

Aspects of Radical Constructivism*

The main difference between science and religion, we were told in school, is that religion is founded on a dogma that is absolute and immutable because it stems from divine revelation, whereas science is tentative because it develops theories that are always open to refutation by new findings or novel experiments. Scientists, therefore, are supposed to be open-minded and to welcome the solution of stubborn problems, even if the new solutions entail a change of thinking and the demise of concepts that seemed well established in the past.

A look at the history of scientific ideas, quickly shows that scientists do not always live up to this ideal open-mindedness. The concepts and methods they grew up with frequently seem to be as unshakable as any matter of religious faith, and the perpetrators of innovation tend to be treated as heretics. This happened to Darwin and his theory of evolution, to Einstein when he first published the theory of relativity, and it happened to Alfred Wegener when he suggested the idea of continental drift. In these spectacular instances the break with tradition advocated by the new theory was unmistakable and, consequently, triggered violent indignation on the part of those who were anxious to maintain the familiar established dogma. The new theories won out eventually, because they enabled scientists to do things they had not been able to do before and to cover a larger area of experience with fewer assumptions.

In philosophy, the pattern has been different, especially with regard to the problems of epistemology, i.e., those concerning knowledge, its origin, and its “truth”. These problems remained unchanged and unsolved, and they have troubled Western philosophy for more than 2500 years. It is an historical fact that some of the pre-Socratics, the philosophers who wrote before Plato’s reports of the Socratic dialogues, had already seen the basic epistemological crux. Its source can be found in two presuppositions that have always seemed natural and inevitable:

a) that a fully structured world *exists* independently of any experiencing or knowing human subject;

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b) that the human subject has the task of finding out what that “real” world and its structure are like.

These assumptions inevitably lead to a paradox. Whatever a human subject perceives or conceives is necessarily the result of that human subject’s ways and means of perceiving and conceiving. There is no way of comparing the results of these activities with what might exist independently, because the only access to the presumed “reality” would be through yet another act of perceiving and conceiving.

Throughout the Western history of ideas, the sceptics have not ceased to reiterate this irrefutable logical argument, but it has not deterred philosophers from trying to find a way around the impasse.

Michel de Montaigne is often listed among the sceptics, but this is a little misleading. He actually used his outstanding wit and erudition to defend the realm of religious faith against the threat of the *Pyrrhoniens*, a group of 16th-century thinkers in France, who had rediscovered Sextus Empiricus and his account of Pyrrho, the father of scepticism in the Hellenic world. Montaigne merely cut down to size the efforts of human reason in order to safeguard the power of faith. He put it as concisely as one can:

*La peste de l’homme, c’est l’opinion de savoir.*¹

The translation that to me seems the most adequate, would be: Mankind’s plague is the conceit of knowing.

Principles of Constructivism

Radical constructivism is an effort to eliminate that conceit. It does not deny the possibility of knowing, but it strives to show that knowledge is not the commodity the tradition of Western philosophy would have us believe. Indeed, constructivism is a theory of active knowing, not a conventional epistemology that treats knowledge as an embodiment of Truth that reflects the world “in itself”, independent of the knower.

The two basic principles of radical constructivism are:

1) Knowledge is not passively received either through the senses or by way of communication, but it is actively built up by the cognizing subject.

2) The function of cognition is adaptive and serves the subject’s organization of the experiential world, not the discovery of an objective ontological reality.

To adopt these two principles means to relinquish the pillars of a venerable conceptual network. It means stepping out of habitual pathways and reconceptualizing a very different rational view of the world. In short, it involves a good deal of thinking and, as Bertrand Russell once said, people would rather die than think, and they do.

The stumbling block is perhaps this: the sceptics’ arguments have always focused on the negative. By reiterating that true knowledge of an objective world is impossible, they have helped to perpetuate the idea that knowledge, in order to be good knowledge, would *have* to be a “true” representation of the real world.

During the last three decades, however, symptoms of change have appeared. It is not the first time that scientific developments are having an influence on the professional thinking of philosophers, but I believe it *is* the first time that scientists are raising serious questions about the kind of epistemological assumptions philosophers have been making. The disruption shows itself in the discipline that has

become known as the Philosophy of Science, and awareness of the trouble was spread to a much wider public by Thomas Kuhn's book *The structure of Scientific Revolutions*. There, for everyone to read, was the explicit statement:

... research in parts of philosophy, psychology, linguistics, and even art history, all converge to suggest that the traditional epistemological paradigm is somehow askew. That failure to fit is also made increasingly apparent by the historical study of science... None of these crisis-promoting subjects has yet produced a viable alternate to the traditional epistemological paradigm, but they do begin to suggest what some of that paradigm's characteristics will be. (Kuhn, 1970, p.121)

While the troubles of the "traditional epistemological paradigm" have shown no sign of subsiding in the years since Kuhn's publication, one could not honestly say that any substitute has been generally accepted. In most Departments of Philosophy, Psychology and Linguistics, and in the Schools of Education, teaching continues as though nothing had happened and the quest for immutable objective Truths were as promising as ever. For some of us, however, a different view of knowledge has emerged, not as a new invention but rather as the result of pursuing suggestions made by much earlier dissidents. This view differs from the old one in that it deliberately discards the notion that knowledge could or should be a representation of an observer-independent world-in-itself and replaces it with the demand that the conceptual constructs we call knowledge be viable in the experiential world of the knowing subject.

