with rejection was the most destructive to the rate of language acquisition. What happens when you add a further element: a mismatch of mode?

There is a further danger here for the handicapped child. If, because of any estrangement, the child's experience with his environment is restricted, this could lead to cognitive deviations as well, which will serve to exacerbate poor linguistic achievement. Although some have argued against this happening (e.g. Furth and Youniss 1975), others have argued that this can and does happen (e.g. Lewis 1963; Elkind 1967; Wachs et al. 1971). My argument is that until we can begin to separate out what the possible stimuli are, it is difficult to assess the responses. As with any complex system, there are interactions between the various parts such that a disturbance in one leads to unknown perturbations in the rest of the system, sometimes leading to similar outcomes arrived at by completely different routes.

My bias, and that of others (e.g. Bruner 1975, 1978a; Lewis and Freedle 1973; Stern 1974b; etc.) is that an examination of early interaction patterns is basic to an understanding of later communicative functioning. A model which frames my thinking is presented in the next section and is derived from my knowledge of the dynamics of mother-young relations in altricial mammals (mammals whose young are born helpless) (see also White 1977).

SOCIAL ORIGINS OF LANGUAGE FUNCTIONING: A PROPOSED MODEL

We are mammals, and if that means nothing else, it means that we have to be nursed as infants. We have a very long period of dependency relative to that of other mammals, and because of this we have had to develop mechanisms which ensure strong bonding between the infant and his primary caretaker, usually the mother.[1] If my premise is correct, that language has evolved because it is adaptive for maintaining the type of social system that we have (White 1977, 1979), then it should not be surprising that infants deprived of adequate social stimulation (e.g. institutional children) not only do not flourish, but do not develop adequate language. What *is* universal is that we all have to be nurtured; all else follows from that. From a knowledge of the dynamics of mother-young relations in altricial mammals it is possible to formulate a model, based solely on initiation of approaches, which I suggest can account for the dynamics of early human social relations as well. Viewing relations in this way may give us a means of explaining some of the inconsistent effects of early experience on later development noted in the literature, as well as allowing us to make predictions of the effects of various treatments which may occur – naturally or otherwise – during childhood (e.g. separation, rejection, overprotection, etc.). More pertinent to the theme of this article, language functioning is seen as arising within it. Communication does not appear in isolation from joint activities or social interactions (Bruner 1975, 1977, 1978a; Lewis and Freedle 1973).

It has been amply demonstrated in many mammals that there are three distinct phases in the mother-young relationship which can conveniently be represented by a simple vector diagram where *the direction of the arrows indicates the probability of the initiation of approach:*

Phase I: mother → young (mother initiating)
Phase II: mother ⇄ young (mutual approach)
Phase III: mother ← young (child initiating)

The length of each phase varies according to the animal under study, and has been described in the context of retrieving and feeding behaviors in the cat (Schneirla et al. 1964), rat (Rosenblatt and Lehrman 1964) and dog (Rheingold 1964), and in the context of contact or clinging behaviors in the monkey (Harlow et al. 1964; Hinde and Spencer-Booth 1967).[2] What I would like to do in this section is to show how this model may be applicable to humans, demonstrate how and when language functioning arises within it, and illustrate its potential usefulness in studying problems of language disorders.

Phase I

During the first phase (mother → young), the young are extremely helpless: many young mammals are initially unable to regulate temperature, to feed themselves or to locomote, and, in the case of rats and cats, unable to see. This phase is characterized by extreme attentiveness and active initiation of contact by the mother (retrieving behaviors in rats, cats, and dogs; female monkeys do not allow their infants off their bodies, etc.). The human child begins to smile during this phase – but indiscriminately at all human faces – and emits simple vocalizations which are expressive of pleasure and displeasure. Physically, babies are unable to locomote, although they can follow or track visually and can localize sounds. I am postulating that this stage may account for the first four months of human infants' lives. (One reason for choosing this age, aside from the fact that infants do not locomote at this time, rests on the results of a study by Moss [1974], who was looking for correlations between a woman's attitudes towards mothering prior to birth and her actual performance after having her child. There were no correlations during the first weeks; however, mothers' attitudes could be correlated with types of mothering when their infants were 3 months old. Moss took this to mean that at earlier ages, the state of the infant was more dominant in the interaction process. Escalona's work [1973] indicates a high percentage of positive parental social input in the early months which begins to decline when infants are about 4 months old.) Infants of 3-4 months give well-defined social responses to adults, emitting 'coos' and crying less in social situations. Infants who are separated from their mothers at this age do not seem to be affected in adverse ways (e.g. Casler 1968).

Phase II

The second phase (mother ⇌ young) can be characterized by reciprocal approaches between the mother and the child: as the child begins to be able to locomote, there is an equal probability of approach by either partner. With the ability to move, the young make attempts to explore their environment, necessitating contact to be maintained over a distance (see below). From being initially restrictive, mothers grant their young more and more freedom. This stage is demonstrable in all the animals noted above. In humans, it may well be evidenced by events ongoing between 5-6 months (when the child is just starting to crawl and can discriminate between the mother and 'others') and 12-13 months (when first words may appear and walking starts).

Let me document some of the changes that occur during this time span in the human infant: *Physically*: at 5-6 months, children begin to crawl; at 7 months, they can sit without support; 9-10 months, can crawl quite rapidly and independently; 10-12 months, can pull themselves up on furniture; 12-13 months, can walk with help, although, in some, walking is already accomplished at this time. *Socially*: a definite social smile is present in the 4-5-month-old; between 7-9 months, stranger anxiety is evidenced, which is generally considered to be evidence of attachment and can also be considered as evidence for having achieved 'person permanence'. Up to this age, children can be separated from their mothers with few problems; after this point, there may well be problems, for example, if a child has to go to the hospital without his mother. *Vocal behavior:* at 5 months, the child starts babbling; at 6 months, can differentiate between scolding and affectionate tones; at 7-9 months, begins 'conversations' using singing tones and expressive sounds; at 9-10 months, there is evidence of some word understanding; at 10-12 months, the first word may be spoken and the child will point to indicate wants; at 13 months, children may say one or two words other than 'mamma' and dada'. *Cognitively*: by 7-9 months, there is evidence of person permanence, as noted above, and evidence of object permanence (possibly stage IV of Piagetian sensorimotor development); by 10-12 months, the child may begin to account for spatial displacements, a fact which is most likely connected with the child's being able to displace himself.

Phase II draws to a close with the child's recognition of his mother as a source of sustenance both physically and psychologically. The gradual shift from this phase to the next occurs somewhere between the first and second year. Freud and Burlingham (1943) note that children between 1 and 2 years of age react violently when parting from their mothers, while Robertson and Bowlby (cited in Bowlby 1969) place the peak of the child's dependency at somewhere between 18 and 24 months. On the other hand, Phillips (1973) notes that somewhere between 8 and 18 months, mothers, reacting to changes in their children, change their verbal output (becoming simpler, clearer, slower). Truncating Phase II at 12-13 months seemed reasonable for two reasons: First, I do not believe it is fortuitous that the first words and the first steps are so closely juxtaposed. Vocalizations are a logical way of maintaining contact over a distance. As contact has been shown to be so important in primates in general (e.g. Harlow 1961), the use of a spoken communication system might be thought of as first serving this purpose, allowing children to solve the dilemma of how to both explore and remain 'attached' simultaneously. Second, Escalona's study (1973) showed that 70% of all social input to the child other than routine caretaking activities was positive to about 4 months of age (Phase I, mother initiating) and then started to decline, reaching a low of about 30% at about 13 months and stabilizing there (transition between Phases II and III) with an upswing starting again toward the end of the second year (near the end of Phase III; see below).

Phase III

It is during this phase (mother ← young) that children not only feel free to stray more, but also to make more and more demands. Exercizing their increasing locomotor and manipulative skills, many animal young use their mothers as playgrounds: jumping off them, playing with their tails, and being nuisances in general. Human children are no different: they do not readily let mothers out of their sight and become extremely insistent on constant attention, and separation at this time is terrible for the child. Animal mothers retreat at this point (see fig. 10 in Rheingold, 1964 and fig. 5 in Hinde and Spencer-Booth 1967; they stay out of reach and will actually rebuff or punish their young. In cats, rats, and dogs, this constitutes the weaning process and in some, the young are rejected outright (rats). In humans, this phase may account for the time span between 14-15 months of age and 2 to 2½ years. By 14-15 months, infants walk alone and some may already be combining words; by 2½ years, children are quite accomplished.

It is during this phase that children blossom linguistically. (It is also the time when a large percentage of hearing parents receive the verdict of deafness in their children.) One is tempted to postulate a need hypothesis in order to account for this blossoming: the child 'needing' maternal contact, sometimes almost desperately (e.g. Bowlby 1969). It is not only a matter of 'refueling' (a term used by Mahler et al. 1975), but a desire for mutual engagement. Mothers' behaviors to their children change, partially due to differing expectancies they have as the children grow (e.g. Phillips 1973). These may be some of the mechanisms – and there are undoubtedly many others, including cultural traditions – which do not allow the human mother to reject her child so early.

A fourth phase has to be postulated for primates: (mother ⇌ young, renegotiated). This phase is characterized by the growth of independence (or some modicum thereof) by the child. It involves continual adjustment on the part of the parents as the child grows and on the part of the child as it becomes aware of the rules of the world around it. This phase has to be postulated in order to account for and describe the continuing mutual dependence evidenced in primates. In the human child, this phase may start as early as the end of the second year; children are appropriately verbal at this time and one may speculate that the appropriateness has been forced upon them as part of the renegotiation process. In the Escalona study noted previously, there was an upswing of positive social responses starting towards the end of the second year. Unfortunately, her study did not extend beyond 2 years of age, so that later changes of this type go unrecorded. However, I would predict that there should be an increase of positive responses certainly by 30 months of age: by this age, children begin to exhibit social skills which make them a bit more easy to live with. For example: understanding turn-taking, being aware of household or nursery routines, helping with simple tasks, etc. (Tesauro and Takeshita 1971). With increasing experience of the world, children will demand more, and if they wish to be gratified, they have to make themselves understood. And so the cycle continues. After the third year, children can leave their parents without fussing – to go to nursery school, for example, and this ease increases with age (Bowlby 1969).

APPLICATION OF THE MODEL

How can this model be applied to children with language problems? Below are two examples of deaf children, each of hearing parents, and both showing the same apparent impairment: poor social skills and poor language development. Child A was diagnosed late; child B was diagnosed early:

A's deafness was not diagnosed until he was 16 months old, although his parents suspected that there was 'something wrong' at about 6 months of age. It is quite possible (and the literature is full of examples) that the behavior of a deaf child whose parents fail to understand his deficit is seen by the mother as rejecting. If the mother feels rejected, then one might expect that Phase II parental behaviors (equal approach by mother and child) might be truncated, and the child might be thrust too quickly into the parental withdrawal phase (III). This would lead to communication problems of the type wherein the child will not view his environment as responsive and will therefore not be motivated to develop language skills (Mussen et al. 1963, note examples of this phenomenon in hearing children).

