

## ANIMAL "LANGUAGES" AND HUMAN LANGUAGE <sup>1</sup>

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FROM time to time, anthropologists draw up lists of the kinds of behavior common to all human beings but not shared with other species. One item found on every such list, though under various labels, is the power of speech.

It is true that human language is a remarkably powerful institution. Yet Man is by no means the only animal that carries on communication. Until we can describe in detail just how human language differs from any variety of communicative behavior manifested by non-human or pre-human species, we cannot really know how much or little it means to assert this particular human uniqueness.

So far as I can see, the only way to find out what we want to know in this area is as follows. First, we must itemize those design-features of human language which seem to be of crucial importance in making it possible for language to do what it does. Second, we must examine all the non-human systems of communication that can be found, to see to what extent each crucial design-feature of human language recurs. It goes almost without saying that in carrying out this program we must not allow ourselves to neglect any point because of its apparent triviality. Indeed, the most important items will surely tend to be hidden from our view because they are right under our noses.

My own research on this problem has so far yielded a list of seven properties of human language that seem to merit consideration. None of these is my own discovery; my role has been merely that of bringing the seven together because of their possible relevance for the particular problem, and, in some cases, of rephrasing a point in such a way as to render it easier to handle.

The first of the seven may be called *duality of patterning*. For some

<sup>1</sup> This is an interim report on a project begun during 1955-6 at the Center for Advanced Study in the Behavioral Sciences. Research continues as time allows, and a fuller discussion will eventually appear.

Although the practice is virtually unprecedented with works smaller than whole books, I should like to dedicate this article to Alfred L. Kroeber, in appreciation of his stimulation and encouragement.

reason, this seems to be the most difficult to explain. I shall therefore begin with a simple nonlinguistic example.<sup>2</sup> Suppose that Paul Revere and his colleague had needed a total repertory of several hundred messages, instead of just two. It would have been inconvenient to have had several hundred lanterns on hand in the Church tower. But it could have been agreed that each message would take the form of a row of 5 lights, each one either red, or yellow, or blue. Then only 15 lanterns would have been needed—one of each color for each position—but the system would have provided for a total of  $3^5 = 243$  different messages. We assume that meanings would have been assigned only to the whole messages, so that, for example, “red light in first position” would not have had any separate meaning of its own, but would merely have served to distinguish certain messages from others. This modified Paul Revere system would then show what we mean by duality of patterning: a set of conventions in terms of *smallest meaningful elements*—here the whole messages—and also a set of conventions in terms of *minimum meaningless but differentiating ingredients*—the three colors and 5 positions.

Any human language has this same design-feature. In English, for example, the phoneme /b/ at the beginning of an utterance has no meaning of its own, but merely serves to distinguish *beat* from *meat*, *bat* from *rat*, and so on. Phonemes are the minimum meaningless but differentiating ingredients in a language; the smallest meaningful elements are what we call morphemes.

The principle of duality is a great convenience in any communicative system where the repertory of messages must be large, since a relatively small stock of minimum meaningless ingredients can be ordered into a very large stock of combinations to which meanings can be assigned. Many human communicative systems, though not all, show duality, perhaps just because of its economy. But wherever it turns up, it seems to have been developed by analogical transfer from language. No animal communicative system on which I have information incorporates this principle. In duality, then, we may have found one genuine uniqueness of human behavior.

The second key property may be called *productivity*.<sup>3</sup> It is a

<sup>2</sup> I have published a fuller description of duality, using the same example, (Hockett, 1955). See also Martinet (1949), where the hints implicit in linguistic discussions since the Middle Ages are explicitly spelled out for the time.

<sup>3</sup> According to Wells (1949) this vital property of language was first overtly pointed out by the philosopher Bertrand Russell.

commonplace that a speaker may say something that he has never before said or heard, and be understood without either speaker or audience being aware of the novelty. That is, we coin a new utterance on the analogy of familiar ones. We build a new utterance out of parts that have occurred in previous utterances, putting them together by patterns familiar from previous utterances. Since the audience, as well as the speaker, has had previous experience with the parts and patterns, the new combination is understood.

