

Ernst von Glasersfeld and the Italian Operational School

Didactic Implications of Operational Awareness

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> Context • Ernst von Glasersfeld collaborated with the Italian Operational School from the early 1960s when the project on the mechanization of higher human activities began. **> Problem** • To analyze the cognitive processes in terms of a mnemonic-attentional dynamic and to study every thought content in light of the interdependence between observer and observed. **> Method** • The project comprised two research areas: the linguistic translation, in which von Glasersfeld participated; and the semantic analysis of words, in which I participated. The common basis was the analysis of attentional dynamisms. This allowed the syntactic complexity of a sentence to be transferred to the correlational structure of the thought. The semantic analysis, especially of the observational words, was based on the attentional dynamisms used for the categorization, perception, and representation processes. **> Results** • The analysis of visual processes led to the “constitutive structures.” These structures allowed me to establish an operative didactic based on the awareness of mental operations. **> Implications** • The comparison between von Glasersfeld’s and my experiences revealed the equivalence of some analyses, which was due to the common presumption that the experiential units depend on the operation performed by the perceiver. **> Key words** • Constitutive structure, attention, vision, experience, cognitive processes, Silvio Ceccato.

Preface by Marco Bettoni

*... la bellezza risulta sempre
dall'esecuzione di certe operazioni mentali
... beauty always results from
performing certain mental operations
(Ceccato 1987: 7)*

Working with Ceccato for fifteen years (1947–1962) “laid down solid foundations” for Ernst von Glasersfeld’s thinking (Glasersfeld 2010: 126) and determined, from their first meeting in the summer of 1947 near Val di Sogno on the Lake of Garda, the future course of his life (Glasersfeld 1995: 6, 2010: 127). On the surface it was Wittgenstein’s *Tractatus* that provided “a fertile common ground” for conversation in the first meeting between von Glasersfeld and Ceccato but – having known them both personally for 25 and 16 years, respectively – I am convinced that their shared passion for art also contributed more profoundly to their lasting friendship. In 1947 von Glasersfeld became a regular member of Ceccato’s group, later called the “Scuola Operativa Italiana” (Italian Operational School), which

was “attempting to rewrite the theory of knowledge and language” (Glasersfeld 2010: 128) and from then participated in their informal meetings. When Ceccato founded *Methodos* in 1949, von Glasersfeld translated “Il teocono” (Ceccato 1949) and other articles for the first issue and in the following years regularly translated Italian and German articles into English for the journal. But the period of his collaboration with Ceccato that most profoundly influenced his later research when he moved to the USA was probably that of the last four years (1959–1962). In this period Ceccato and his collaborators applied their operational analyses to two complementary experimental lines of research: mechanical translation (Ceccato 1960) and the “cronista meccanico” (mechanical reporter), a machine that observes and describes events in its environment (Ceccato 1964).

Ceccato had devised the first ideas for these two applications after two meetings in London, one with Dennis Gabor in 1953 (Ceccato 1964/1966: 648; Ceccato 1987: 59) and one with Colin Cherry in 1955 (Ceccato 1960: 18). Gabor had encouraged Ceccato to

build a mechanical model of his analyses of mental operations and Cherry had suggested that Ceccato could submit a proposal for mechanical translation to the research centres of the US Air Force or Navy (Glasersfeld 2010: 176). In 1957 Ceccato founded the Centre for Cybernetics and Linguistic Activities at the University of Milan (Ceccato 1987: 75) and this background allowed him to submit in the following two years one research proposal for each of his two projects.

The mechanical translation proposal, which envisaged mutual translation of three languages, i.e., Russian, English and Italian, was submitted to the Air Research and Development Command of the US Air Force. It was accepted and in 1959 von Glasersfeld was hired for this project as a full-time research assistant at the Milan Centre for Cybernetics (Glasersfeld 1995: 7). Besides him and Ceccato, the mechanical translation team included, among others, Enrico Albani, Enrico Maretti, Sergei Perschke, Bruna Zonta, Elsa Samet, Renzo Beltrame and, from 1960, Jehane Burns, too.