B's deafness was detected at 5 months old. There is a great probability (and this, again, is noted in the literature) that Phase I parental behaviors (mother-initiating) will last too long. The resulting parental overprotection can exacerbate problems of language learning such that the child will not be motivated to develop speech as a necessary tool for obtaining his desires. Examples of this type of phenomenon have also been noted by Mussen et al. (1963) in hearing children.

In each of the above cases, the apparent impairment of the child was the same. The model, however, can illuminate how different precursors lead to very similar end results and would, on that basis, prescribe different treatments or intervention policies in each case. The model thus allows a separation of effects of parent from the effects of children in communication problem areas and can account for some of the inconsistent responses to separation, rejection, overprotection, etc., noted in the literature. It can also offer a framework within which to compare the dynamics of parent-young relationships between different types of populations (e.g. between deaf and hearing parents of hearing-impaired children, etc.).

CONCLUDING STATEMENT

This article has attempted to elucidate, albeit speculatively, the nonverbal antecedents of verbal functioning. Where one makes a sharp division between 'communication' and 'language' is not always clear. What is clear, however, is that language – human or otherwise – need not be verbal. In fact, what I am postulating is that without the nonverbal social base (which continues to operate side-by-side with verbal performance throughout our lives, particularly with those with whom we are intimate) verbal proficiency does not develop. I have also presented a model of the dynamics of early social interactions to show why – but not how – verbal performance occurs when it does, if it appears at all. Verbal language, within this model, is indicated as being the means to maintain contact over a distance at a time when children are very strongly 'attached' to their parents and yet have both the means and desire to explore the world around them. If we ignore our nonverbal language history, we face the danger of not knowing how to help those whose verbal functioning is not all that it could or should be.

NOTES

1. 'Bonding', as used in animal behavior literature, is a term meant to indicate a strong attachment, usually between a pair of animals. So, for example, there are allusions to sexual bonds or mother-infant bonds. The point to keep in mind here is that bonding is the end result of a process: courtship between the sexes, or consistent interactions between mothers and young. Mother-young bonds in animals are studied in much the same way as in infants: one can measure following or distress calls by the young, or retrieving by the mother, etc. The dynamics of the changes in interactions between a pair constitutes the so-called study of maternal behavior but, truly, it is an examination of transactional events between the mother and the child. The end point is, of course, the eventual independence of the young, and the amount of time allotted for this varies in proportion with the complexity of the adult world the young will eventually have to enter.
2. Unless otherwise stated, references to animal repertoires will be found in these citations. References to human infant milestones can be found in a variety of sources dealing with early childhood milestones but here, unless noted otherwise, the citations are from Mussen et al. (1963) and Thompson and Grusec (1970).

JAAN VALSINER and JÜRI ALLIK

General Semiotic Capabilities of the Higher Primates: Some Hypotheses on Communication and Cognition in the Evolution of Human Semiotic Systems

The present paper treats the evolution of human communication systems and cognitive characteristics with respect to how much can be deduced from the data on cognitive and communicational characteristics of the anthropoid ape. Indeed, as with any paper devoted to subject matter which is difficult to prove by the data, the present one includes some speculation.

Recent years have proved the existence of extraordinary (from the viewpoint of traditional understanding) communicative and semiotic capabilities among anthropoid apes. A number of investigators have been successful in teaching chimpanzees and gorillas some kind of artificial sign system, either American Sign Language of the deaf (Gardner and Gardner 1971, 1972, 1975; Fouts 1972, 1974; Patterson 1978; Terrace and Bever 1976), which is a kind of human language (used regularly as a communication medium by a group of humans – deaf people), or special artificial languages based on the visual-kinesthetic communication channel (Premack 1971, 1976; Rumbaugh 1977) with the language signs being geometric forms of various colors and qualities. After becoming efficient in communicating with the humans with the help of the artificial languages, the chimpanzees have learned to use that medium to communicate with each other to solve problems where cooperative efforts are inevitable for the solution (Savage-Rumbaugh et al. 1978a, 1978b). It has also been argued that some kind of gestural sign system (consisting of position movements, touch movements and iconic hand motions) is used among the pygmy chimpanzee (*Pan paniscus*) to coordinate the copulation of the individuals (Savage-Rumbaugh et al. 1977). Surely the copulation is a standard interactive situation where coordination of two individuals of the given species is required, and since the requirements of that situation are highly constant, it is no wonder that there we can look for the emergence of gestures as special communicative signs in chimpanzee behavior. Despite the great difficulties of observing the chimpanzee in the wild to understand the possible natural sign systems of that species (which we are usually doing via application of models of human communication systems upon those animals), some investigators have managed to extract some gestures which apparently serve as conventional signs to communicate among chimpanzees in natural habitats (Kortlandt 1967; Plooij 1978).

These data seem to demonstrate quite convincingly that the closest species of animals to *Homo sapiens*, the chimpanzees (and other anthropoid apes as well) possess some extra *semiotic capabilities*: the capabilities to invent sign systems of their own or to learn those provided by some agent in the environment, when some environmentally determined need is generated for adapting new ways to communicate. There has been continuing argument about the problem of whether the apes have managed to learn 'human language' and whether some 'human linguistic privileges' in *Homo sapiens*' self-esteem should be retained (Ploog and Melnechuk 1971; Healy 1973; Limber 1977; and others). Those kinds of arguments, we are convinced, are only misleading since it is impossible to prove or disprove the axiomatics present in the argument from both sides – that language is and remains a purely human phenomenon, or that language is and remains a sign system which is not necessarily purely human. For the purposes of the present study, we simply argue that the apes possess latent semiotic capabilities. Further, we argue that those semiotic capabilities are similar in man and the anthropoid apes, and that the borderline, as far as the semiotic abilities in principle are concerned, is not to be drawn between *Homo sapiens* and all other 'animal' species, but rather between the great apes and other primate species (Rumbaugh 1970, 1975; Firsov 1972; Gallup 1970, 1975). Those semiotic capacities, indeed, evidently differ among the various species both quantitatively (signs of how much of the arbitrariness can be utilized) as well as qualitatively (upon which communication channel the sign system is most easily learned or created), but these differences seem to be less than the difference between the anthropoid apes and man from other primates in this semiotic capacity.

The important thing about the semiotic capacities of any species is the question of correspondence of the semiotic abilites and cognitive characteristics. Here, a two-way relationship is apparently present – from one side, the cognitive characteristics of a species provide the basis for the semiotic capabilities; from the other side, if the semiotic capacity begins to develop into some kind of sign system, the cognitive characteristics of the animals (or species) are altered. The data on teaching language to chimpanzees provide us with nice examples of how the new cognitive phenomena first appear in the communication process between the ape and the human being, and later become internalized and used at different times in noncommunication situations (Washoe signing to herself, Lana asking the computer to open windows at night, etc.) (Gardner and Gardner 1972; Rumbaugh 1977). Evidently teaching a chimp a term to use to denote himself would bring with it a difference in the chimpanzee's cognitive sphere. A similar development can be seen in human ontogenesis, where much of the child's cognitive development is based on the gradual internalization of the interactive patterns (Bruner 1975, 1978b; Ratner and Bruner 1978; Ninio and Bruner 1978; Lock 1978). It is evidently this two-way relationship between communication and cognition that may appear similar for different higher primate species of the general latent semiotic capability. However, the maximum level to which the the communication and cognition can 'bring each other' when the need for such development exists is different among the different species, with *Homo sapiens* evidently having the highest 'ceiling' for that development (Goldin-Meadow and Feldman 1977).

As has been argued (Premack 1976), of all the prerequisites for language none is more vital, or more easily overlooked, than memory. Firsov (1970, 1972) and Suvorov and Firsov (1975) have revealed an important difference in the organization of the anthropoid ape memory from that of the lower primate species. Among anthropoids, the visual memory codes seem to be the primary mechanisms that control the ape's behavior, dominating the conditioned reflexes the ape has acquired. The chimpanzee has been found to possess the most elaborate and long-term visual memory among the primates – the 70% correct solution of some problems among chimpanzees was possible even after 300 minutes had passed from the demonstration of the solution, whereas the same characteristic for the macaques was only 10 minutes (Suvorov and Firsov 1975). Firsov et al. (1974) have argued that the anthropoids are capable of generalization of the experience and creating some (visual) 'concepts' of the surrounding objects. Their extraordinary visual memory characteristics surely make this high-level cognitive development possible, and this also provides a nice cognitive basis for the development of sign systems based on the visual-kinesthetic channel.

Besides memory, the other important aspect of the cognitive side of the story of the primate semiotic capacities is the logic they use in problem solving. Premack (1976) has convincingly demonstrated the possibility of teaching the chimpanzee artificial language and the formal logical operations connected to the use of that language. The possibility of transitive inference has been experimentally demonstrated among squirrel monkeys (McGonigle and Chalmers 1977). Chevalier-Skolnikoff (1976) has demonstrated that only the human and gorilla infants, but not macaques, are efficient on the Piaget Sensorimotor Intelligence Scales, with humans completing the scales on both visual-facial and vocal modes, whereas the apes managed to complete the visual-facial mode only. The performance of the macaques was clearly inferior on these scales. Similar qualitative differences between the great apes and other nonhuman primates were found by Rumbaugh (1970, 1975; Rumbaugh and Gill 1973) on the basis of tests of the reversal of discrimination-learning procedures. These data on great ape learning abilities are highly correlated with the values of the average cranial capacity of the species studied (Rumbaugh and Gill 1973). It has been hypothesized that this qualitative superiority in intelligence of the great apes as compared with other nonhuman primates may be due to their adaptation to the terrestrial way of life (Rumbaugh 1975: 363). If this hypothesis were probable we could be faced with the task of finding the bases for higher primate cognitive and symbolizing capacities in the environmental pressures which made our ancestors adapt to moving around and acting on the ground, besides leading the arboreal type of life. This would mean that the basic semiotic capabilities underlying the development of different sign systems are of rather old evolutionary origin, certainly much older than the factors usually cited for the development of sign systems (toolmaking) which have been specified in history.

One other factor that is important in characterizing the cognitive and semiotic abilities of the present-day primates is their possible ability of cross-modal transfer of experience. If a species can transfer the experience from one sensory modality to make judgments on the basis of some other modality, the existence of generalized (independent of the particular input modality) 'concepts' about the environment will become possible. Although there have been some methodological problems with the research on cross-model transfer in primates (see Davenport and Pralinsky 1977), the post-1970 research has generally demonstrated that visual-tactual cross-modal transfer is present in apes (Davenport et al. 1975; Davenport and Pralinsky 1977) but is rarely found in monkeys (Frampton et al. 1973; Petrides and Iversen 1976; Milner 1970, 1973; Milner and Ettlinger 1970; Weiskrantz and Cowey 1975). These findings also demonstrate the superiority of the apes over the other nonhuman primates in the basic mechanisms which the new artificial sign systems can be based upon in laboratory conditions and what nature may have based the creation of natural sign systems upon in evolution, culminating in the development of the human multichannel (but mostly vocal) communication systems.