Gibbons, reported to be the noisiest of our near kin, seem not to do this (Carpenter, 1940). They have a repertory of some dozen different calls, but no matter how novel may be the situation in which a gibbon finds himself, he is constrained to respond to it with one or another of this small finite set: he does not coin a new call by putting parts of old ones together.<sup>4</sup>

But productivity is not unique to human beings. It recurs in bee dancing (von Frisch, 1950). A worker can report a source of nectar at a location which neither she nor her coworkers has ever visited before. The mechanisms involved are quite different, but at the moment this is irrelevant.

The third property is *arbitrariness*.<sup>5</sup> A message means what it does *iconically* if it resembles its meaning in physical contours, or if the whole repertory of possible messages shows a geometrical similarity to the whole repertory of possible meanings. Otherwise the semantic relationship is arbitrary. Human language is almost wholly arbitrary. For example, there is no similarity between the sound of the word *dog* and the sight, sound, or smell of a dog. Nor is the difference between the sounds of the words *dog* and *cat* in any way similar to the difference between dogs and cats. In this framework, onomatopoetic forms constitute only faint traces of iconicity.

By contrast, bee-dancing is iconic. The rate of the dancing is inversely proportional to the distance from hive to source of nectar,

<sup>4</sup> A gibbon may vary the intensity and duration of a single call. This, however, finds its human counterpart not within language but in the nonlinguistic (though communicatively relevant) variations of volume, pitch, tempo, and tone-quality which accompany the linguistic ingredient in speaking. See Trager, (1958).

<sup>5</sup> Arbitrariness and iconicity have been the source of more trouble than any other aspect of communicative behavior, from the medieval dispute between "realists" and "nominalists" down to the present. Yet Charles S. Pierce made the distinction quite clearly in the nineteenth century; and Saussure (1916) took the arbitrariness of linguistic symbols as one of the cornerstones of his work.

and the angle between the line of dance and the vertical is directly proportional to the angle between the line of sight to the sun and that to the source of nectar.

The contrast between arbitrary and iconic is also exemplified by digital and analog computers. An analog computer is often beautifully adapted for a narrow function and worthless for anything else. Just so, bees can talk about nectar and hive-sites; human beings can talk about anything.

Yet arbitrariness is not a human prerogative. It characterizes gibbon calls, and probably most other vocal systems among mammals and birds (King, 1955).

The fourth property is *interchangeability*.<sup>6</sup> Any speaker of a language is theoretically capable of saying anything that he can understand when someone else says it. Actual limitations on this theoretical interchangeability are practical or accidental, imposed by institutionalizations of social roles or by pathologies of individual capacity. So likewise, it would seem, for gibbon calls and for bee dancing. But in some systems there is not even theoretical interchangeability. In the signalling of certain fish, male and female sticklebacks, during courtship, it is inherently impossible for roles to be exchanged (Tinbergen, 1953).

The fifth is *specialization*. An act cannot be communicative unless it involves *triggering* (Bloomfield, 1942). But any act, merely as physical activity, also has direct *energetic* consequences. When these two kinds of consequences are unrelated, we say that the communicative system is specialized. When sticklebacks are courting, an essential ingredient in one of the signals from the female is her seasonal appearance, with abdomen distended by roe. The direct consequences of this distension are obviously closely related to the trigger consequences in the male's behavior, and so the system is unspecialized. When Mrs. Jones calls out "Dinner is ready," her family are triggered into coming to the table; but the direct consequences of her action are only some minor flurries in the air, damping out with a tiny rise in the temperature of air and walls. Here we have a high degree of specialization.