Ludwik Fleck, whose monograph of 1935 Kuhn acknowledged as a forerunner, wrote an earlier article in 1929 that went virtually unnoticed and that already contained much that presages what some philosophers and sociologists of science have been proposing in recent years:

The content of our knowledge must be considered the free creation of our culture. It resembles a traditional myth (Fleck 1929, p. 425).

Every thinking individual, insofar as it is a member of some society, has its own reality according to which and in which it lives (p.426).

Not only the ways and means of problem solutions are subject to the scientific style, but also, and to an even greater extent, the choice of problems (p. 427).

The notion of cognitive construction was adopted in our century by Mark Baldwin and then extensively elaborated by Jean Piaget. Piaget's constructivist theory of cognitive development and cognition, to which I shall return later, had, unbeknownst to him, a striking forerunner in the Neapolitan philosopher Giambattista Vico. Vico's epistemological treatise (1710) was written in Latin and remained almost unknown.² Yet no present-day constructivist can afford to ignore it, because the way Vico formulated certain key ideas and the way they were briefly discussed at the time, is, if anything, more relevant today than it was then.

The Nature of Knowledge

One of Vico's basic ideas was that epistemic agents can know nothing but the cognitive structures they themselves have put together. He expressed this in many ways, and the most striking is perhaps: "God is the artificer of Nature, man the god of artifacts." Over and over he stresses that "to know" means *to know how to make*. He substantiates this by saying that one knows a thing only when one can tell what components it consists of. Consequently, God alone can know the real world, because He knows how and of what He has created it.

In contrast, the human knower can know only what the human knower has constructed.

The anonymous critic who, in 1711, reviewed Vico's first exposition of a thoroughly constructivist epistemology, expressed a minor and a major complaint. The first, with which any modern reader might agree, was that Vico's treatise is so full of novel ideas that a summary would turn out to be almost as long as the work itself (e.g., the introduction of developmental stages and the incommensurability of ideas at different historical or individual stages; the origin of conceptual certainty as a result of abstraction and formalization; the role of language in the shaping of concepts). The reviewer's second objection, however, is more relevant to my purpose here, because it clearly brings out the problem constructivists run into, from Vico's days right down to our own.

Vico's treatise *De antiquissima Italorum sapientia* (1710), the Venetian reviewer says, is likely to give the reader "an idea and a sample of the author's metaphysics rather than to prove it." By proof, the 18th-century reviewer intended very much the same as so many writers seem to intend today, namely a solid demonstration that what is asserted is true of the real world. This conventional demand cannot be satisfied by Vico or any proponent of a radically constructivist theory of knowing: one cannot do the very thing one claims to be impossible. To request a demonstration of Truth from a radical constructivist shows a fundamental misunderstanding of the author's explicit intention to operate with a different conception of knowledge and its relation to the "real" world.

For constructivists, the word knowledge refers to a commodity that is radically different from the objective representation of an observer-independent world which the mainstream of the Western philosophical tradition has been looking for. Instead, knowledge refers to conceptual structures which, given the range of present experience within their tradition of thought and language, epistemic agents consider viable. This constitutes a drastic modification of the relation between the cognitive structures we build up and that "real" world which we are inclined to assume as "existing" beyond our perceptual interface. Instead of the illusory relation of "representation", one has to find a way of relating knowledge to reality that does not imply anything like a match or correspondence.

The most frequent objection to radical constructivism takes the form of discarding it as a kind of solipsism. It is the same objection that George Berkeley had to contend with, and what it claims is as inappropriate in our case as it was in his. The title of Berkeley's major epistemological work was *A treatise concerning the principles of human knowledge* (1710). If one keeps that title in mind, it will be clear that when he declares "*esse est percipi*" (to be is to be perceived), the "to be" refers to the only

way of being a human knower can conceive of, and that is being in the world of experience. It is the being constituted by the kind of permanence that results from invariants created by an experiencer's successful assimilation of experiences. In other words, we have no way of conceiving what the words "to be" or "to exist" should refer to *outside the space and the time of our experiential world*. But Berkeley's opponents, just as today's critics of constructivism, reacted as though he had been talking about the world-in-itself rather than about the *principles of human knowledge*.

It is a strange coincidence that Berkeley published his Treatise in the very same year that Vico published his constructivist manifesto. Both authors were concerned with the human activity of knowing and both had strong ties with the religious dogma that claims an absolute, eternal order of the universe. Their way of reconciling their blatantly subjectivist theories of knowledge with the requirement of an immutable objective world were parallel and equally ingenious. For Berkeley the unity and permanence of ontological existence was assured by God's perception which, because God is considered omniscient, was ubiquitous and all-encompassing. Vico, instead, maintained that, while the human mind could know only what the human mind itself had constructed, God alone, who had created the world as it is, could truly know it.

Radical constructivism is less fanciful and more pragmatic. It does not deny an ontological "reality" – it merely denies the human experiencer the possibility of acquiring a true representation of it. The human subject may meet that world only where a way of acting or a way of thinking fails to attain a desired goal – but in any such failure there is no way of deciding whether the lack of success is due to an insufficiency of the chosen approach or to an independent ontological obstacle. What we call "knowledge", then, is the map of paths of action and thought which, at that moment in the course of our experience, have turned out to be viable for us. Such a limitation of the scope of human understanding is, of course, considered dangerous heresy by all who, in spite of the sceptics age-old warnings, still cling to the hope that human reason will sooner or later unravel the mystery of the universe.

