Why I Consider Myself a Cybernetician[1]

At the beginning of the sixties, before the foundation of an American Society for Cybernetics was first contemplated, I was working in Italy on a project in computational linguistics. The place where this work was being done, was called *Centro di Cibernetica;* but since I had only a dim notion of what cybernetics was supposed to be, I did not think of myself as a cybernetician. The fact that I was there, was due to a sequence of accidents which, in retrospect, could perhaps be regarded the result of communication and control. At the time, they seemed more like divine providence. That I was able to form my own research group in Milan, a few years later, was also due to extraordinary circumstances.

In those days, the *Information Sciences Directorate*, a division of the *US Air Force Office of Scientific Research*, was sponsoring research in many different areas, some of which, like computational linguistics, had only the vaguest connection with military objectives. The Directorate was run by Harold Wooster and Rowena Swanson, two outstanding individuals who were in many ways the opposite of what you have come to expect of administrators, let alone military administrators. They were both highly imaginative, widely read and cultivated, and enthusiastically open to new and controversial ideas. They were ready to support a project on sentence analysis based on ideas that were diametrically opposed to Chomsky, who was just becoming the high prophet of linguistics.[2] In fact, we were analyzing the relations that link words in sentences in terms of conceptual elements, i.e., *semantically*.[3] And we were developing a computer program that was beginning to do this, but we still did not think of ourselves as cyberneticians.

When the Air Force funds for research abroad began to dry up, Harold and Rowena suggested to some of their European protégés that continuation of their work could be supported in the United States. That is how I and the small team I had assembled decided to move to Athens, Georgia.

Athens – as Rowena put it – was to become "the M.I.T. of the South". Warren McCulloch was to spend two months of the year in Athens, Heinz von Foerster was to run a large project there, and we were to keep the home fires burning while the giants were busy elsewhere.

As it turned out, Heinz came on two brief visits, Warren did not come at all, and at the end of 1969 our institute was wiped out in Mr.Nixon's first economy drive. However, our work was apparently deemed sufficiently cybernetic for me to be invited to join the American Society for Cybernetics when it was founded. Had someone asked

me why I considered myself a CYBERNETICIAN, I would have been hard pressed to find a plausible reply.

A few years later, however, the work of Gregory Bateson provided me with an answer. In one of his essays in *Steps to an Ecology of Mind*[4] he throws out the idea that the theory of evolution is not a causal theory but a cybernetic one, because the "effects" in this theory are not the result of causes, but are shaped by *constraints*.

This fitted well with some observations I had made about communication. Having grown up not in one, but *between* several languages, gave me, as I later realized, a privileged position for thinking about communication. For if you live between languages, you cannot help noticing that you are operating between different sets of constraints. Hence I felt I had at least *one* cybernetic root.

I had also come across Claude Shannon's theory, and in the first two pages of his famous paper on *The mathematical theory of communication*,[5] he mentions that *meaning* does not travel from a sender to a receiver. The only thing that travels are changes in some form of physical energy, which he called "signals". More important still, these changes in energy are signals only to those who have associated them with a code and are therefore able, as senders, to *encode* their meanings in them and, as receivers, to *decode* them. Too often, in discussions on communication, it is overlooked that the initial code of a particular communication system cannot be established *within* that system but has to be arranged by other means. The communication system we call "natural language" is no different in that regard.

Until a child's vocabulary is rich enough to cover a variety of concepts and conceptual relations, the meanings of new words cannot be explained to that child. That is the first and most stringent reason for the claim that each user of a language must build up meanings for him- or herself. The meanings of words and phrases, consequently, are essentially subjective – even if the constraints of social interaction then compel individuals to adapt their meanings to fit a more or less common usage.

The claim that a language user's semantic basis is subjective, usually comes as a shock to anyone who has grown up with one native tongue. They find it hard to believe because their language seems to be working remarkably well in their interactions with others. If, however, you grow up switching language several times a day because you live, as I did, among native speakers of different languages, you gain a different perspective. You cannot help realizing that the world a native speaker of, say, German experiences and talks about is noticeably different from the world of a native speaker of Italian; both their worlds are different again from those of a Frenchmen or a Briton – let alone a native speaker of American English. Even the everyday things a young man like myself might have been interested in – things supposed to be common to all languages, like cars, mountains, girls, and food – are not quite the same in the experiential worlds of speakers of different languages. Having noticed this, you also begin to suspect that the concepts associated with words are not the same from person to person in one and the same language.