The sixth property is *displacement*. We can speak about sticklebacks, or about shoes and ships and sealing wax, when none of those things

<sup>6</sup> So far as I know, this is the first overt discussion of interchangeability and of specialization (the next property to be treated). These properties of human language come into view only when one examines certain types of animal interaction which lack them—types of interaction which many scholars would refuse to subsume as "communication" at all.

are around. Our speech can be removed in space and time from what we are talking about. Bee-dancing is also displaced: the worker goes back to the hive to give her report. Gibbon calls are reported not to be displaced. If a gibbon finds food, he stands by it and emits the proper call to the rest of the band.

The seventh property is *cultural transmission*. A behavior pattern is transmitted culturally if it is not only learned but *taught*, and if the teaching behavior, whatever it may be, is also learned rather than genetically determined.<sup>7</sup> Human language is transmitted in this way, as are many other facets of human life. There is evidence for culture of a rather thin sort among the hominoid apes, and even stronger evidence in the case of waterfowl (Hochbaum, 1955), but it is not clear in either case that it is the *communicative* systems of the species that are so transmitted. Thus it may be that gibbon calls are passed down genetically, even if in some other connections gibbons, like chimpanzees, show traces of culture. For bees, we can be almost certain that genetics rather than culture is involved.

There are other universal properties of human language that might be considered, and there are certainly a great many animal communicative systems about which we are as yet in total ignorance. However, I am now going to venture a historical hypothesis based on the partial findings, fully cognizant that subsequent research may upset it.

The proto-hominoids, common ancestors of the hominoid apes and ourselves, lived some ten to fifteen million years ago.<sup>8</sup> It seems reasonable to suppose that they had a vocal-auditory communicative system something like that of present-day gibbons, characterized by specialization, interchangeability, and arbitrariness, properties which we may suspect were inherited from early mammalian times. It would also seem reasonable to suppose that they had a small amount of cultural transmission, though perhaps not in the domain of their most highly developed communicative system.

This proto-hominoid system was the precursor of human language. In order for it to evolve into genuine language, it had to develop four new properties. Of these, I believe the first to develop was productivity,

<sup>7</sup> Note that if we drop the requirement that the teaching behavior itself be learned, the transmission may be what the geneticists call a "maternal effect," and thus basically genetic.

<sup>8</sup> Based on the antiquity of *Proconsul*, who may have been our remote uncle or up-generation cousin rather than direct ancestor, but is nevertheless the nearest to a proto-hominoid so far discovered.

because it is easier to explain the inception of the other three if productivity came first, and not impossible to account for the development of productivity in the absence of the other three.

An unproductive system, with a finite repertory of signals, can be rendered productive only by one mechanism with which we are familiar: a mechanism known to linguists as *blending*. In blending, a speaker confronts a situation partly like two different types of situations previously experienced. He starts to say two words at once, and comes out with something different from either but partly similar to both. An example is Lewis Carroll's *slithy*, based on *lithe* and *slimy*. Conscious planning, however, is not necessary: I once hesitated between "Don't shout so loud" and "Don't yell so loud," and actually said "Don't shell so loud." A number of English words are known or suspected to have originated in this way.

I imagine that in pre-human times our remote ancestors would occasionally produce such blends, perhaps under the stress of unusual circumstances, despite the fact that their repertory of vocal signals was basically closed. Probably in thousands of cases no one responded appropriately, the blend being too radical an innovation to be intelligible. But sooner or later a few blends were communicatively successful. As soon as this happened, the closed circle was broken, and productivity was on its way.\*

The conventions of the earlier unproductive system could be transmitted genetically, and perhaps were. But productivity, conjoined to arbitrariness, implied that members of the species were acquiring new habits from each other. It seems to me that this must automatically have called into play any capacity for culture our ancestors of the time had. Also, the more flexible communicative system had considerable survival value, and bestowed survival value on the capacity for culture (and thus perhaps also, indirectly, on increased cranial capacity).