Richard Rorty, in his Introduction to *Consequences of Pragmatism*, announces this shift of focus in terms that fit the constructivist's position just as well as the pragmatist's:

He (the pragmatist) drops the notion of truth as correspondence with reality altogether, and says that modern science does not enable us to cope because it corresponds, it just enables us to cope. (Rorty 1982, p.XVII)

Constructivism is related to pragmatism. It shares the attitude towards knowledge and truth and, as does pragmatism, it goes against "the common urge to escape the vocabulary and practices of one's own time and find something ahistorical and necessary to cling to" (Rorty 1982, p.165).

Vico's anonymous reviewer exemplified that urge. He complained that Vico did not prove his thesis, and he reproached him for not having claimed for his "metaphysics" (which was actually a theory of knowing) the correspondence with an ahistorical ontic world as God might know it. But this notion of correspondence was precisely what Vico – like the pragmatists – intended to drop. Present-day constructivists, if pressed for corroboration rather than proof in the traditional sense, have an advantage over Vico. They can claim compatibility with scientific models that

enable us to “cope” remarkably well in specific areas of experience. For instance, one might cite the neurophysiology of the brain and quote Hebb’s:

At a certain level of physiological analysis there is no reality but the firing of single neurons (Hebb, 1958, p.461).

This is complemented by von Foerster’s (1970) observation that all sensory receptors (i.e. visual, auditory, tactual, etc.) send physically indistinguishable “responses” to the cortex. If this is so, the sensory modalities (seeing, hearing, smelling, etc.) can be distinguished only by keeping track of the part of the body from which the responses come, and not on the basis of “environmental features”. Such statements make clear that contemporary neurophysiological models may be compatible with a constructivist theory of knowing but can in no way be integrated with the notion of transduction of “information” from the environment which any realist epistemology demands.

Knowledge as an Adaptive Function

What distinguishes Constructivism from pragmatism is the predominant interest in *how* we come to have the knowledge that “enables us to cope”. The work of Jean Piaget, the most prolific constructivist in our century, can be interpreted as one long struggle to design a model of the generation of viable knowledge. Piaget has reiterated innumerable times that, from his perspective, cognition must be considered an adaptive function (cf. especially Piaget, 1967a, pp.210ff). In spite of this, most of his critics argue against him as though he had been concerned with the traditional notion of knowledge as correspondence.

To some extent this misinterpretation is due to a misconception about adaptation. The technical sense of the term that Piaget intended comes from the theory of evolution. In that context, adaptation refers to a state of organisms or species that is characterized by their ability to survive in a given environment. Because the word is often used as a verb (e.g. this or that species has adapted to such and such an environment), the impression has been given that adaptation is an evolutionary activity. This is quite misleading. In phylogeny no organism can actively modify its genome and generate characteristics to suit a changed environment. According to the theory of evolution, the modification of genes is always an accident. Indeed, it is these accidental modifications that generate the variations on which natural selection can operate. Although Darwin occasionally slipped into using the expression (Pittendrigh 1958, p.397), nature does not select “the fittest”, it merely lets live those that have the characteristics necessary to cope with their environment and lets die all that have not. In other words, every species or organism found alive and capable of reproducing, at that moment in the history of living organisms, must by that very fact, be considered adapted. To be adapted, therefore, means no more and no less than to be viable.

This interpretation of the theory of evolution and its vocabulary is crucial for an adequate understanding of Piaget’s theory of cognition. For Piaget (as for Vico), knowledge is not and can never be a “representation” of the real world. Instead it is the collection of conceptual structures that turn out to be adapted or, as I would say, viable within the knowing subject’s range of experience. However, it must be made clear that, while biologists may tend to think of viability and adaptedness in terms of

differential reproduction, in the cognitive domain the two terms refer to the achievement and maintenance of internal equilibrium. For the constructivist, therefore, knowledge has the function of eliminating perturbations; and the higher we move in the hierarchy of conceptual abstractions, the more the perturbations tend to be conceptual rather than material. This, obviously, is one of the features that made the constructivist approach interesting for therapists.

In both, theory of evolution and the constructivist theory of knowing, viability is tied to the concept of equilibrium. Equilibrium in evolution indicates the state of an organism or species in which the potential for survival in a given environment is genetically assured. In the sphere of cognition, though indirectly linked to survival, equilibrium refers to a state in which an epistemic agent's cognitive structures have yielded and continue to yield expected results, without bringing to the surface conceptual conflicts or contradictions. In neither case is equilibrium necessarily a static affair, like the equilibrium of a balance beam, but it can be and often is dynamic, as the equilibrium maintained by a cyclist.

To make the Piagetian definition of knowledge plausible, one must immediately take into account (which so many interpreters of Piaget seem to omit) that a human subject's experience always includes the social interaction with other cognizing subjects. This aspect of social interaction is, obviously, of fundamental importance if we want to consider education, that is, any situation in which the actions of a teacher are aimed at generating or modifying the cognitive constructions of a student. But introducing the notion of social interaction, raises a problem for constructivists. If a cognizing subject knows can know only what that subject itself has constructed, it is clear (from the constructivist perspective) that the others, with whom the subject may interact socially, cannot be posited as an ontological given. I shall return to this problem, but first I want to explicate the basis of a Piagetian theory of learning.