Thus far, we have been looking upon the cognitive and communicative prerequisites of semiotic systems from the apes' side. The same problem can be dealt with from the human side as well, by asking the question whether, in some special conditions, humans are capable of alternating their usual vocal-dominated communication system for some other sign system. The case of deaf subjects gives some idea about that. It is natural that deaf children are able to learn sign language as the best available sign system for their communication. What is more relevant theoretically is that deaf persons tend to 'invent' sign language for themselves even in cases where no model of that language is given to them by their social environment (Kuschel 1973; Goldin-Meadow and Feldman 1977). This may be interpreted by the simple idea that in case the 'usual' human main communication channel (vocal channel) is blocked for some reason or other, the subjects can realize their semiotic capabilities (if there is a need to communicate) through other communication channels. Note that here we are dealing with subjects who have had no vocally-based communication system before during their lives. But what about the possibilities of such 'channel change' among people who had used the vocal channel during their lives, and because of some accident had lost the possibility to communicate vocally? There have been many speculations about the causes and consequences of aphasia, but the thing that interests us most in the present context is whether the aphasic patients can learn to use some artificial sign system to communicate with other people? It has been demonstrated (Velletri-Glass et al. 1973; Baker et al. 1975; Gardner et al. 1976; Davis and Gardner 1976) that aphasic patients can be taught visual shapes-based artificial sign systems, of the same kind that the chimpanzees have managed to learn. What is more extraordinary about this is that among the aphasics, the patients whose verbal linguistic functions were *more* disturbed tended to be more successful in learning the visual communication system (Gardner et al. 1976). It must be emphasized that those patients had used the normal vocal communication channel to interact with other people before the accidents that brought about the aphasic condition and that the patients were at least middle aged, when it is usually difficult to readapt to the usage of new communication systems.

The data reported provide a basis for the intricate hypothesis that it is the generalized semiotic capabilities upon which any sign system that is to be acquired or that is acquired already is based. These semiotic capabilities are closely related to the organism's cognitive makeup, which in its turn is closely connected to the phylogenetic and ontogenetic life history of the species and the individual organism (see Davenport et al. 1973, for data on individual environmental influences). The concrete sign systems that are invented or learned may be based on different modalities, for different species and individuals, or for the same species and individuals, if some kind of necessity emerges. Thus the fact that *Homo sapiens* predominantly makes use of the vocal channel may be considered some kind of 'evolutionary accident'; some kind of evolutionary environmental pressure has pushed that species toward the usage of the vocal channel and language, with all the consequences that result from that.

However, to emphasize the crucial role of such a global semiotic capacity may to some readers appear like reduction of the problem to *ad infinitum* constructs. Thus far we have not been dealing with the possible substrate of that capability, neither have we emphasized the difference of 'semiotic capacities' from the 'linguistic competence' construct Chomsky has used. Apart from being applied to all higher primates, our 'semiotic capabilities hypothesis' does not consider the semiotic abilities to be independent of the general cognitive development. On the contrary, it is hypothesized that semiotic abilities are very closely connected to the cognitive development, and evidently not all primates, but just the 'bright' ones among the chimpanzees and gorillas, would pass the artificial sign system training successfully (Gill and Rumbaugh 1974; Fouts 1974). What the *generalized semiotic capabilities hypothesis* emphasizes is that the concrete sign systems are just codes to be used at the input-output mechanisms of the brain and do not constitute the code which the brain is dealing with in semantic information (Bechtereva et al. 1977). Since the sign systems are input-output codes for the brain where the semiotic capabilities are represented in some form of nerve codes, they can be altered if this is necessary. The limits of that alteration evidently vary both among the species as well as among the individuals within the species. The very interesting problem of how the alteration of the input-output code will influence the cognitive characteristics of the subjects still remains to be solved.

THE RECONSTRUCTION OF HUMAN COMMUNICATION AND COGNITION PHYLOGENY

Turning to the phylogenetic aspects of the cognitive and communication characteristics of *Homo sapiens*, the question may be asked, *what do the semiotic capabilities and cognitive characteristics of the present-day apes tell us about the human being*? The most straightforward (and incorrect) view of this seems to be that in the chimpanzee and gorilla of the present-day laboratories and in the field we can observe the same cognitive and communicative characteristics our ancestors had. This kind of assumption of linearity in development from ape to man, that seems to be present in some discussions, is highly misleading. As an alternative, a hypothesis presented by Kortlandt (Kortlandt and VanZon 1969) since 1957, called the Dehumanization Hypothesis, can be outlined. Kortlandt (1967, 1974a, 1974b) has held the view that due to some natural environmental pressures, the ancestors of humans had to become adapted to life in open terrains, whereas the ancestors of the apes (chimpanzees) retreated to live in dense forests. Thus, it has been hypothesized that the common ancestor of man and the great apes could have possessed cognitive and communicative characteristics well beyond those that are used by chimpanzees in their natural habitat in the present, and indeed lower than those of present-day human language and cognition. The noteworthy 'residual intellect' of the chimpanzee (the term was coined by A. N. Severtsov) revealed in the laboratory studies of primate language learning reviewed above, and primate toolmaking (Katz 1975),.may provide some support to the idea that psychologically the natural-living chimpanzee may happen to be just a degenerate of the one-time chimp/human common ancestor.

Hypothetically, we argue that the factors which directed the development of human cognitive and communicative systems could be found in the environmental molding of man's developing behavioral and neurological characteristics. Here we are far from emphasizing the environmental role as the almighty determinant of the human phylogenetic development. On the contrary, and as the contemporary research literature on the plasticity of the nervous system and behavior in ontogenesis seems to show (Gottlieb 1976), the environmental modifications of an organism's characteristics are possible only in some genetically determined directions. However, the causes of *changes* in behavior of a species are attributable to environmental factors, though they are effective only in some directions. As it is customary for the primate species to live in groups, the environment of an individual ancestor of man should be divided into physical environment and group environment, two types of environmental factors which at some time may have independent influence on the individual, whereas at other times the changes in physical environment may have influenced the behavior of the individual via producing changes in the group environment. These environmental pressures can bring with them the need to elaborate the existing communication system and to acquire some new cognitive characteristic. These pressures, however, are effective in the course of many generations of the developing species, and, as has been demonstrated on living primates, they have their influence mostly on immature rather than adult representatives of the species. These pressures have evidently been effective on both the communication system of the species as well as its cognitive characteristics. When toolmaking emerged from natural tool-use in the anthropogenetic process, this apparently had a great but not too wide an effect on the development of the cognitive and communicative systems of developing man.

The recent success in teaching artificial sign systems to nonhuman primates and understanding more thoroughly the behavior of the great apes in the wild has resulted in wide speculation about the gestural origin of human communication systems (Hewes 1973, 1976; Wescott 1974). Although we have termed human language 'an evolutionary accident' by having it in the vocal channel, we can suggest some possible ways why human language may have developed in the direction it has, to make the picture more detailed. Firstly, let us suppose that the main difference of any new sign system for the developing human being should have better possibilities of referential communication than the previous one. As we presume, some kind of environmental change brought the need to communicate messages about some environmental objectives. As Premack (1973) has emphasized, the prerequisites for the development of referential sign systems are the breakdown in the 'shared' knowledge of the members of the group, as well as the growth in the variability of subjective preferences for environmental and other objectives. To a great extent, since developing man has always been active in *space*, the sign system should be adapted to express easily the spatial-visual characteristics of the environmental objects. The perceptual basis of language has been emphasized in the course of child language development study. Evidently the need to represent spatial relationships of the environment in the first sign system of the developing man must have been even more urgent than is the case with human ontogenetic sign system development, for there were no models of the sign system provided in the anthropogenesis. Some kind of referential information about the character and spatial characteristics of environmental objects have been seen to be communicated in the groups of present-day chimpanzees living in semifree troop conditions. Menzel et al. (1973, 1975; Menzel and Halperin 1975; Menzel and Johnson 1976) have demonstrated that chimpanzees can convey to each other referential information about the nature of some hidden object (food/snake) as well as about the quantity of the food object (more food/less food), and that the location of the environmental objects is communicated to the group members via the use of the triangulation principle. This kind of information is best of all conveyed via total body communication, including gestures and facial displays. The vocal channel is evidently less capable of coding spatial-environmental information easily, and would have been therefore much worse a medium to serve as the basis for the first referential sign system for developing human beings. To approach the problem from the point of view of that probable first sign system, the problem of coding is of central importance. As Ekman and Friesen (1969: 60) have outlined, coding of some referents of nonverbal sign systems may be intrinsic, iconic, or arbitrary. The lowest in referentiality among these principles of coding are intrinsic codes, which are not like their referents but they *are* the referents. Iconically coded signs only resemble their referents in their appearance, whereas arbitrarily coded signs have no relationship between their form and that of their referents. This classification of coding principles in sign systems seems especially convenient for the reconstruction of the first *Homo sapiens* sign system. If we look upon those classes as a continuum of iconicity of coding, a continuum from maximum iconicity (intrinsically coded signs) to minimum iconicity (arbitrarily coded signs), we can understand why a visual-kinesthetic communication channel was much better a medium for the first representational sign system to emerge than any other communication channel (particularly vocal) could have been. Actually, the total body communication and hand gestures allow a very wide range of that iconicity continuum to be used for making reference to environmental objects. Observational learning has evidently been an important information transmission means in the anthropogenesis, and in this sense any act an individual performs serves as an intrinsic sign for the others. As it becomes necessary to convey information without the execution of some act in full (as coded intrinsically), some characteristics of the act may be used (rather than the full act) which means that the user has invented an iconic sign to denote the given act. It has now been documented by investigators of sign language of the deaf (Frishberg 1975) that there exists the tendency in the history of Ameslan (American Sign Language) to become more and more arbitrarily coded. We can suppose that the general tendency for the development of sign systems is the change towards more arbitrariness in the course of the anthropogenesis and is the main direction for the development of any sign system, and that when necessary, the main communication channel may be changed to achieve greater arbitrariness of the signs. This must have taken place in the case of the vocal channel (which allows not too great a variation of the signs on the iconicity continuum, mostly at the arbitrariness end of the continuum), which in some curious way has become dominant in human communication.

Now it is necessary to clarify one point – communication between individuals of the primate species is always multichanneled, so that visual-kinesthetic and vocal channels interact in some way (see Key 1974, 1977: Ch. II, 1980). This must have been the case with the developing human being as well. Contrary to the overwhelming belief – based partly on the fact that limbic structures are active in producing primate vocalizations (Ploog 1974) – that primate vocalizations are just expressions of the emotions, it has been argued that the seemingly 'emotional' vocalizations of the chimpanzee may be much more complex in their function of interaction (Firsov 1969). Evidently it is as difficult for primate vocalizations as for primate gestures in their natural communication to reveal the functions of those behaviors in the communication process – all the more that they seem to depend heavily on the *context* of the interaction. Parallel to the development of arbitrariness of the sign system, its context-sensitivity (the dependence of the signs on some particular behavioral context) is evidently reduced. However, even sign systems of the contemporary adult *Homo sapiens* are not completely context-free; so that linguists (who used to strive for the study of 'pure' language) have to come back to the contextual functions of the words to understand the semantic functions of language (Fillmore 1976; Key 1975: Ch. VII). Together with that growth of context-independence, a behavioral phenomenon that could be called freedom of behavior has also been developing, i.e. an individual of some species, having received a message via some communication channel urging him to behave in some way, may decide not to conform to that request. It seems to be that this kind of freedom of behavior is rather well developed among the apes, which makes it very difficult to extract the meanings of some behavioral signs from the ongoing behavior. The same kind of thing may be observed in human behavior, especially in adult-infant interaction (Valsiner and Tamm 1978).