Given arbitrariness, productivity, and cultural transmission, the young had to learn the conventions of the system before they could use it. As soon as the young were sometimes taught a habit out of the exact context in which the response would normally be evoked, circumstances were ripe for the development, or sharp increase, of displacement. The innate capacity to learn to *imitate*, outstanding in hominoids though most fully developed in Man, must have helped here.

\* An innovation consisting of two old signals in immediate juxtaposition counts, in the case of a closed system, as one kind of blend.

Finally, increasing productivity led to the development of duality of patterning. The exact causal connection is not clear, but I shall speculate. As the once closed system came to have a larger number of minimum meaningful elements, the latter came to be more and more similar to each other in physical contours. In time an impasse was reached. Further increase in their number would surpass the discriminatory powers of the speakers, if they had to keep the signals apart by listening to them as wholes. But this impasse could be avoided by paying attention to the smaller constituent features of sound occurrent in the wholes. It is only after the fact, of course, that we can know that the second alternative was followed. This line of reasoning derives, rather dangerously perhaps, from an observation of the language-learning process of contemporary children. Some children acquire rather large vocabularies, with excellent pronunciation; but then suddenly seem to discover that words are kept apart by constituent sounds rather than holistically; their pronunciation then deteriorates for a period, and the rate of vocabulary-learning is slowed, until they build up the necessary skills for producing and distinguishing phonemes.<sup>10</sup>

These successive evolutionary changes, leading to genuine language, presumably did not begin more than 10 to 15 million years ago, since our nearest non-human cousins do not show the consequences; they may have begun much earlier. They were concluded at least 50,000 years ago, and may have been completed much earlier. This second date is based on a rough estimate of the time which would have been required for all the languages of the world today to have differentiated from a single parent language, on the assumption that they are all related. I do not recommend this assumption, which is highly dubious; but it affords us our only way of directly estimating a *terminus ad quem*. Indirect inferences, based on archeological reconstructions of paleolithic life, would suggest a much earlier terminal date. Quite possibly *Pithecanthropus*, if not *Australopithecus*, shared with *Homo* the power of speech.

<sup>10</sup> Again, in the history of the Chinese writing system it early became necessary, for mnemonic reasons, for new characters to be partly similar in visual shape to old ones. Here, however, full-fledged duality was never reached.

## LITERATURE CITED

- BLOOMFIELD, LEONARD 1942 Philosophical aspects of language, in *Studies in the History of Culture*, George Banta Publishing Company, Menasha, pp. 173-177.
- 1933 *Language*, Henry Holt, New York.
- CARPENTER, C. R. 1940 A field study of the behavior and social relations of the gibbon, *Comparative Psychology Monographs*, 16, No. 5.
- HOCHBAUM, H. ALBERT 1955 *Travels and Traditions of Waterfowl*, University of Minnesota Press, Minneapolis.
- HOCKETT, CHARLES F. 1955 "How to Learn Martian," *Astounding Science Fiction*, 55 (May): 97-106. Reprinted in GREENBERG, MARTIN, ed., *Coming Attractions*, New York, 1957.
- KING, JOHN A. 1955 Social behavior, social organization, and population dynamics in a black-tailed prairiedog town in the Black Hills of South Dakota, *University of Michigan Contributions from the Laboratory of Vertebrate Biology*, No. 67.
- MARTINET, ANDRÉ 1949 La double articulation linguistique, *Travaux du Cercle Linguistique de Copenhague*, 5: 30-37.
- SAUSSURE, F. DE 1916 *Cours de Linguistique Générale*, edited posthumously by CHARLES BALLY and ALBERT SECHEHAYE, Payot, Paris.
- TINBERGEN, N. 1953 *Social Behavior in Animals*, Methuen, London, and John Wiley, New York.
- TRAGER, GEORGE L. 1958 Paralinguage: a first approximation, *Studies in Linguistics*, 13: 1-12.
- VON FRISCH, KARL 1950 *Bees, their Vision, Chemical Senses, and Language*, Cornell University Press, Ithaca, New York.
- WELLS, RULON S. 1949 *Language*, 25: 323.