The Context of Scheme Theory

Two of the basic concepts of Piaget's theory of cognition are assimilation and accommodation. Piaget's use of these terms is not quite the same as their common use in ordinary language. Both terms must be understood in the context of his constructivist theory of knowing. Unfortunately, this is what contemporary textbooks in developmental psychology (most of which devote at least a few pages to Piaget) often fail to do. Thus one reads, for instance:

Assimilation is the process whereby changing elements in the environment become incorporated into the structure of the organism. At the same time, the organism must accommodate its functioning to the nature of what is being assimilated. (Nash 1970, p.360)

This is not at all what Piaget meant. One reason why assimilation is so often misunderstood is that its use as an explanatory postulate ranges from the unconscious to the deliberate. Another stems from disregarding that Piaget uses that term, as well as "accommodation", within the framework of his theory of schemes. An example may help to clarify his position.

An infant quickly learns that a rattle it was given makes a rewarding noise when it is shaken, and this provides the infant with the ability to generate the noise at will.

Piaget sees this as the “construction of a scheme”³ which, like all schemes, consists of three parts:

(1) Recognition of a certain situation (e.g. the presence of a graspable item with a rounded shape at one end);

(2) association of a specific activity with that kind of item (e.g. picking it up and shaking it);

(3) expectation of a certain result (e.g. the rewarding noise).

It is very likely that this infant, when placed in its high-chair at the dining table, will pick up and shake a graspable item that has a rounded shape at one end. We call that item a spoon and may say that the infant is assimilating it to its rattling scheme; but from the infant’s perspective at that point, the item is a rattle, because what the infant perceives of it is not what an adult would consider the characteristics of a spoon but just those aspects that fit the rattling scheme.

Shaking the spoon, however, does not produce the result the infant expects: the spoon does not rattle. This generates a perturbation (“disappointment”), and perturbation is one of the conditions that set the stage for cognitive change. In our example it may simply focus the infant’s attention on the item in its hand, and this may lead to the perception of some aspect that will enable the infant in the future to recognize spoons as non-rattles. That development would be an accommodation, but obviously a rather modest one. Alternatively, given the situation at the dining table, it is not unlikely that the spoon, being vigorously shaken, will hit the table and produce a different but also very rewarding noise. This, too, will generate a perturbation (we might call it “enchantment”) which may lead to a different accommodation, a major one this time, that initiates the “spoon banging scheme” which most parents know only too well.

This simple illustration of scheme theory also shows that the theory involves, on the part of the observer, certain presuppositions about cognizing organisms. The organism is supposed to possess at least the following capabilities⁴:

- The ability and, beyond that, the tendency to establish recurrences in the flow of experience; this, in turn, entails at least two further capabilities,
- remembering and retrieving (representing) experiences,
- and the ability to make comparisons and judgements of similarity and difference;
- apart from these, there is the presupposition that the organism likes certain experiences better than others, which is to say, it has some elementary values.

The first three of these are indispensable in any theory of learning. Even the parsimonious models of classical and operant conditioning could not do without them. As to the fourth, the assumption of elementary values, it was explicitly embodied in Thorndike’s Law of Effect: “Other things being equal, connections grow stronger if they issue in satisfying states of affairs” (Thorndike 1931/1966, p.101). This assumption remained implicit in psychological learning theories since Thorndike, and the subjectivity of what is “satisfying” was more or less deliberately obscured by behaviorists through the use of the more objective-sounding term “reinforcement”.

The learning theory that emerges from Piaget’s work can be summarized by saying that cognitive change and learning take place when a scheme, instead of producing the expected result, leads to perturbations. Perturbation, in turn, leads to accommodation that may establish a new equilibrium.

Learning and the knowledge it creates, thus, are explicitly instrumental. But here, again, it is crucial not to be rash and too simplistic in interpreting Piaget. His theory of cognition involves a two-fold instrumentalism. On the sensory-motor level, action schemes are instrumental in helping organisms to achieve goals in their interaction with their experiential world. On the level of reflective abstraction, however, operative schemes are instrumental in helping organisms achieve a coherent conceptual network that reflects the paths of acting as well as thinking which, at the organisms' present point of experience, have turned out to be viable. The first instrumentality might be called "utilitarian" (the kind philosophers have traditionally scorned). The second, however, is strictly "epistemic". As such, it may be of philosophical interest – above all because it entails a radical shift in the conception of "knowledge", a shift that eliminates the paradoxical conception of Truth that requires a forever unattainable ontological test. The shift that substitutes viability in the experiential world for correspondence with ontological reality applies to knowledge that results from inductive inferences and generalizations. It does not affect deductive inferences in logic and mathematics. In Piaget's view, the certainty of conclusions in these areas pertains to mental operations and not to sensory-motor material (cf. Beth & Piaget 1961; Glasersfeld, 1985b).

The Social Component: "Others"

In connection with the concept of viability, be it "utilitarian" or "epistemic", social interaction plays an important role. Except for animal psychologists, social interaction refers to what goes on among humans and involves language. As a rule it is also treated as essentially different from the interactions human organisms have with other items in their experiential field, because it is more or less tacitly assumed that humans are from the very outset privileged experiential entities. Constructivists have no intention of denying this intuitive human prerogative. But insofar as their theory of knowing attempts to model the cognitive development that provides the individual organism with all the furniture of his or her experiential field, they want to avoid assuming any cognitive structures or categories as innate. Hence, there is the need to hypothesize a model for the conceptual genesis of "others".