THE TRANSFER OF COMMUNICATION SYSTEM FROM MAINLY GESTURAL TO MAINLY VOCAL IN ANTHROPOGENESIS

The vocal channel, although having been rather inconvenient for the requirements of the first sign system in the anthropogenesis, becomes preferable at some point for the following reasons:

a. it permits somewhat quicker communication than the gestural system does;
b. it permits communication in darkness and across barriers;
c. it provides the sign system with the possibilities of highly arbitrary coding of the messages.

These reasons are really trivial and nonexplanatory for how the vocal channel has become the leading communication channel in *Homo sapiens.* It still remains to be explained how the gestural sign system prevalence was taken over by the vocal sign system. It has been argued that the visual-kinesthetic channel is quite plastic for new behaviors to be conditioned while the vocal channel of primates is rather rigid in the respect of novel behaviors being adapted (Tihh 1970). Besides, the vocal tract anatomy of the paleoanthropologic specimens have been found to differ from that of *Homo sapiens* (Lieberman et al. 1971; Lieberman et al. 1972; Lieberman 1976). Although these findings have been disputed on methodological grounds (Falk 1975; DuBrul 1977; Burr 1976), it may well be that the exact correspondence of sounds the developing human was capable of making were somewhat different from the sounds that modern humans make. However, this difference does not allow us to conclude that the Neanderthal type (or earlier) had no representational sign system based on the vocal channel. It has even been argued (Wind 1970, 1978) that the primates, including their peripheral vocal and auditory organs, have been preadapted to a large extent for speech long before *Homo sapiens* evolved. It is considered to be the cerebral reorganization that might have triggered the development of speech-like communication. As far as the pre-adaptation to vocal channel primacy is concerned, the data on auditory perception provide some support to this hypothesis. Nonhuman primates have been shown to possess the categorical acoustic pattern analyzing system for the perception of the phonemes of human language (Morse 1976; Morse and Snowdon 1975; Waters and Wilson

1976) which is also present among human newborns (Molfese 1977) and infants (Eimas 1975; Trehub 1976). The similarity in the acoustic perception mechanisms between humans and primates, as well as humans and other species (chinchilla) has been demonstrated by a number of investigations (Kuhl and Miller 1975; McGee et al. 1976; Sinnott et al. 1976; Dewson and Burlingame 1975). These data can be interpreted as providing support for the idea that in the course of evolution the pre-adaptation to create representational sign systems on the basis of the vocal channel has been provided by the tuning of the auditory system to some characteristics of the sounds rather than other ones (Baru 1978: 96). Thus, in the phylogeny we can presume that the articulation and auditory systems were both pre-adapted to the emergence of human speech, and that just some evolutionary environmental pressure was needed to execute that task. It is highly speculative to reconstruct these possible pressures. They must possess some characteristics in order to qualify as effective in the phylogenetic transfer to the vocal channel: (a) the rate of the changes in the environment of the developing human must have been low but continuous during a long period, and (b) the changes must have had some challenges to the existence of the developing human being. If those two criteria are valid, the explanation for the emergence of vocal-channel-based representational sign systems in the course of environmental pressures by the glaciations advocated by Jaynes (1976) may be probable. In any case, the neurological 'barrier' resisting the control of the vocal channel by higher nervous mechanisms had to be overcome. If we do not accept the rather subjective hypothesis of some kind of 'genetic mutation' having taken place (such explanations can explain everything) then transfer to the vocal channel dominance should be explained in some behavioral way. We here propose a hypothesis that the total body synchrony present in actions and communication episodes of contemporary humans and animals (Condon and Ogston 1966, 1967) may have been the behavioral basis for that transfer. The generality of this synchrony is further supported by the data obtained by Condon and Sander (1974a, 1974b) that human neonates' micromovements are synchronized in time with the segmentation of the adult's speech. Besides, it has been found that while a child of less than five years of age is speaking, covert activity can be recorded from the muscles of the whole body, not only from those engaged in the speaking activity. Thus, it is possible (as we hypothesize), that at some time period in the phylogeny of man, when the total body communication system had been in use as the medium for a representational sign system of some kind and when it appeared preferable to use a sign system less iconic and quicker in execution, the vocal channel gradually began to code the representations present in the visual-kinesthetic signs of the communicational usage. The body movement signs became associated with different vocalizations, and the vocalizations themselves changed due to the growing coordination between the channels due to the total body movement synchrony. The role of the total body movement has been convincingly demonstrated in the field of spatial sound localization study (see Alexeenko 1978), where it has been found that information from the body muscles has some kind of influence on the sound localization – i. e. on the auditory space of the subjects. We argue here that the synchrony of the total body motion used in communication situations of the developing human led the vocal channel to the coding of environmental events, thus making the vocal signs representational. After that had taken place, the body motion sign system still remained effective in some traditional cultures where we can encounter both vocal and gestural sign systems being used alternately. However, in the case of the majority of the developing human groups, the vocal channel became more effective in coding and communicating representational information, leaving the visual-kinesthetic channel only a supplementary role in the communication process – that of regulating the interaction process, providing some cues about the 'emotions' of the interactants, etc. – just as we look upon the functions of 'nonverbal behaviors' at the present time. However, the visual-kinesthetic channel of communication has not fully lost its significance of conveying representational information even in the present *Homo sapiens*, a very vocal creature. In different languages, some gestures carrying specifiable (and translatable into verbal code) meanings – emblems (Ekman and Friesen 1972; Ekman 1977; Johnson et al. 1975) – are sometimes used in the communication process either to substitute for some verbal expression, or to provide complementary semantic information to the verbal message. This shows that the vocal and visual-kinesthetic communication channels have been developing along parallel lines in the course of the evolution, and are dependent upon the necessities of the adaptation to the environment. One or the other channel served as the main medium of conveying messages in the communication process, with the support and complementation from the other. This is the reason why we earlier termed the emergence of the vocal-channel-based human language 'a historical accident' – if it were not necessary, it need not have been the vocal channel that became leading in the communication. This hypothesis of ours allows the possibility of the vocal-channel-based representational sign system to have emerged several times in the course of evolution – a hypothesis logically possible but, interestingly, seldom considered when we are speculating on the topic of the anthropogenesis. Besides, if some new 'environmental condition' (deafness, language breakdown in aphasia) emerges that blocks the usage of the vocal sign system in humans, people can switch to the usage of the visual-kinesthetic channel-based sign system for the purposes of communication. On the other hand, if some new 'environmental pressure' is present upon the life condition of the chimpanzee in the laboratory, which demands that some communicational artificial sign system be learned to communicate with humans or with another chimpanzee, the subject will manage all right if the medium is convenient and if the training procedures (the 'environmental pressure') are directed at very gradual learning of the sign system. An important fact of all these sign system developments, in the laboratory or aphasia clinic, as well as during anthropogenesis, is the interactive nature of the sign system modifications, just as Vygotsky (1956) and Premack and Anglin (1973) have argued for.

CONCLUSIONS

1. It is argued that humans and great apes possess a general semiotic capability which is related to the cognitive and communicative characteristics of the species. That latent capability can be expressed in any communication medium, either vocal or visual-kinesthetic, or some other one, dependent upon the environmental demands for the sign system used by the species to communicate and the plasticity of the channels that can be utilized for creating representational sign systems.
2. The prevailing implicit view of anthropoid apes demonstrating the cognitive and communicational capacities of the human ancestors is challenged. It is considered more probable that the common ancestors of humans and the great apes might have possessed different cognitive and communicative characteristics, which have been changed since the differentiation of the species and their habitats. The semiotic capacities of the great apes revealed in laboratory experiments on sign system acquisition and toolmaking are considered as support for that idea, put forward by Kortlandt in 1957 (Kortlandt and VanZon 1969).
3. The possibility of encoding spatial relationships of environmental objects and events into signs is considered crucial for the development of representational sign systems by the developing human. The visual-kinesthetic communication channel has some advantages in this respect, allowing a wider range of *iconicity* in the signs that constitute the sign system than the vocal channel can allow.
4. It is hypothesized that the vocal and visual-kinesthetic channels have developed along parallel lines in the phylogeny, switching the role of the main channel when necessary. The first representational sign system in developing man could have been based on the visual-kinesthetic channel, and at some point of his evolution, the functions of representation could have switched over to the vocal channel. The hypothesis of Total Body Synchrony is proposed to explain the possible shift, and the data in support for this hypothesis are reviewed.

PART VI

Theoretical Modeling of Communicative Behavior

C.F. HOCKETT

Biophysics, Linguistics, and the Unity of Science*

The purpose of this paper is to indicate certain parallels between the role of biophysics in biology and the function of an as yet unnamed specialty in the social sciences. If it turns out that the parallels are correctly delineated, then a clearer and deeper meaning can be ascribed to the expression 'the unity of science', which often is little more than a catchphrase. The term 'linguistics' appears in the title because the study of human speech has much to contribute to the 'unnamed specialty in the social sciences' referred to above – more, perhaps, than any other discipline. The nature of this contribution will be discussed in due time, but, for clarity, it is advisable to begin with a brief summary of the method and content of science; the first three sections are devoted to that.

SCIENTIFIC STATEMENTS[1]

There is general agreement on the conditions under which a statement is acceptable as a hypothesis capable of scientific testing, and on the nature of that testing. We require of such a statement, first, that it be phrased – directly or recursively – in operationally defined terms; and, second, that it be capable of serving as the basis of predictions. When predictions based on such a statement do not come to pass, the statement is false, and is revised or rejected. Statements which do not meet our requirements, however, are neither true nor false, but meaningless; insofar as possible, we try to exclude meaningless statements from our discussions.

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We may consider, for example, the statement: 'The moon is 50,000 miles from the earth'. This is built on operationally defined terms, involving the assumptions of Euclidean geometry and certain techniques of observation. It can be tested, not, it is true, with a yardstick or speedometer, but by predicting what readings certain instruments will show when certain operations are performed. Since the prediction is not verified, the statement is false.