The second project, the mechanical reporter, received funding from Euratom in

1960 and started with a smaller team, a subgroup of the mechanical translation team, composed of Maretti, Beltrame and Ceccato himself (Ceccato 1987: 75).

It was in this period of very intense activity at the Milan Centre for Cybernetics that Pino Parini, a painter and art pedagogue, read in a magazine about Ceccato's research and remained fascinated by his "innovative cybernetic model of the human mind" (Parini 1997). At that time Parini – who had recently founded in Rimini a group that investigated the relationship between art and science, the "Gruppo V" – was experimenting with "logoschemi," a visual art technique for drawing philosophical concepts, for example concepts taken from Immanuel Kant's "Critique of pure reason". He contacted Ceccato in the hope of getting some ideas, critique and suggestions for this kind of painting (Ceccato 1987: 123). After a meeting on

3 March 1961 at the Centre for Cybernetics (Parini 2007), Parini began to collaborate on the mechanical reporter project (Ceccato 1964: 54) and became the first artist to adopt Silvio Ceccato's idea of defining concepts in terms of mental operations, transferred it to his own interpretation and production of visual art, and contributed to the progress of operational methodology with original concepts such as that of "constitutive structure" (see Parini's article).

The collaboration of an artist with an advanced cybernetics research group in the early 1960s may seem surprising at first sight. However, it becomes quite consistent and clear if one takes into account Ceccato's tight connection to art since his youth – with passions for music and an education in music composition (Ceccato 1964/1966: 31) – and considers as relevant the fact that the research that led first to the development of

Operational Methodology (1948–1952) then to the cybernetic turn (1953–1956) and finally to experiments in machine intelligence (1956–1964) had begun many years before with a philosophical inquiry (1940–1947) into the conceptual foundations of art and aesthetics (Ceccato 1941; 1964/1966; 1987).

Without Ceccato's art research we would not have radical constructivism today. Parini's contribution is a welcome reminder of this fact and points to some essential aspects of the intimate relationship that connects art research, operational methodology and the foundations of radical constructivism. I am convinced that clarifying the role that music, painting and art in general have played in Ceccato's work from the beginning of his inquiry in the late 1930s until his death in 1997 could provide a much better understanding of the essence of radical constructivism. ■ *End of preface*