On the sensory-motor level, the schemes a developing child builds up and manages to keep viable will come to involve a large variety of "objects". There will be cups and spoons, building blocks and pencils, rag dolls and teddy bears – all seen, manipulated, and familiar as components of diverse action schemes. But there may also be kittens and perhaps a dog. Though the child may at first approach these items with action schemes that assimilate them to dolls or teddy bears, their unexpected reactions will quickly cause novel kinds of perturbation and inevitable accommodations. The most momentous of these accommodations can be roughly characterized by saying that the child will come to ascribe to these somewhat unruly entities certain properties that radically differentiate them from the other familiar objects. Among these properties will be the ability to move on their own, the ability to see and to hear, and eventually also the ability to feel pain. The ascription of these properties arises because, without them, the child's interactions with kittens and dogs cannot be turned into even moderately reliable schemes.

A very similar development may lead to the child's construction of schemes that involve still more complex items in her experiential environment, namely the human individuals who, to a much greater extent than other recurrent items of experience, make interaction unavoidable. (As we all remember, in many of these inescapable interactions, the schemes that are developed aim at avoiding unpleasant consequences rather than creating rewarding results.) Here, again, in order to develop relatively reliable schemes, the child must impute certain capabilities to the objects of interaction. But now these ascriptions comprise not only perceptual but also cognitive capabilities, and soon these formidable "others" will be seen as intending, making plans, and being both very and not at all predictable in some respects. Indeed, out of the manifold of these frequent but nevertheless special interactions, there eventually emerges the way the developing human individual will think both of "others" and of him- or herself.

This reciprocity is, I believe, precisely what Kant had in mind when he wrote:

It is manifest that, if one wants to imagine a thinking being, one would have to put oneself in its place and to impute one's own subject to the object one intended to consider... (Kant 1781, p.223)

My brief account of the conceptual construction of "others" is no doubt a crude and preliminary analysis, but it at least opens a possibility of approaching the problem without the vacuous assumption of innateness that "social constructionism" entails. Besides, the Kantian notion that we impute the cognitive capabilities we isolate in ourselves to our conspecifics, leads to an explanation of why it means so much to us to have our experiential reality confirmed by the interaction with others. The use of a scheme always involves the expectation of a more or less specific result. On the level of reflective abstraction, the expectation can be turned into a prediction. If we impute planning and foresight to others, this means that we also impute to them some of the schemes that have worked well for ourselves. Then, if a particular prediction we have made concerning an other's action or reaction turns out to be corroborated by what the other does, this adds a second level of viability to the scheme we have imputed to that other; and this second level of viability helps to strengthen the reality we have constructed for ourselves (cf. Glasersfeld 1985a, 1986).

A Perspective on Communication

Although it is not always explicitly acknowledged, the separation of two kinds of instrumentality, which I mentioned above, is not a new one in the field of education. Since the days of Socrates, teachers have known that it is one thing to bring students to acquire certain ways of acting – be it kicking a football, performing a multiplication algorithm, or the reciting of verbal expressions – but quite another to engender *understanding*. The one enterprise could be called "training", the other "teaching". However, educators, who are often better at the first than at the second, do not always want to maintain the distinction. Consequently, the methods for attaining the two goals tend to be confused. In both, communication plays a considerable part, but what is intended by "communication" is not quite the same.

Early studies of communication developed a diagrammatic representation of the process as it appears to an outside observer. Success or failure of a communication

event was determined on the basis of the observable behaviors of a sender and a receiver. This schema was highly successful in the work of communication engineers (Cherry 1966, p.171). It was also immediately applicable to the behaviorist approach to teaching and learning. The teacher's task, according to that view, consisted largely in providing a set of stimuli and reinforcements apt to condition the student to "emit" behavioral responses considered appropriate by the teacher. Wherever the goal is students' reliable replication of an observable behavior, this method works well. And because there is no place in the behaviorist approach for what we would like to call understanding, it is not surprising that the behaviorist training rarely, if ever, produces it.

The technical model of communication (Shannon 1948), however, established one feature of the process that remains important no matter from what orientation one approaches it: The physical signals that travel from one communicator to another – for instance the sounds of speech and the visual patterns of print or writing in linguistic communication – do not actually carry or contain what we think of as *meaning*. Instead, they should be considered instructions to select particular meanings from a list which, together with the list of agreed signals, constitutes the "code" of the particular communication system. From this it follows that, if the two lists and the conventional associations that link the items in them are not available to a receiver before the linguistic interaction takes place, the signals will be meaningless for that receiver.

From the constructivist point of view, this feature of communication is of particular interest because it clearly brings out the fact that language users must individually construct the meaning of words, phrases, sentences, and texts. Needless to say, this semantic construction does not always have to start from scratch. Once a certain amount of vocabulary and combinatorial rules (syntax) have been built up in interaction with speakers of the particular language, these patterns can be used to lead a learner to form novel combinations and, thus, novel conceptual compounds. But the basic elements out of which an individual's conceptual structures are composed and the relations by means of which they are held together cannot be transferred from one language user to another, let alone from a proficient speaker to an infant. These building blocks must be abstracted from individual experience; and their interpersonal fit, which makes possible what we call communication, can arise only in the course of protracted interaction with others, through mutual orientation and adaptation (cf. Maturana, 1980).