The two requirements of operational definition and predictability are, of course, really just one requirement: predictions can be made only by specifying operations to be performed and stating what the results will be. This single requirement, with its obverse and reverse as described above, is sufficiently similar to many of our habits in everyday matters that some have been led to say 'science is organized common sense.' Like so many other well turned and oft repeated aphorisms, this says too much and too little: too much because what people call 'common sense' often has a high assay of meaningless and demonstrably false in it; too little because it hints at, without actually stating, the following important fact. Those engaged in any particular branch of science get much of their fundamental terminology – the 'nontechnical' part – from everyday life, where words like *up*, *down*, *left*, *right*, *fast*, *slow*, *one*, *two*, *three* and the like are actually defined for us, as we grow up and learn to speak, by the operational process. Such common-vocabulary words cannot be eliminated from scientific discourse – a textbook on mathematical physics never consists *entirely* of equations – and if we remember that nontechnical terms, too, are ultimately operationally defined, we shall make no such foolish attempt. On the other hand, we must not fall into the error of taking common-vocabulary words for granted. Major revolutions in science have come about when someone decided not to take some nontechnical term or phrase for granted, but, instead, to examine critically its operationally acquired meaning: witness what happened when Einstein investigated what we mean when we say 'What time is it?'

At any particular moment, the statements which pass our fundamental requirement, and which have not been proved false, constitute the working hypotheses of scientists. Within this group there is a somewhat smaller set of statements which have served as the basis for numerous predictions of a high degree of accuracy; this we may label the scientific knowledge of the moment. Between working hypotheses and scientific knowledge there is no sharp line of demarcation: a statement which up to a given time has always been involved only in predictions of a high degree of accuracy may at that time be invalidated by a new set of predictions which are not borne out. So scientific knowledge is relative, and is dated; one of the most important bits of information in any article on a scientific subject is its date of publication.

Sometimes one mentions additional criteria for the scientific acceptability of statements. There has been a hue and cry for the rejection of statements phrased teleologically. This seems hardly relevant; the terminologies of purpose, of causality, of probability, and of functional relationship are all available ways of talking about things, and we should be permitted to choose one or another of them, or invent a new one, on the basis of convenience, as long as we adhere to the fundamental requirement of operational definition and predictability. Of course, if one or another of the possible terminologies proves to be consistently confusing, in one phase of science or in all phases, then it is well that that terminology be abandoned; this may or may not be the factor responsible for the attempts to leave teleological wording behind.

It should also be obvious that only from within the framework of scientific method do we pass judgment on statements as meaningful or meaningless, as false or (for the time) true. There are other frames of reference than the scientific, involving other definitions of 'meaningful' and 'true'. Since fruitful discussion is hardly possible unless the participants agree on a consistent usage of such terms as these, it is hard to see how an argument between a person who defends the scientific approach and a person who supports some other system can ever be settled. The scientist cannot profitably quarrel with the nonscientist.

FIELDS OF SCIENCE[2]

Our body of scientific knowledge is not spread evenly over all possible subject matter. People have been led to examine this or that facet of the universe for this or that reason; at any one moment there exists a variety of scientific statements, classed roughly under such rubrics as archaeology, psychology, botany, linguistics, embryology, and so forth. It is never completely clear, at a given moment, just what relations hold between the statements of these different fields, for the operational definitions of one differ more or less from the operational definitions of another.

If the expression 'unity of science' is taken to imply something more than merely a methodological agreement between scientists in different fields, that something more is in the nature of a constant compulsion on scientists to understand the interrelationships among fields. We reverse the biblical injunction 'Let not thy left hand know what thy right hand doeth'; we require, ideally, that the entire body of scientific statement be consistent. The statements of the chemist, for example, based on one approach, and those of the cytologist, based on another, should not contradict each other. The discovery of such contradiction serves, just as do inaccurate predictions, to stimulate reinvestigation and restatement.

In the course of this search for overall consistency, a significant fact appears; it is sometimes found, from a comparison of the operational definitions of terms in two different fields, that one field is markedly more *general* than the other. One of the statements of mechanics describes the motion of a falling body. The operational definitions underlying this law do not limit its application to inanimate bodies. The same law of motion covers the fall of a stone and of a cat. It is true that not all of the statements of mechanics have been tested with animate objects, but there is presumptive evidence that those statements, insofar as they hold at all, hold for all material bodies, regardless of those differentiae between stones and cats which the zoologist counts as important. The reverse is not true: the statements of the zoologist describe the behavior of animals, but not of stones. In this sense it seems legitimate to say that mechanics is a more general field than zoology.

Similarly, physics is more general than chemistry. Chemistry is concerned only with those properties of matter which depend on valence. The chemical properties of an element are definable as those which remain invariant under all purely nuclear transformations. Not all nuclear transformations are free from effects on the valence shell of electrons, so some physical changes are accompanied by chemical changes. But the chemist qua chemist is concerned in such a case only with the chemical results, not with the nuclear changes which accompany, or (if one prefers) which 'cause' them.

Again, Newtonian mechanics, involving Euclidean geometry and Aristotelian logic, works out well for bodies of medium size moving at fairly slow velocities relative to the observer. It proves embarrassingly inaccurate for high velocities and for very small-scale phenomena. The problem therefore arises of constructing a mechanics which will account well for what is observed at high velocities and on a small scale, but which will contain within itself, as a special case applicable within certain limits, the earlier Newtonian mechanics. The new mechanics will then constitute a more general field than the old, in precisely our sense. Its geometry may be non-Euclidean, and yet operationally equivalent to Euclidean within certain bounds; its logic will perhaps be non-Aristotelian, and yet will contain Aristotelian logic as a special case.

THE REDUCTION THEORY[3]

Although preliminary examination often leads us to suspect that one field is more general than another, that impression is not necessarily right. The crucial test is the possibility of what we will call reduction. Given chemistry, which involves the fundamental term 'valence', and physics, which seems more general, can we, so to speak, 'explain' the chemist's phenomenon of valence in the terms of the physicist? Can we translate the chemist's statements into a set of physical statements which do not involve the term 'valence'?

The electronic theory of valence is an effort at such translation. We must distinguish between this particular theory and the more general theory of the reducibility of chemistry to physics. Each is a hypothesis, like any other scientific statement, but the failure of the former after prediction and experimentation would not perforce entail the rejection of the latter. The general theory could be disproved only by formulating, testing, and disproving every specific reduction theory logically possible. Such a program is not necessarily unending, for some of the specific theories would probably turn out to be testable in batches. Meanwhile the general theory of reducibility of chemistry to physics is fruitful, whereas its converse – that is, that there are chemical 'ultimate simples' – is not. For this alternative hypothesis is not subject to any direct testing; it can be proved or disproved only as a result of the outcome of experimentation based on the theory of reducibility.

Economists build up a description of the economic behavior of individuals and groups within our own Western community, and are able to make some correct predictions on the basis of their theory. The attempt, often made, to 'explain' their valid generalizations in terms of an assumed 'economic man' is not an application of the reduction theory; for the 'economic man' is not an inductive generalization, but rather simply part of the terminological apparatus economists use in describing and predicting. A reduction theory for the body of western economic doctrine would be an effort to translate the statements which constitute that doctrine into the more general terms of cultural anthropology, the statements of which are based on the observation of many different communities, not just of our own community of expanded Europe.

We must pause here to emphasize that the validity of that body of statement called chemistry, or economics – or, for that matter, hydrodynamics, linguistics, pomology, or any other field – depends in no way on the possibility of reduction to some apparently more general field. If, after all, there should prove to be chemical (or western economic, or hydrodynamic) 'ultimate simples', then so be it; the irreducible field is still a branch of science, to the extent that its methods are those of operational definition and prediction.

Now when the reduction theory is presented in terms of chemistry and physics, few, if any, objections are raised. It seems a belaboring of the obvious. Not so, however, in the cases of two other pairs of fields which seem, at least superficially, to be related much as are chemistry and physics. One of these pairs is biology and physical science; the other is human sociology and biology. Certainly on first examination human sociology seems the least general of these three, and physical science the most general. Therefore one would assume that the reduction theory ought to apply here, as in other cases, as the working hypothesis in terms of which to test the validity of the impression.

In fact, however, only some of the workers in the fields concerned have made that assumption (under one label or another). Some social and biological scientists have not concerned themselves with the problem at all, and that is perfectly legitimate, since a particular investigator may simply say 'I shall operate within such-and-such prescribed limits, and leave the problems of interconnections with other fields to other investigators'. But when the reduction theory has been discussed, in each case there has been, and still is, a controversy between two opposing points of view. For biology and physical science the label *mechanist* has been applied to the point of view which assumes the reduction theory, and the label *vitalist* to the point of view which assumes the contrary. For social science and biology, the same label *mechanist*, significantly enough, applies to the approach which assumes the reduction theory, and the term *mentalist* is used for the converse approach.

We shall see shortly that the points of view of the vitalist and of the mentalist are quite similar. This does not imply any necessary identification of the two; that is, a vitalist may be, insofar as he concerns himself with the problem, either a mentalist or a nonmentalist, and a mentalist, when he feels entitled to take a stand on the biological problem, may be either a vitalist or a nonvitalist.

The claims of the vitalists, stated in the terminology of this paper, are more or less as follows:

(1) It may be true that all of the generalizations of the physicist hold for living and nonliving matter alike. That has not yet been demonstrated; there is some reason to believe that living matter behaves in a manner contrary to some of the generalizations of physical science, based, as they have been, mainly on the observation of nonliving matter (e.g., do transformations in the cell nucleus really conform to the law of the conservation of energy?).

(2) Even if the statements of the physical scientist prove to be general in their applicability, there nevertheless remains a core of operationally and predictably valid biological statement which cannot be translated into the terms of physical science, and which therefore requires the assumption of certain biological ultimates; we may use, for these, such terms as *life*, *élan vital*, *vital essence*, *entelechy* – the terms do not matter, as long as their status is clear.

The claims of the mentalists, similarly stated, are approximately these:

(1) It may be true that all of the generalizations of the biologist (and of the physical scientist) hold for human beings and for other organisms alike. That has not yet been demonstrated; there is some reason to suspect that human beings behave in a manner contrary to some of the generalizations of the biologist, based largely on experimentation with other and simpler species.

(2) Even if the biologist's statements prove to be general in their applicability, there nevertheless remains a core of operationally and predictably valid human-sociological statement which cannot be translated into the terms of biological (and physical) science, and which therefore requires the assumption of certain human-sociological ultimates. We may use, for these, such terms as *mind*, *spirit*, *soul*, *human nature* – the terms do not matter, as long as their status is clear.

Obviously either or both of these theories may eventually prove correct. Unfortunately, neither the vitalist nor the mentalist assumption tells us what experiments to perform, what observations to make, in order to test its validity. The situation is precisely analogous to that described for chemistry and physics. It is the theory of reduction, in its specific form of the two mechanistic assumptions, which here as with chemistry and physics tells us how to conduct our investigations. Here, as there, any ultimate proof of vitalism or mentalism can come only by default.

A slightly cynical cultural anthropologist might remark that the theory of reduction meets with greater difficulty in gaining acceptance for biology and for social science than it does for chemistry in relation to physics because of man's typical anthropocentrism – the common desire of human beings to mark themselves as something fundamentally different from the rest of the universe. This remark would really be irrelevant, since we are concerned here with methods and results, not with the motivations of scientists as human beings. But in the same vein it could be countered that for those scientists who, as human beings, dislike the 'mysterious', the reduction theory strips the mystery from man, and from life itself; for those who, on the contrary, *like* the 'mysterious', it may instead be regarded as adding the 'mystery' of man to that of life, and the 'mystery' of life to that of the rest of nature. Such matters are stylistic: neither Watson's matter-of-fact *Behaviorism* nor Sir James Jeans's lonely *Mysterious Universe* are properly to be judged in this light, but rather only in terms of whatever positive scientific content they may possess.