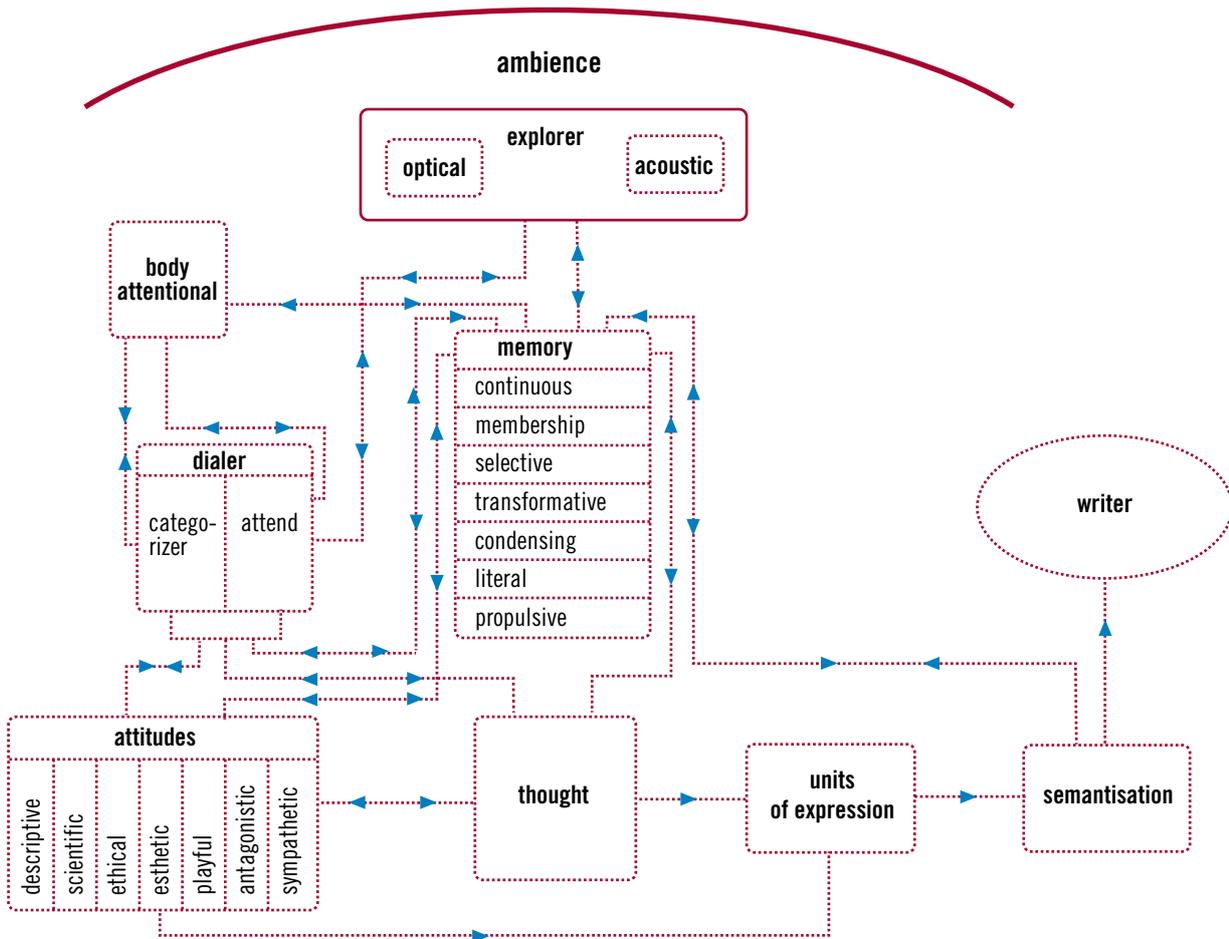


Figure 1: Block diagram of the machine that observes and describes (Ceccato 1965).

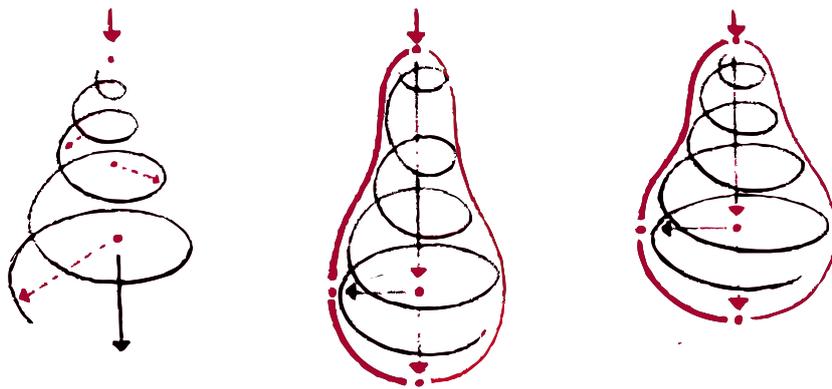


Figure 2: "Pearness."

A cybernetic approach to cognitive processes

My first memory of Ernst von Glasersfeld goes back to the beginning of the 1960s when Silvio Ceccato brought together a group of scholars, which included some international scholars, at the Centre for Cybernetics at Milan University to involve them in the project on the mechanization of higher-level human activities.

This project had as its objective the cybernetic approach to cognitive processes with particular reference to visual perception, which Ceccato presented with his model of the "machine which observes and describes." This project was integrated with a linguistic translation project that was financed by the American government with the principal aim of translating from Russian to English, which at that time was of great strategic importance.