Though it is often said that normal children acquire their language without noticeable effort, a closer examination shows that the process involved is not as simple as it seems. If, for instance, you want your infant to learn the word "cup", you will go through a routine that parents have used through the ages. You will point to, and then probably pick up and move, an object that satisfies your definition of "cup", and at the same time you will repeatedly utter the word. It is likely that mothers and fathers do this intuitively, i.e., without a well-formulated theoretical basis. They do it because it usually works. But the fact that it works does not mean that it has to be a simple matter. There are at least three essential steps the child has to make, if the procedure is to be successful.

The first consists in focusing attention on some specific sensory signals in the manifold of signals which, at every moment, are available within the child's sensory system; the parent's pointing provides a merely approximate and usually quite ambiguous direction for this act.

The second step consists in isolating and coordinating a group of these sensory signals to form a more or less discrete visual item or "thing". The parent's moving the cup greatly aids this process because it accentuates the relevant figure as opposed to the parts of the visual field that are to form the irrelevant ground.⁵

The third step, then, is to associate the isolated visual pattern with the auditory experience produced by the parent's utterances of the word "cup". Again, the child must first isolate the sensory signals that constitute this auditory experience from the background (the manifold of auditory signals that are available at the moment); and the parent's repetition of the word obviously enhances the process of isolating the auditory pattern as well as its association with the moving visual pattern.

If this sequence of steps provides an adequate analysis of the initial acquisition of the meaning of the word "cup", it is clear that the child's meaning of that word is made up exclusively of elements which the child abstracts from her *own* experience. Indeed, anyone who has more or less methodically watched children acquire the use of new words, will have noticed that what they abstract as meanings from their experiences in conjunction with words is often only partially compatible with the meanings the adult speakers of the language take for granted. Thus the child's initial concept of cup often includes the activity of drinking, and sometimes even what is being drunk, e.g., milk. Indeed, it may take quite some time before the continual linguistic and social interaction with other speakers of the language provides occasions for the accommodations that are necessary for the concept the child has associated with the word "cup" to become adapted to the adults' extended use of the word (e.g. in the context of a game of golf or a championship).

The process of accommodating and tuning the meaning of words and linguistic expressions actually continues for each of us throughout our lives. No matter how long we have spoken a language, there will still be occasions when we realize that, up to that point in time, we have been using a word in a way that now turns out to be idiosyncratic in some particular respect.

Once we come to see this essential and inescapable subjectivity of linguistic meaning, we can no longer maintain the preconceived notion that words *convey* ideas or knowledge; nor can we believe that a listener who apparently understands what we say, must necessarily have conceptual structures that are identical with ours. Instead, we come to realize that *understanding* is a matter of fit rather than match. Put in the simplest way, to understand what someone has said or written, means no less but also no more than to have built up a conceptual structure that, in the given context, appears to be compatible with the structure the speaker had in mind – and this compatibility, as a rule, manifests itself in no other way than that the receiver says and does nothing that contravenes the speaker's expectations.

Among proficient speakers of a language, the individual's conceptual idiosyncrasies rarely surface when the topics of conversation are everyday objects and events. To be considered proficient in a given language requires two things among others: to have available a large enough vocabulary, and to have constructed and

sufficiently accommodated and adapted the meanings associated with the words of that vocabulary so that no conceptual discrepancies become apparent in ordinary linguistic interactions. However, when conversation turns to predominantly abstract matters, it usually does not take long before conceptual discrepancies become noticeable – even among proficient speakers. The discrepancies generate perturbations in the interactors, and at that point the difficulties become insurmountable if a participant believes that his or her meanings of the words that have used are true representations of objective entities in a world apart from any speaker. If, instead, the participants take a constructivist view and assume from the outset that a language user's meanings cannot be anything but subjective constructs derived from the speaker's individual experiences, some accommodation and adaptation is usually possible.

From this perspective, the use of language in therapy, school, or any form of instruction is far more complicated than it is mostly presumed to be. Language does not serve to *transfer* information or knowledge to a client or student. As Rorty says: "The activity of uttering sentences is one of the things people do in order to cope with their environment" (1982, p.XVII). In fact, language is a means of constraining and orienting another's physical responses as well as conceptual construction.

The inherent and inescapable indeterminacy of linguistic communication is something the best teachers have always known. Independently of any epistemological orientation, they were intuitively aware of the fact that telling is not enough, because understanding is not a matter of passively receiving but of actively building up. Yet many who are involved in educational activities continue to act as though it were reasonable to believe that the verbal reiteration of facts and principles must eventually generate the desired understanding on the part of students.

Resistances against the Constructivist Model

The pattern of maintaining categorizations, concepts, and, indeed, whole theories, even if some experience makes their adequacy questionable, is a universal pattern. From the constructivist point of view, the reason for this is that, wherever theories and concepts have proved useful in the past, there is a considerable vested interest in maintaining the status quo. That is to say, the proponents of a theory will assimilate new experiences as long as they possibly can, even in the face of considerable perturbations.

Silvio Ceccato, the Italian pioneer in the analysis of mental operations and construction, once after a public discussion of his theory, overheard an aged philosopher say: "If Ceccato were right, the rest of us would be fools!"⁶ Most of the readers of the works of Piaget and the contemporary constructivists are not as direct and outspoken. Instead they desperately try to assimilate what they read and hear, disregarding all sorts of clues and bending the interpretation of words to their own notions; and when this proves impossible, they conclude that the author is contradicting himself, because what he says is no longer compatible with their own conceptual construction.