BIOPHYSICS AND 'SOCIOBIOLOGY'[4]

The problem of describing biological phenomena in the terminology of physical science is so intricate, and of such crucial importance, that activities directed toward its solution have received a name: *biophysics*. D'Arcy Wentworth Thompson, who is virtually the founding father of modern biophysics, sets forth the fundamental problem of the field in the introductory chapter of his remarkable book *On Growth and Form*, and states the point of view and the methodology in the following words:

We may readily admit . . . that besides phenomena which are obviously physical in their nature, there are actions visible as well as invisible taking place

> within living cells which our knowledge does not permit us to ascribe with certainty to any known physical force; and it may or may not be that these phenomena will yield in time to the methods of physical investigation. Whether or no, it is plain that we have no clear rule or guide as to what is 'vital' [i. e., irreducible] and what is not; the whole assemblage of so-called vital phenomena, or properties of the organism, cannot be clearly classified into those that are physical in origin and those that are *sui generis* and peculiar to living things. All we can do meanwhile is to analyze, bit by bit, those parts of the whole to which the ordinary laws of the physical forces more or less obviously and clearly and indubitably apply.

Even in 1917, when these words were published, Thompson was able to demonstrate the partial reducibility of a number of biological phenomena to physical terms: the similarities of behavior of a cell and an oil droplet, or of a quadruped backbone and a suspension bridge, or of walking legs and swinging pendulums, all afford clues; one can hardly assay the differences until such similarities are investigated. Since 1917 much more work has been done, and it may be there is a steady decline in the amount of biological statement which remains irreducible to physics; we need hardly be dismayed if the volume of such apparently irreducible biology still remains large.

The problem of describing human-sociological phenomena in the terminology of biological (and physical) science is as intricate and as important as the problem of biophysics, and much work has been done on it; but activities directed toward this have so far received no name – or, at least, no name on which there is general agreement. That need not hamper our discussion. Since there is no generally accepted word for just what we mean, we can, for the purposes of the present discussion, coin one. On the analogy of *biophysics*, we shall speak of *sociobiology*.

We can even define the problem of sociobiology by paraphrasing Thompson's words:

> Besides phenomena which are obviously physical or biological in their nature, there are actions, visible as well as invisible, taking place within and between human beings which our knowledge does not permit us to ascribe with certainty to any known physical and biological forces; and it may or may not be that these phenomena will yield in time to the methods of physical and biological investigation. Whether or no, it is plain that we have no clear rule or guide as to what is 'mental' [i. e., irreducible] and what is not; the whole assemblage of so-called human phenomena, or properties of human beings and human groups, cannot clearly be classified into those that are physical and biological in origin and those that are *sui generis* and peculiar to human beings. All we can do meanwhile is to analyze, bit by bit, those parts of the whole to which the ordinary laws of physical and biological forces more or less clearly and obviously and indubitably apply.*

* [Note added in 1977 by CFH: For a more recent and (I think) totally independent coinage of the term 'sociobiology', in a sense very similar to that given the word in this essay, see E. O. Wilson, *Sociobiology: The New Synthesis* (Cambridge, MA, 1975).]

It is not surprising, all things considered, that no label generally agreed on has yet been assigned to the field of investigation here called sociobiology.

In the first place, it is obvious that the reduction theory cannot be applied in a field until there is a substantial body of scientific knowledge in that field itself. The status of our knowledge in social science is far from clear. That is partly because so much social study is still conducted within frames of reference other than that of science. It is partly because social scientists have until recently confined their attention almost exclusively to patterns within our own society, and so have not had an adequate basis for the extraction of the human common denominator, the patterns common to all human societies everywhere. But there is another factor, perhaps even more important. Contrary to the popular view, social science is not the easiest of the three main branches of scientific endeavor, but by far the most complex. One of the clearest bits of evidence for this is the great difficulty encountered in any effort to apply mathematical procedures in social science; the difficulty is less in biology, and least of all in physical science. Not unrelated, as evidence, is the historical sequence in which the three branches have been established; physical science first, then biology, then social science (and so one often hears that social science awaits its 'Darwin', while biology awaits its 'Einstein'). The complexity of social science also manifests itself in the intricate division of labor which now obtains, and perhaps must obtain: workers in different phases of social science have trouble enough trying to understand one another, without the superimposed problem of understanding biologists and physical scientists.

If such factors have prevented the emergence of sociobiology as a defined and ticketed discipline up to the present, it is nevertheless clear that the time must soon arrive for the overt establishment of that field. The relation between biology and biophysics has not been one-way; the relation between social science and sociobiology will not be one-way. Biophysics has served as a cogent stimulus for a wide variety of biological investigation, and has tended to unify and clarify biological science as a whole; a similar effect of sociobiology on social science would be eminently desirable.

LINGUISTICS AND SOCIOBIOLOGY[5]

Our intention now is to state some of the specific lines along which that branch of social science called *linguistics* can contribute to the solution of the problem of sociobiology.

First we must indicate the position of linguistics among the social sciences. Linguistics is a subdivision of anthropology, which we may define quite specifically, in contrast to other social sciences, in terms of the fundamental problem of anthropology: what, precisely, are those patterns of behavior which are common to all human communities everywhere, but are not shared also by any nonhuman organisms? Within this framework, what are the ranges of variation? How, in history, were these specific patterns developed, in contrast to more general biological patterns? We may similarly state the fundamental problem of linguistics: of all that is generally but peculiarly human (as determined by anthropology), what specific portion is due to language, and in what way? Of the variations within this framework, which are due to linguistic differences, which are due to the nature of language in general, which are independent of language? How, in history, has language had the function it has? In this second set of questions there is but one common-vocabulary term which needs comment: by language the linguist means to include only speech, communication by sound, to the exclusion of gesture, writing, and other modes of behavior which are sometimes loosely called 'language'; the first of these is known to be shared by all human communities which have been observed, whereas the others either are not known to be, or are known not to be.

Linguistics is only in its beginnings, and yet there is already a substantial body of achievement. These achievements, unfortunately, are almost totally unknown to the general educated public. When the subject is mentioned, most of us think first of all of the 'grammar' we learned in high school; that bears about the same relation to scientific linguistics that the ancient Greek theory of the four 'elements' bears to modern physics and chemistry. It would lead us too far astray to discuss this in detail; we shall have to assume a knowledge of the main tenets of modern linguistics just as we assumed familiarity with such matters as the electronic theory of valence earlier in our discussion.

Linguistics has, first of all, an indirect methodological contribution to make to sociobiology. We have said that social science is the most complex of the three major branches of science; of all the possible facets of human life on which one can focus, language, despite its enormous complexity, is one of the simplest. Consequently our methods in linguistics may be defined with relative ease and clarity, and there are already certain *general* results: once the necessary terms have been defined, one can speak without repetition for as long as fifteen or twenty minutes on those properties of human language common to all known human communities. There is serious question whether the list of generally valid statements about any other phase of human life would take that long to present.

But language is one part of culture – in the anthropologist's sense: patterns of behavior transmitted not through the germ plasm, but socially. Methods which have been worked out for the analysis of language ought to apply, at least in part, to the study of other phases of culture. One might propose a program in which the techniques of analysis which have been developed in linguistics would be extended, analogically, first to those human sign-systems, such as writing, which are historically and genetically derivative from language; then to whatever human sign-systems there may be (possibly facial gesture) which are not so related to language; and then to nonsymbolic phases of culture, if indeed there are any. Such an extension of linguistic methodology to other parts of cultural study, partly by those methods which have been called 'ethnolinguistics', promises to be fruitful, and to the extent that it proves so, has an indirect bearing on sociobiology.

Beyond that, linguistics has also a much more direct and important bearing on sociobiology, because of the crucial position of language in human behavior. Language is the most typically human of all man's sign-systems, and unquestionably the most elaborate sign-system to be found, either among humans or elsewhere. On the biological and physical levels, it seems probable that to 'explain' language, as well as any other human or nonhuman sign-system (here 'explain' has the meaning given to it in the earlier discussion, page 264), just two things are needed. One is the biological mechanism known as the conditioned response. That is a complex matter, but we may regard the mechanism, for sociobiological purposes, as given; further analysis of conditioned responses is the business of biology, or perhaps of biophysics, but not of social science. The other requisite is a fuller knowledge of the structure of the human organism, particularly the central nervous system, as it bears on the process of speaking and hearing. This aspect of the matter has only recently begun to come under control; in a brilliant monograph Martin Joos outlines the nature of the problem and hints at what the answer may be.

Now let us direct our attention the other way, and examine some of the things that language accomplishes. Language is the fundamental mechanism of human collective behavior, functioning for human communities – as has been said again and again – much as the nervous system functions for the various organs of a single organism. This is more than an analogy. Because of language, a stimulus to one person (say the sight of an apple) may give rise to a response on the part of a different person (climbing a fence, picking the apple, and giving it to the first person); the most complex example of human collective behavior is but a more intricate manifestation of the same mechanism. The habits and apparatus with which human beings gather or produce their biological necessities constitute *technology*; the elaborateness of collective patterns among human beings in this regard is made possible by language so that it may quite literally be said that language is the most fundamental element of human technology.

Language channels those behavior patterns which underlie, or perhaps constitute, *social structure*. If we observe a community and chart the differences in speech-forms dependent on who is speaking, to whom, and about whom, and correlate this with nonspeech behavior patterns similarly organized, the resulting chart informs us completely as to the behavior of individuals in the community relative to one another. A newcomer to the community, e.g., a newborn child, assumes a position in the social structure, and changes that position from time to time; the pattern for such transformations of social position is socially inherited, and the main mechanism for the enculturation is language. This complex of more or less stable forms of speech and associated nonspeech behavior may be regarded either as a *representation* of social structure, or, with complete validity within our operational approach, as *constituting* social structure – just as a gravitational or electromagnetic field may be regarded either as a representation of how certain objects will behave under certain conditions, or else as an actual objective 'reality'.

In economic behavior, the role of language, and of secondary sign-systems derived from or made possible by language, is essential. Exchange of commodities is hardly a uniquely human matter; different species living in symbiosis manifest something more than vaguely similar. The special (though not universal) feature of commodity exchange among humans is the equating, for purposes of exchange, of varying quantities of different commodities, an operation possible in any elaborate form only because of language. In some societies, including our own, there is the further establishment of certain specialized commodities which have, in themselves, no or very little biological value, but which serve as a means for the equating of other commodities with one another. These special commodities (coins, currency, instruments of credit) are indubitably symbolic. The absence in them of any great immediate biological value is exactly the case of the lip-and-jaw motions or the sound waves which constitute speech, and their relation to items which do have immediate biological use is also exactly the case of language. Further, the historical process by which they came into being and acquired the semantics they have is a process which involves language at every step. Symbols may come to be manipulated without much regard for what they represent biologically; when this happens with the symbols which constitute language, one has metaphysics; when it happens with economic symbols, one has high finance. Either may have significant biological consequences.