This raises a troubling question: if concepts are not fixed and universal, how does a child ever learn to *decode* the signals of the language in which it grows up? The occasions in which adults explain the meanings of words to their children are fairly rare. Even when they do, there are only two ways they can do it: either they define what they are talking about by using other words which the child already knows – but

this they cannot do at the beginning; or they simply point to what the word "refers" to, i.e., they define by ostension.

It is obviously this second way that may help the child towards language acquisition. Ostensive definitions are usually considered to be unproblematic. I think this is so because many of the people who have been interested in studying language acquisition are native speakers of *one* language, and therefore what is being pointed to seems perfectly clear to them. You point at a thing, the child looks in the direction you indicate, and the child sees the thing — because the thing *is there*, just as *you* see it.

I would like to suggest that this is a mistaken oversimplification. What the adult sees and what the child sees are not at all the same thing. In fact, it could not be the same thing, be-cause for the adult the conceptions of things are shaped by a variety of experiences the child has not yet had. In principle, this is similar in the case of two adults, because one person's experiences are never the same as another's. Thus, when you are told that a particular word *means* "that thing over there", the word's meaning, *for you*, becomes what *you* see — and what you see is not what the other sees. What *you* see is what you have learnt to isolate in your own visual field, by handling things, pushing things, avoiding things — in short, by interacting with your own experiential world, not with anyone else's. And although, as a child, you may have learned the ways you handle, push, and avoid things, to a large extent by copying what *you think* the adults do among whom you are living, this, too, is a subjective enterprise.

Even monolinguals, when they grow up, sometimes discover that what they thought those others were doing is not what *they* thought they were doing. So they may become aware of discrepancies between their use of certain words and other people's. But since they have to interact not only with things but also with other speakers of the language, they adapt their meanings as best they can to the meanings they believe others to have in their minds. Quite often this leads to the feeling that one "sees things their way". But, as most of us discover, the need for adaptation never ends. In fact, as you advance to old age, you realize how much you are alone in your conceptual world.

On the strength of all this, I came to believe that the meanings we attribute to words and phrases, and to whole speeches and texts, are meanings, or built up of meanings, that we ourselves have generated in our own experience. They are the result of "self-regulation" — and the study of self-regulation is an integral part of cybernetics.

This brings me to my second and, I think, far more important cybernetic root. The person who, in this century, has laid the foundation to the study of cognitive self-regulation, was Jean Piaget. His often quoted maxim, *intelligence organizes the world by organizing itself,* does not seem to have been taken very seriously by many of his expounders and interpreters outside Geneva. I suppose it remains a rather abstract statement until it is taken together with the other guiding principle that pervades Piaget's work, the principle that knowledge has *an adaptive function, not a representational one.*

Piaget did not start out as a psychologist or as a philosopher. He started out as a biologist. When he speaks of "adaptation" or "adaptedness", he uses these terms in their original biological sense. To understand him, one has to have a clear idea of what adaptation meant to Darwin, Mark Baldwin, and others who influenced Piaget during

his formative years. This meaning is not at all abstract but practical. Any organism that manages to *get by* the constraints set by its environment is adapted.

When Piaget applied this notion to the activity of *knowing,* he stepped out of the epistemological tradition of the Western world. Knowledge was no longer expected to provide a "true" picture of an absolute reality — something the sceptics of all ages had shown to be impossible. Instead, it was to be seen as a means towards the organism's *equilibration*.

I shall not bore you with a detailed exposition of Piaget's theory of equilibration.[6] But I do want to suggest that this theory, too, is essentially a cybernetic theory. Norbert Wiener defined cybernetics as "control and communication in the animal and the machine".[7] Let me first focus on the notion of control. For Piaget, knowledge is adaptive insofar as it enables us to *control* experience and to maintain our equilibrium. I hasten to add that "equilibrium" is a multileveled concept that covers survival on the physical/biological level as well as coherence and non-contra-diction in the conceptual sphere.