Radical constructivism is unashamedly instrumentalist (in the philosophical sense of that term) and this must offend advocates of the maxim "Truth for Truth's sake". Consequently, they dismiss it as cheap materialism. But this, again, is

inappropriate. The instrumentalism embodied by constructivism is not to be equated with materialism. The second principle listed above states that the function of the cognitive activity is adaptive. For the biologist, of course, the quest for viability concerns the fit with an external environment. For the constructivist, whose interest is focused exclusively on the cognitive domain in which there is no access to an external environment, viability and fit are always relative to the cognizing subject's experiential world.

This shift of meaning was convincingly explained and demonstrated by the biologist Jakob von Uexküll (1933). In his charming book (English title: *Strolls through the environments of animals and men*) he showed that every living organism creates two coordinated environments for itself: an environment of actions (*Wirkwelt*) and an environment of perceptions (*Merkwelt*). Both these environments are necessarily subjective, because the first depends on the particular organism's capabilities of acting, and the second on the range of the organism's sensory equipment.

There are other consequences of the constructivist approach to knowing that are sometimes met with indignation. If viability depends on the goals one has chosen – goals that necessarily lie within one's world of experience – and on the particular methods adopted to attain them, it is clear that there will always be more than one way. And when a goal has been attained, this success must never be interpreted as having discovered *the* way. This goes against the notion that repeated success in dealing with a problem proves that one has discovered the workings of an objective world. Solutions, from the constructivist perspective, are always relative – and this, in turn, makes clear that problems are not entities that lie about in the universe, independent of any experiencer. Instead, problems arise when obstacles block the way to a subject's goal.

Much uneasiness is created also by the constructivist analysis of communication. In a theory that considers all knowledge the result of individual construction, the meaning of signals, signs, symbols, and language, cannot be anything but subjective. Yet, language cannot be altogether private because we all use it with more or less success in what we usually call communication. This looks like a paradox, but that appearance dissolves as soon as we begin to see linguistic communication as just another form of mutually tuned interaction that arises in much the same way as the coordinated movements of a pair of dancers.

The linguistics literature often cites the example of a child inappropriately using the word "dog" when, for the first time, she sees a sheep or a lamb. It shows in the first place that the child has assimilated the new experience to her concept/meaning of "dog" which at that moment may comprise no more than fur, four-legs, and moving. If an adult "corrects" the child and says, "No dear, this is a lamb", it will cause some perturbation in the child's, which may lead to an accommodation and to the formation of a new perceptual/ conceptual structure to associate with the word "lamb". This sequence of events is not very different from a dancer making an inappropriate step, treading on his partner's toes, and consequently modifying his motor pattern.

The experiential sequence of accommodation triggered by the UN-successful use of a word, provides a model, at one and the same time, for the acquisition of new

concepts and for the construction of leicall meaning. Without going into the details of the process that links the experience of a thing with the experience of a word, it should be clear that both these items are composed of elements that are part of the acting subject's experiential world and are, therefore, determined by what the subject attends to and how the subject perceives and conceives it.

What makes this approach seem so unacceptable is its incompatibility with the traditional notion that, when we speak or write, the words and sentences contain the meanings we have in mind and carry them from a speaker or writer to a listener or reader, as though meanings were things that one could wrap in sounds or graphic marks at one end, in order to have them unwrapped at the other. It does not take much reflection to realize that this is not how communication can work. Yet, to deny that meanings are essentially generalized representations of external referents goes against the venerable philosophical notion of objective denotation.

However, even if we discount the philosophers' objection (because it stems from a realist epistemology which we believe to have successfully dismantled) we shall have to explain how it comes about that, by and large, linguistic communication works fairly well. This successful functioning may seem surprising, given our assumption that meanings are subjective constructs. The constructivist answer to this question is simple. It derives directly from the basic notion that human action is essentially instrumental, be it physical, conceptual, or communicatory. Just as our concepts are shaped, modified, or discarded according to how well they serve us in our conceptual schemes, so the semantic associations between words and concepts are shaped and modified according to how well they function in our continual interactions with speakers of our language. Since this process of accommodation and adaptation is driven largely by failures in our linguistic exchanges with others, it is without end, and we never reach a point where we could say that we now know *the* meaning of all the words and expressions we have been using. The most we can claim is that our use of the language seems compatible with that of others.

The revolutionary aspects of the constructivist approach to communication is, as I mentioned above, that it drastically changes the concept of *understanding*. There can no longer be the claim that the meanings of words must be "shared" by all users of a language because these meanings are derived from fixed, external entities. They are not. Each language user has, in fact, abstracted them from his or her own experiential world. At best there is a relation of fit or compatibility among the meanings individuals attribute to a given expression. From the constructivist point of view, this must be so, because understanding what other speakers mean by what they say, can not be explained by the assumption that we have managed to replicate identical conceptual structures in our individual heads. Our feeling of having understood arises from the conclusion that our interpretation of their words and sentences seems compatible with the model of their thinking and acting that we have built up in the course of our interactions with them.