Thus two distinct research sectors were formed that, although having different aims, were based on the same theoretical presuppositions. These presuppositions were those that Ceccato had revised in years of research in the attempt to analyze the human mind in terms of processes and that in his model were identified in the mnemonic-attentional activity, the constituent of every content of thinking.

Bridging the mind-body gap

On the basis of these theoretical and methodological presuppositions and from

the meetings of Ceccato with Giuseppe Vaccarino and Vittorio Somenzi in the second half of the 1940s was born the "Scuola Operativa Italiana" (Italian Operational School), which they founded.

It was at that time that von Glasersfeld began to collaborate with Ceccato, dedicating himself to the translation of Ceccato's theoretical papers, which were the basis on which he developed the pathway of thought that identified him in the realm of radical constructivism.

Due to his interest, when Ceccato suggested taking part in the linguistic project, he accepted the invitation with enthusiasm. For two years he worked for the linguistic group, developing that correlational approach to thought that has always distinguished the operational direction from traditional linguistics concerned exclusively with syntactical and grammatical aspects of language.

To overcome these limitations a semantic analysis of words was required. This was exactly the task of the team working on the cybernetic project, with the engineer Enrico Maretti and the collaboration of another engineer, Renzo Beltrame. They were moving from the stage of a purely theoretical outline to the stage of planning the organs and functions of the thinking machine.

In a previously published article in Leonardo Sinisgalli's *Civiltà delle Macchine* ("Civilization of Machines") in 1962 under the title "L'osservazione nell'uomo e nella macchina" ("Observation in man and ma-

chines"), Ceccato demonstrated the block model (Ceccato 1962). It dealt with the mental functions associated with visual processes, indicated in the diagram by the interconnections between the various apparatuses (Fig. 1).

Ceccato's block model was essentially a project for research and experimentation, and it was only with the most advanced technical developments of those days that it could have been achieved. This project was, above all, intended to be a theoretical statement to overcome the antitheses, "mind-body," "spirit-matter," "object-subject," and so on.

Based on these theoretical assumptions, the extensive research executed by the "Italian Operational School," with the fundamental contributions of von Glasersfeld and Giuseppe Vaccarino, made possible the most advanced level of analysis of cognitive processes. (Ceccato 1972; Ceccato & Zonta 1980; Vaccarino 1988, 1997, 2000).

The research carried out in the center for cybernetics in the early 1960s had already outlined an almost complete framework of mental activity, in particular concerning the complex functions of vision. The latter was crucial as the construction of the "viewer" had already begun. It was the only component of the machine to be constructed.

The model still maintains its innovative power because since then it has dealt with the problem of overcoming the antithesis "observer-observed," which is at the focus of many constructivist approaches nowadays.

The concept of "constitutive structure"

The project, when integrating visual functions with mental activity, required those analyses at the semantic level to which von Glasersfeld was committed. So the activity of the two groups was complementary.

The machine would be able to recognize objects from its *experiential world* only if the "viewer" had functioned interactively with the *unit of semantization* (i.e., linking words using a suitable "constitutive structure." Cf. bottom right of Fig. 1 and Fig. 5 below).

These in turn had the function of setting up the link with the *matrix of memorization*, where the articulations of the various objects were recorded according to a pattern,