This is one of the points where, I think, Humberto Maturana and Piaget are in agreement. Maturana speaks of "effective action" — and it is easy to translate "effective action" into Piaget's terms as any action that maintains or restores the actor's equilibrium.

And there is another connection that may be worth making. Bill Powers, who has developed his own theory of control, frequently points out that there are always two ways of counteracting an "error signal". On the one hand, an organism can try to act so that what it perceives changes towards the reference it has chosen; on the other, the organism can change the reference so that it fits what it perceives.[8] In general terms, the reduction of an error signal is always a move towards equilibrium. By the way, that there are two ways of reducing error or perturbation is, of course, a feature psychotherapists know quite well. When something upsets you, you may try to change either that thing or your conviction that it is upsetting. — So much for the cybernetics of control.

That leaves the question of communication. Earlier I suggest-ed that we adjust the meaning we attribute to words when we discover that we have it "wrong". We adapt to the constraints imposed by the way we think other speakers use language. But when we feel we are using words "right", when we are being "understood", we should not allude ourselves that we have come to *share* the meanings of those others whom we believe we understand — we have merely avoided noticeable discrepancies in the context of the particular situation.

This may sound like splitting hairs, but in my way of thinking that split is of great importance. Compatibility does not imply identity, it merely implies *viability* in the given circum-stances. That is why, after having used a word in a particular way for fifty or more years, we may discover that it is not quite the way others are using it — it is just that the circumstances in which we have so far used the word happened to be such that they did not bring out any differences.

If you accept this view, it radically changes the convention-al notion of "understanding" in linguistic communication. Rather than believing that an idea, a chunk of "information", or quite generally, a specific conceptual structure has been communicated from one person to another, we shall have to say that the listener or

reader has generated a conceptual structure which, as far as we can see at the moment, seems to be *compatible* with the linguistic context, the situation in which it was uttered, and the model we have been able to construct of the other's experiential world. This compatibility is, again, a fitting within constraints, and not a replica of what is in the other's mind.

From my point of view, then, what Bateson remarked about the theory of evolution is equally applicable to the *construction of knowledge*, to our *acquisition of language*, and to any interaction that we might want to call *communication*. None of these developments or activities can be explained in terms of causes, but we can go a long way towards explaining them in terms of constraints. For me, therefore, the world in which we find ourselves living, is the world that we have been able to build and maintain within the constraints we have so far experienced. – What could be more cybernetic than this?

Hence, I do consider myself a cybernetician, because I believe I have come to adopt a cybernetic way of thinking.

In retrospect I realized that, without knowing it, I had tended that way long before cybernetics was invented. I became aware of this in the many conversations with students who were worrying about their future and asked for advice. I heard myself telling them that it was far more important to know what one did *not* want to do, than to have detailed plans of what one did want to do. One day it dawned upon me that this was plain cybernetic advice: *It is more useful to specify constraints rather than goals.* – And then I explained it by adding that in one's teens or twenties one usually has already discovered a number of things that one cannot stand, whereas it is quite impossible to foresee what, ten or twenty years later, will provide the satisfactions needed to maintain one's equilibrium.

Footnotes

1. This paper is a revised and expanded version of an introductory address at the Annual Conference of the American Society for Cybernetics, Amherst, MA, July 17, 1991.
2. Noam Chomsky, *Syntactic structures*, The Hague: Mouton, 1957.
3. cf. E.v.Glasersfeld, A project of automatic sentence analysis, *Beiträge zur Sprachkunde und Informationsverarbeitung,* 1964, 4, 38–46.
4. Gregory Bateson, Cybernetic explanation, in *Steps to an ecology of mind,* New York: Ballantine, 1972.
5. Claude Shannon, The mathematical theory of communication, *Bell Systems Technical Journal, 27*, 379–423, 623–656.
6. This theory is outlined in Piaget's *Biologie et connaissance* (Paris: Gallimard, 1967) and *L'équilibration des structures cognitives* (Paris: Presses Universitaires de France, 1975).
7. Norbert Wiener, *Cybernetics,* Cambridge, MA: M.I.T. Press, 1948.
8. William Powers, *Behavior: The control of perception,* Chicago: Aldine, 1973.