Early in this paper we spoke of predictions. A prediction is a statement (an instance of language) about something that has not yet happened, about something in the future; every known language supplies its speakers with at least a dozen or so differentiated ways of speaking about future events. We shall see that predictions are of fundamental importance in various facets of human behavior, not only in science. A contract is a prediction; so is a law; so is a court decision. Difficulty over a contract arises when the terms used therein are not operationally defined, or when their operational definitions are different to the various parties, or when the provisions for various alternative possibilities are not elaborate enough, or when the contracting parties, one or more of them, behave as though one or another of these factors were involved – or, finally, when record of the contract (the written document which is commonly, though wrongly, termed a 'contract') was either never made or has been lost, so that memories of the prediction may diverge. A law might be similarly characterized. A legal decision is a prediction; it is accurate if people have the habit of performing the operations which constitute punishment or corporation-dissolving or the like.

The nature of language and the particular quirks of specific languages shape our daydreaming and our philosophizing, and are instrumental in our errors and our neuroses. Bloomfield, describing the process by which the child acquires his speech habits, writes:

The [child's previously acquired] habit of saying *da* at sight of the doll gives rise to further habits. Suppose, for instance, that day after day the child is given his doll (and says *da*, *da*, *da*) immediately after his bath. He has now a habit of saying *da*, *da* after his bath; that is, if one day the mother forgets to give him the doll, he may nevertheless cry *da*, *da* after his bath. 'He is asking for his doll', says the mother, and she is right, since doubtless an adult's 'asking for' or 'wanting' things is only a more complicated type of the same situation. The child has now embarked upon *abstract* or *displaced* speech: he names a thing even when that thing is not present.

From 'asking for' or 'wanting' one passes on, with the great variety of terminological differentiation a language supplies, to more complicated emotional reactions; from naming things even when they are not present, one passes easily to naming things that cannot be present because they do not exist: hence the cultural channeling of emotion, institutionalization of error, the production of neurosis, daydreams, abstract philosophy.

In such matters, the differential effect of one language versus another is harder to pin down. The nineteenth-century philosophical-descriptive students of language, such as Humboldt, Steinthal, von der Gabelentz, Wundt, thought that they had discovered such differences, but much of what they had to say was based on an inadequate knowledge of the variety of language types to be found in the world, and, in addition, was based far more on a-priori speculation than on induction. We are now past this stage of easy generalization; yet there are clues. It has been proposed that the structure of Aristotelian logic is what it is at least in part because of the syntactic structure of the Greek language. It is equally possible that the Chinese tradition of the 'doctrine of the mean' is not unrelated to a certain well defined set of grammatical patterns, found in most modern Chinese dialects (though not in the artificial literary dialect), which may be old enough and deep-seated enough to have shaped the emerging philosophical doctrine some centuries ago. It has been demonstrated that the language of the Hopi Indians is far better suited, in its essential grammatical structure, to the discussion of vibratory phenomena of the kind that concerns the modern physicist so much, than is English or any other modern European language; yet it is our community that has developed harmonic analysis, not the Hopis. The followers of Alfred Korzybski emphasize this type of language influence; their control of the accomplishments of linguistics is in general not sufficiently detailed, but what they have said ought not to be written off on the grounds that they are faddists. Benjamin Whorf, who made the Hopi demonstration, and who was a well trained linguistic scientist, made some other extremely bold statements along these lines during the thirties, and his work, even if of doubtful validity in details, is of fundamental importance as a guidepost pointing towards badly needed research.

Now it would be ridiculous to claim that in such phases of human life as have been mentioned above, or others (political behavior, literature and related fields of art, magic, religion, science), language was the *only* factor making human behavior what it is. Our point is that the importance of this factor is not to be underestimated; that in taking it into consideration one cannot simply rest, as have many, upon acquiring a general notion of what linguistics has accomplished, but must devote the necessary hard labor to acquire the highly technical and precise procedures and terminology of modern linguistics; and, above all, that since this is one aspect of human behavior about which we do have some well established information, linguistics affords an excellent point d'appui for the attack on the whole field. To the extent that various phases of peculiarly human behavior, as mentioned above, can be 'explained' in terms of language, which in turn is 'explained' in terms of the conditioned response and the specific structure of the human organism, a part of the problem of sociobiology can be regarded as solved.

To emphasize the fact that linguistics is by no means a complete answer to the problem of sociobiology, we may mention a few forms of human behavior which are universal, or at least widespread, and which seem to be quite unrelated to language. Unexpectedly, perhaps, one such institution is music: out of the same mouth come both song and speech, sometimes at the same time, yet our knowledge of the latter seems not to help us in understanding the mechanisms of the former (expect perhaps methodologically). Other art forms – the dance, painting, sculpture, architecture – seem to be in the same position. It is only to the study of literature, and of the literary side of music or drama, that linguistics has any relevant contribution to make.

There are characteristically human ways of handling such general biological matters as reproduction, eating, elimination, walking, and the like, which may have no relation to the fact that man is the speaking animal. In every human community sex and reproduction are regulated, at least partly, by some more or less permanent form of family organization. Is there any correlation between man's language and his family structure, in contrast to the muteness and less permanent mating habits of the anthropoid apes? In most communities, though perhaps not in all, one eats *meals*: certain specific times are set aside for the intake of food, in contrast to the general anthropoid habit of eating whenever food is found, sometimes all day long. Was language a necessary antecedent to this? Bipedal ambulation is not exclusively human; but the precise manner of walking varies, from community to community and often from subgroup to subgroup or from individual to individual, in a way which is obviously partly culturally determined. In some communities women pointedly accentuate the breadth of the female pelvis in their gait, whereas in others women walk as much like men as is biologically possible (a contrast somewhat of this type is easily seen between female walking habits in most of Europe and in America).

Matters of this kind are just as important for anthropology and, by virtue of that, for sociobiology as are those where our understanding of language can help.

CONCLUSION

We return to our original concern: the implications of the expression *the unity of science*.

The first implication of this expression is an agreement in method, in point of view: any field of human endeavor in which those involved act in accordance with operational definition and predictability is a branch of science.

The second implication is somewhat deeper: we strive against any elementalistic acceptance of the various branches of science, or separate 'sciences', as having no necessary relation to each other except that of agreement on method. In actuality, their various subject-matters overlap, so that we must search for overall consistency.

The third implication is our acceptance, as an overall fundamental working hypothesis, of the reduction theory, with physical science as most general, to which all others are reducible; with biological science less general; and with social science least general of all.

This third implication requires the recognition of two specific borderline fields with special tasks: biophysics, already well established, which deals with the reduction of biological knowledge to physical statement; and sociobiology, which treats of the translation of sociological knowledge into biological terms.

An endeavor has been made to show that sociobiology, although never before called that, already exists; that its problems, largely through what has been learned so far about the nature of human language, are already partway toward solution; that its further development is a prime desideratum for the demonstration of the fundamental unity of science.

NOTES AND REFERENCES

1. Operationalism needs no comment; but on predictability see particularly Anatol Rapoport, 'The Criterion of Predictability', *ETC. A Review of General Semantics* 2.129–151 (1945). For scientific hypotheses as *statements* (and for many other remarks in this paper) see Leonard Bloomfield, 'Linguistic Aspects of Science', *International Encyclopedia of Unified Science* 1:4 (Chicago, 1939).

   Science as organized common sense: Thomas H. Huxley, *Collected Essays* 3.45. Operational definition of common-vocabulary terms: A. P. Weiss, *A Theoretical Basis of Human Behavior* (2nd ed., Columbus, 1929), pp. 21–23.
2. On non-Aristotelian logic, see J. von Neumann and G. Birkhoff, 'The Logic of Quantum Mechanics', *Annals of Mathematics* 37 (1936).
3. For the anthropological frame of reference for economics, see the bibliography in chap. 6 of M. Jacobs and B. J. Stern, *Outline of Anthropology* (New York, 1947).

   There is a pseudo-reduction theory which would forbid, for example, the discussion of the behavior of nations as wholes, because nations are 'really' just agglomerations of individuals, and only individuals really 'do' anything. This is well criticized by G. A. Lundberg, *Foundations of Sociology* (New York, 1939), pp. 163–172.

   The mechanist-mentalist controversy is most apparent in linguistics and psychology; see the works of Weiss and Bloomfield cited above; also the latter's *Language* (New York, 1933), esp. pp. 31–33, and his 'Language or Ideas?' in (the journal) *Language* 12.89–95 (1936). Other social scientists use terms such as *idea, mind, concept* as common-vocabulary words; the linguist must not, for part of his task is to investigate the operational definition of these terms and attempt their translation into more fundamental behavioristic language.
4. D'Arcy W. Thompson, *On Growth and Form* (Cambridge, 1917), p. 14. In the present discussion biochemistry, which from its name sounds like a borderline field, is subsumed under the term 'biophysics' insofar as its results are relevant.
5. For the results of linguistics, see the works of Bloomfield already cited, especially his book *Language*. But the most penetrating discussion of modern structural linguistic method will be found in Zellig S. Harris, *Methods in Descriptive Linguistics* (Linguistic Society of America, 1948). [When I wrote this paper I had read Harris's book in typescript, and the reference to it as just given was based on expectations. The book in fact did not appear until 1951, with the changed title *Methods in Structural Linguistics*, and with the University of Chicago Press as the publisher.]

   The generic term *sign-system* is taken from Charles W. Morris, *Signs, Language, and Behavior* (New York, 1946).

   'Ethnolinguistics': see C. F. Voegelin and Z. S. Harris, 'Linguistics in Ethnology', *Southwestern Journal of Anthropology* 1.455–465 (1945), and their 'The Scope of Linguistics', *American Anthropologist* 49.588–600 (1947).

   The physiology of language: Martin Joos, *Acoustic Phonetics* (Linguistic Society of America, 1948).

Language as the nervous system of society (and the example): Bloomfield, ***Language***, chap. 2; and his 'Philosophical Aspects of Linguistics', ***Studies in the History of Culture*** (American Council of Learned Societies, 1942), pp. 173–177.

The passage from Bloomfield is from his ***Language***, p. 30. The physiological components of 'emotions' are probably not very highly differentiated; it is our large variety of emotion-words, classifying much the same physiological reactions in terms of various social situations, that makes for complexity.

Aristotelian logic and Greek grammar: passim in A. Korzybski, ***Science and Sanity*** (Lancaster, 1941). Hopi vibration terminology: B. L. Whorf, 'The Punctual and Segmentative Aspects of Verbs in Hopi', ***Language*** 12.127–131 (1936).

H. PIERRE NOYES

The Eternal Triangle Effect[1]

Communication, whether verbal or nonverbal, is often analyzed as the flow of information between sender and recipient. This causal model, drawn from classical physics, is all too often thought to be the whole story. But we have learned from quantum mechanics that, at least in physics, the entire past history of a system is needed to interpret the present, and that even with such knowledge we cannot guarantee the absence of novelty. In this paper we present a specific example of this general feature of quantum mechanics which has, we believe, a profound analogy to a well-known behavioral situation. We offer this analogy, not as a model, but rather in the hope that it will stimulate a different type of thinking about nonverbal communication and related phenomena.