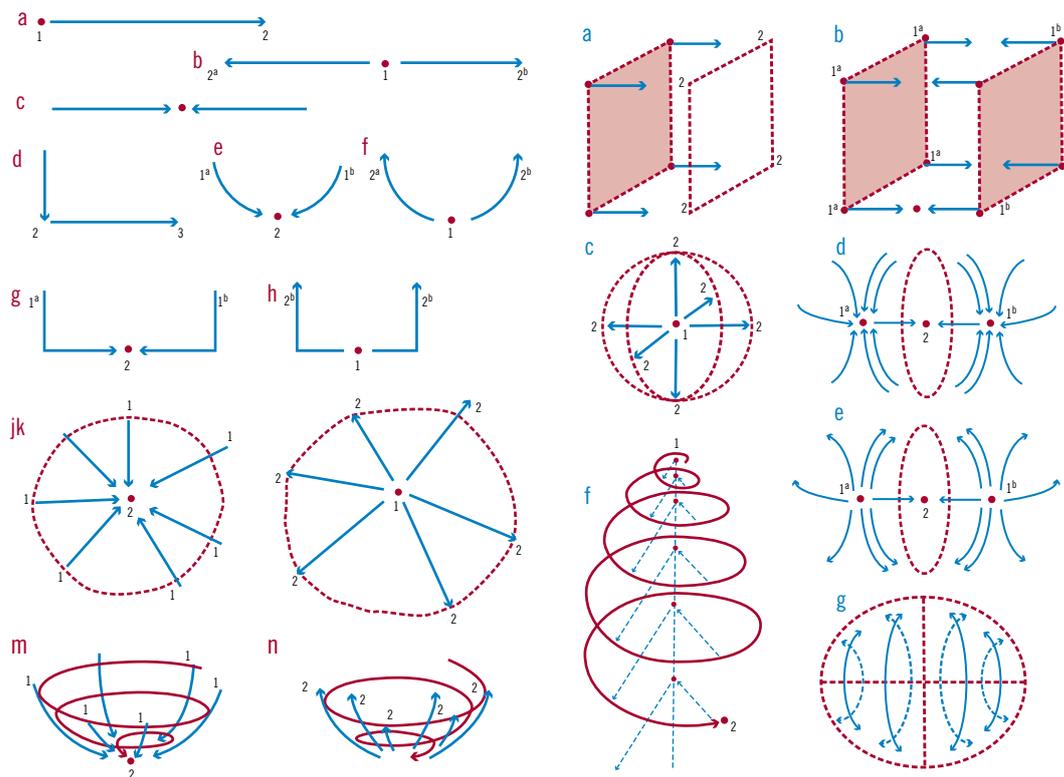


Figure 3: Elementary constitutive structures.

which for its synthesis and dynamism was defined as the *constitutive structure*.

The matrix of memorization required first of all that the articulations of the constitutive structures were ascribed to the dynamism of the basic components of figuration: line, region and volume.

Of course it was not possible to resort to the neutral and static abstraction of geometric figures to build volumes as it would not be possible to adapt them to the variability of the forms and even less so to the dynamism of the constructive structure.

As I was a painter, it was Ceccato himself who suggested looking for a graphic solution to the problem, a solution able to visualize the constitutive structure of seven objects that were to be part of the perceptive world of the machine: an apple, a pear, a plate, a glass, a melon, a head of lettuce, and a mechanical tortoise.

And so the “perità” (“peariness”) was born from this. It was sufficient to estab-

lish a main vector with reference to which a dependent vector constructed unitarily the characteristic volume of the pear, in which the upper bell-shaped part converged with the lower part without interruption (Fig. 2).

The vector, with the aid of other graphics, offered me the possibility to represent the dynamic aspect of the constitutive structures of the other objects. I thus obtained through this analysis a table (Fig. 3) collecting the primary modalities with which to constitute the surfaces and the volume of objects.

The most elementary of the dynamics was the rectilinear movement; this already offered the possibility to proceed in two directions. In turn, the perceptive representations of “concave” and “convex” and “expansion” and “contraction,” etc. were the result of the inversion of the dynamism itself.

Furthermore it was established that in certain objects the constitutive structure presented itself in the invariance of rela-

tionships established between the articulations; that is, with regard to the univocality of the denomination. For other objects or environmental situations, on the contrary, various alternatives were presented that were mainly due to cultural factors or the attitudes of the observer. To give an example, the living unit visualized by the floor plan in its paradigmatic elementary form can be seen alternately as a “room,” a “cell,” or a “prison” (Fig. 4).

The walls are always the same, but in the “room” they are perceived as protection, shelter and comfort, warranted by the belief of being free to come and go at will.