In short, our knowledge of language and our knowledge of others is essentially no different from our knowledge of the world. All we call "knowledge", be it sensory-motor or conceptual, is the result of our own reflecting upon and abstracting from what we perceive and conceive. The hope or the belief that these activities could lead to a true picture of an independently existing reality is an illusion. Whatever pictures

we abstract from our experiences must prove their viability in that experiential world. Insofar as they turn out to be viable, they will serve as a model for further acting and thinking. Thus, if one adopts the constructivist orientation, one loses the impetus to search for ontological Truth. In exchange one gains a relatively consistent theory of knowing that makes the world we actually experience a good deal easier to comprehend.

Footnotes

- 1 Montaigne wrote this in his *Apologie de Raymond Sebond* (1575–76). It can be found on p.139 of Vol.2 of the complete edition of his *Essais*, edited by Pierre Michel.
- 2 Vico's *Scienza nuova* (The new science), published in various editions between 1725 and 1744, has been translated into several languages and many scholars consider it a fundamental work in sociology and the philosophy of history.
- 3 Note that Piaget, throughout his work, distinguishes two notions for which he has different French words: *schéma* is a diagrammatic representation, such as a city plan or an organizational chart; *schème*, in contrast, refers to a dynamic entity that involves a situation, an action, and a result. In English Piaget translations, the two notions are usually confused.
- 4 Piaget nowhere lists these presuppositions, but they are implicit in his analysis of conceptual development (cf. for instance, Piaget 1937). Another implication of his theory is that none of these presupposed capabilities necessarily require the subject's conscious awareness.
- 5 Note that, even if the child has coordinated sensory signals to form such a "thing" in the past, each new recognition involves isolating it in the current experiential field.
- 6 I owe this anecdote to a personal communication: Silvio Ceccato told it to me shortly after the event, sometime about 1960.

References

- Anonymous (1711) 'Osservazioni', *Giornale de' Letterati d'Italia* (Venice), 5, article VI.
- Berkeley, G. (1710) *A treatise concerning the principles of human knowledge*. Part I, §3.
- Beth, E.W., & Piaget, J. (1961) *Epistemologie Mathématique et Psychologie*. Presses Universitaires de France, Paris.
- Cherry, C. (1966) *On Human Communication*. M.I.T.Press, 2nd edition, Cambridge, Massachusetts.
- Fleck, L. (1929) Zur Krise der "Wirklichkeit", *Die Naturwissenschaften*, 17(23), 425–430.
- Fleck, L. (1979/1935) *Genesis and development of a scientific fact*. Chicago: University of Chicago Press (first published in German, 1935).
- Foerster, H.von (1973) On constructing a reality. In F.E.Preiser (Ed.), *Environmental design, research, Vol.2*. Stroudsburg: Dowden, Hutchinson, & Ross.
- Glaserfeld, E.von (1985a) Reconstructing the Concept of Knowledge, *Archives de Psychologie*, 53, pp.91–101.

- Glaserfeld, E.von (1985b) Representation and Deduction, in L.Streefland (Ed.), *Proceedings of the 9th Conference for the Psychology of Mathematics Education, Vol.1*, State University of Utrecht, The Netherlands, pp.484–489.
- Glaserfeld, E.von (1986) Steps in the Construction of "Others" and "Reality", in R.Trappl (Ed.), *Power, Autonomy, Utopia*, (107–116). London: Plenum Press.
- Hebb, D.O. (1958) Alice in Wonderland or Psychology among the Biological Sciences, in Harlow & Woolsey (Eds.), *Biological and Biochemical Bases of Behavior*, (451–467) University of Wisconsin Press, Madison.
- Kant, I. (1781/1910) *Kritik der reinen Vernunft*, 1. Auflage (Gesammelte Schriften, Bd.IV). Berlin: Königl. Preussische Akademie, 1910ff.
- Kuhn, T.S. (1970) *The structure of scientific revolutions*. Chicago: University of Chicago Press, 2nd edition,
- Maturana, H.R. (1980) Biology of Cognition, in H.R.Maturana & F.J.Varela (Eds.), *Autopoiesis and Cognition*, (5–58), Dordrecht/Boston: Reidel.
- Montaigne, M. de (1575/1972) *Essais, Vol.2*. Paris: Librairie Générale Française.
- Nash, J. (1970) *Developmental Psychology*. Englewood Cliffs, New Jersey: Prentice-Hall
- Piaget, J. (1937) *La construction du réel chez l'enfant*. Neuchâtel: Delachaux et Niestlé.
- Piaget, J. (1967) *Biologie et connaissance*. Gallimard, Paris.
- Pittendrigh, C.S. (1958) Adaptation, Natural Selection, and Behavior, in A.Roe & G.G.Simpson (Eds.), *Behavior and Evolution*, (390–416). New Haven: Yale University Press.
- Rorty, R. (1982) *Consequences of Pragmatism*. Minneapolis: University of Minnesota Press,
- Shannon, C. (1948) The Mathematical Theory of Communication, *Bell Systems Technical Journal*, 27, 379–423 and 623–656.
- Thorndike, E. (1966) *Human Learning*. Cambridge, Massachusetts: M.I.T.Press (first published, 1931).
- Uexküll, J.von (with Georg Kriszat) (1933/1970) *Streifzüge durch die Umwelten von Tieren und Menschen*. Frankfurt am Main: Fischer, 1970 (originally published in 1933).
- Vico, G.-B. (1710/1858) *De antiquissima Italorum sapientia*. Naples: Stamperia de'Classici Latini, 1858.

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