Conventional quantum mechanical theory, and its relativistic extension, are embedded in the continuous space-time of classical physics. Within this framework the theory is 'nonlocal' in the sense that the whole space-time region of events described by the wave function has to be included in the calculation. There is no way to make any clear causal separation between 'past' and 'future' that satisfies all physicists who discuss the problem. Although most physicists do not consider fundamental revision of quantum mechanics to be needed, or even desirable, this extreme nonlocality and acausality leaves many of them uncomfortable when they are confronted with specific examples. Physicists are accustomed to believe that they can manipulate apparatus freely in an experiment and then measure the result of the manipulation – even though they may have to content themselves with a statistical result obtainable only through many trials. Consequently, though physicists accept the extreme nonlocality I describe below, they shrink from drawing physical, let alone metaphysical or cross-disciplinary consequences from it.

The wave function of quantum mechanics describes the process of 'preparation of a system' and its absolute square, the probability of detecting the various particles in the system at various places with various correlations. The effect on which I base this essay uses this conventional interpretation for the specific case of three structureless particles which, pairwise, scatter (or 'interact') only when their distance of separation is within some finite range. We also assume that this 'interaction' is not modified by the presence of a third particle, or in technical terms that there is no 'three-body force'. Then, as I showed some time ago (Noyes 1969), the three-body equations predict that – in spite of the fact that the model of the interaction contains no forces in this region due to the third particle – the behavior of any pair can be radically altered by the presence of the third particle, no matter how far away that third particle is!

Discovery of this quantum mechanical effect led me to think of a behavioral analogy. Imagine two people in a room with a closed door. We study them (or in this thought experiment think of their behavior) by means they cannot detect. Their behavior patterns exhibit regularities we are accustomed to meet in pairwise conversations. Yet we all know that these regularities change abruptly if they come to believe (correctly or not) that there is a third person outside the door. This I find exactly analogous to the change in the behavior of a pair of particles when we modify the system by considering it to contain a third particle, even though the interactions are of finite range and the third particle is indefinitely far away. For obvious reasons I call this the 'eternal triangle effect' (Noyes 1970, 1971).

When I first ran across this effect in my study of the quantum mechanical three-body problem, I was startled. It is an obvious effect, and as already said, I could find no way to limit the region over which the effect must take place, even in the extreme case of strictly finite range pairwise interactions. Indeed, I found the effect so bizarre that I thought I must have made a mistake. This mistaken conviction held up my work on the three-body problem for two years. But the physics is correct, and has been independently established by others. For example, Efimov (Efimov 1971)[2] showed that for three identical particles this effect can, in a particular limit, lead to an indefinitely large number of three-particle bound states of indefinitely large size. It was subsequently shown that Efimov's effect is not restricted to identical particles, as my independent line of reasoning had already made clear must be the case.

It is instructive to see how the causal analysis of classical physics would describe the three-particle system with the same finite range interactions. In classical physics, if the masses and forces between the pairs are specified then given the angles and velocities with which a pair come together, we can predict the angles at which they emerge. Alternatively, we could determine these angles experimentally. With this knowledge, we can then predict, in the situation shown in Figure 1, what will happen when first one pair scatters, and then the other, in all cases. This is, of course, just a specific example of the causal nature of classical physics.

At first glance the quantum mechanical situation is not very different. Again we can study the scattering of pairs, and determine from them a unique function (the 'differential cross section') which predicts the angles of scattering. In this case, the prediction is only statistical, so we must make many trials in order to determine the function, or to check a prediction based on it, but this can also be the practical situation when a classical model is appropriate. The difference begins with the fact that, in the classical situation we can, in principle, go uniquely from the observed scattering (if we can follow the motion of the particles along the entire path) to the force which 'causes' the motion. But in the quantum mechanical case we are debarred in principle from making such a detailed study of the trajectory, and it can be

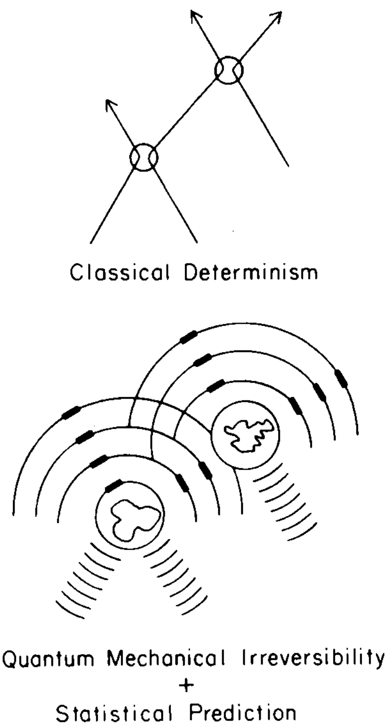

Figure 1. *The eternal triangle effect*

For classical finite range systems, study of the scattering of pairs allows a unique prediction of double scattering in a three-particle system. For the quantum mechanical three-body problem, the scattered wave from the first scattering interferes with the second scattering, making the result not only statistically unpredictable but also *novel*. Thus, the future cannot be unambiguously predicted from the past, and systems *evolve*. The effect does not fall off with the range of forces R, but instead depends on the dynamical scattering length a and its ratio to R.

proved that there are an infinite number of force laws all of which will give precisely the same fit to the two-body scattering data. Consequently, within the range of forces, the models are arbitrary empirically, and in practice must be constructed from other theoretical considerations. This leads to the second situation presented in the figure. In the first scattering, there will be some (unknown – but the same for all cases) specific wave function within the range of forces. This leads now not to emerging particles travelling in unique directions but to a probability amplitude wave. When this wave strikes the region within the range of forces in the second scattering it interferes with the process. Consequently the distribution inside the range of forces is *not* the same as it would have been for an isolated pair. Thus, empirically, we cannot predict what will happen in the second scattering because of the arbitrariness of our model. In consequence, no matter how precise our knowledge of the past, novelty can emerge. Even if we have what we believe to be a trustworthy model for what goes on within the range of force, we see that just where the first scattering takes place will have an effect on the second, and that consequently we must know the entire past history of the situation in order to perform the calculation. In contrast, for the classical calculation all we need know is the positions and velocities of the particles at any one instant of time.

This time-dependent analysis of the situation makes the behavioral analogy profound, rather than trivial. Two people change their behavior when they anticipate the presence of a third because of past cultural experience. In order to make even an educated guess about what form this change will take, we need to know their individual histories, and be familiar with their culture. In principle, we might need to know about the evolution of those cultures, of the planet on which they occur, and of the cosmos in which the planet finds its place. Thus the quantum mechanical analogy takes on aspects like that of Jung's 'collective unconscious' once we take seriously the quantum mechanical proposition that the present emerges from the past via coherent, interfering statistical processes.

Turning back to the question of what this quantum mechanical analogy might tell us about the three-person communication with which we started, it is important to distinguish two situations. In the first we have a part that can be analyzed partly in terms of a 'signal' which the pair in the room receive indicating the presence of the third vertex of the triangle – a sound, heat, a current of air, what have you. This signal may be below the threshold of conscious awareness, and hence difficult to be certain of experimentally. But the situation is still a conventional aspect of nonverbal communication involving the usual complicated interplay between unconscious, preconscious, and explicit thoughts and behaviors which make the study of the subject so difficult. The second case is more interesting. In the absence of a signal, the pair change their behavior, and sometimes correctly anticipate the arrival of the third person. When physical means of communication have been ruled out, this might be called a 'paranormal' phenomenon.

I wish I had at hand a well-documented example to show that I am dealing with a real event. But such examples are hard to come by, and notoriously difficult to make convincing to much of the scientific community. So the event I describe must be treated as illustrative and anecdotal, although I hope it will call to mind for at least some readers items from their own experience. I believe that the event was indeed real. It was described to me by a distinguished scientist, who also stated that he had the documentation to back it up. But in spite of his international reputation, and the fact that he could support the case with evidence, he had delayed (still has so far as I know) publishing the evidence for fear of his professional standing being affected.

The incident involved an anthropologist who had, after many months, gained the confidence and friendship of a shaman in the group with which he was working. One day the shaman asked him out of the blue whether he would like to know what the anthropologist's friend (at that time many thousand miles away) was doing at that moment. The anthropologist took down the description in writing, had it notarized, and wrote his friend asking him (without explaining why) to describe the friend's actions at that time. The result was startingly accurate.

It is not necessary for you to believe the story in order to ask the question, as I do, of how such a remarkable 'communication' might occur. After much rumination on the event, and after the discovery of the eternal triangle effect and its behavioral analog, I have come up with a tentative model, or rather explanatory framework. Since the anthropologist and the shaman had reached a mutual level of confidence and trust, they could to a certain extent 'share each other's thoughts' – phenomenon known to all of us, and not necessarily involving any paranormal phenomena. Further, the anthropologist knew his distant friend well, and might by similar process anticipate (unconsciously) what his friend would be doing at that time. We know of many nstances where such unconscious deductions come to us in dreams – someimes accurate and sometimes not. For the shaman to 'pick up' this knowledge or conjecture from the anthropologist need involve only the types of nonverbal communication' which are discussed in this volume, and which, hough often difficult to understand, model, or demonstrate, are again familiar aspects of human behavior. Thus, granted only the postulate that a human mind makes many accurate deductions about present happenings rom past experience – which would shock no psychoanalyst – the whole ncident can be fitted into the framework of explanatory models, that, eparately, are often accepted.

It is interesting to speculate on whether many phenomena which are called 'paranormal' might not fit into such an explanatory framework. The framework does not really 'explain' anything, of course. To account for an unexplained occurrence by saying that a human mind can make, unconsciously, very accurate deductions about what will occur ('precognition'), what another person is thinking ('telepathy'), or how an unstable system will behave (predictive 'telekinesis') is only to replace one problem with another – namely how to explain this extraordinary computational ability. But it does have the aspect of explaining a fact that is troublesome in 'paranormal research', namely that the ability is not 100% and closely tied to the emotional state of the individual. This is what we would expect, from psychoanalytic theory, of a process deeply buried in the unconscious. Coming back to the theme of this volume, such unconscious processes clearly can have an important bearing on nonverbal communication of more conventional sorts, and it is perhaps reassuring that the underlying physics warns us we should include them in our thinking about how such communications work.

My intention in this essay is not to say that quantum mechanics 'explains' paranormal phenomena by some such route. What I do claim is that quantum mechanics, in the simplest case where the phenomenon can occur (the three-particle problem with finite range interactions), *does* require both an extreme nonlocality of description when forced into an 'instantaneous' or 'static' form, and the inclusion (in principle) of *all* past events in the discussion of the current situation. I hope that this fact can provide an 'explanatory framework' within which it is easier to contemplate correlations between events so distant in space and time from each other as to make models drawn from classical physics seem inadequate or implausible.

NOTES

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2. For a more rigorous mathematical treatment see Sigal (1979).

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