In the “cell” of the mystic, considered as a place for meditation and prayer, the same physicalness of the walls vanishes by direct participation in the absolute and in the transcendent.

However, this physicalness looms inescapably and tragically over the “prison,” where every freedom is denied.

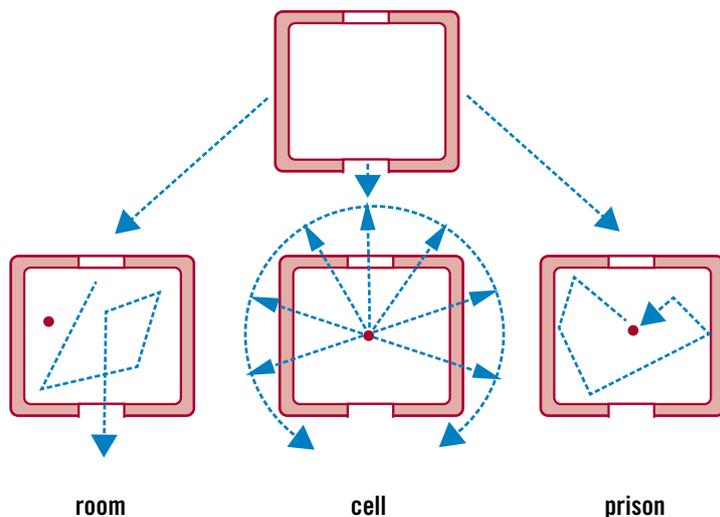


Figure 4: Influence of attitudes on constitutive structures.

Correlational structure

On the basis of the analyses concerning the semantic aspect of language, a community of intention and a complementariness were therefore established between the group dedicated to the cybernetic machine and the group of linguists where von Glasersfeld was elaborating the correlational structure of thought that Ceccato exemplified in the pattern of the three boxes:



The upper section was assigned to the correlator, whose duties are carried out predominantly by prepositions, conjunctions, adverbs etc. In turn the boxes below were reserved for the correlated pair, with the names of the things to be put into relation.

While the group of linguists was intent on developing complex correlated networks, our group, which was dedicated to the cybernetic project, made use of the same triadic unit, as the correlated network of thought established the relationship between the physical sphere and the mental one.

To bring these ideas together, it can be demonstrated how the constitutive struc-

tures of an apple, a pear and a plate recorded in the memory matrix would permit the elaboration of a linguistic expression, even if simple and elementary (Fig. 5).

After many years I was able to meet von Glasersfeld at a small conference organized by the Società di Cultura Metodologico-Operativa, the 5th Intrattenimento Metodologico-Operativo, held in Rimini in September 1997.¹

I still have vivid memories of the lively discussion aroused by the speech made by Giuseppe Vaccarino in which he presented his list of “presentiata,” that is, colours, smells and tastes, etc.

In spite of differences in interpretation, von Glasersfeld maintained the conviction that this initial first moment of perceptive activity was very similar to what he intended when he referred to “sensory signals.”

Reflecting later on some of his writings, and in particular those that I received through the Working Papers, I realize how some of his basic concepts, although arising from his own autonomous thought, confirm his substantial adherence to the presuppositions of the Italian Operational School.

1| Cf. http://www.methodologia.it/wp/WP_88.pdf for a summary.

I refer mainly to his fundamental definition of *experiential*, with which he frees himself once and for all from the *ontic* presupposition of a given, self-existing “reality” and that he articulates in various *experiential situations*.

In the same definition of *experiential patterns*, I find a surprising analogy with the “constitutive structure,” as he manages to summarize with this concept the interactive relationship that is established between the processes of categorization and the solicitations from the experiential world.

Didactic implications of operational awareness

The collaboration with Silvio Ceccato and the association with the “Centro di Cibernetica” (“Centre of Cybernetics”) marked the start of that adventurous and absorbing research activity that permitted me to mediate the “Cybernetics of the mind” with artistic education and that I undertook on the basis of the presuppositions of the Italian Operational School.

The contribution by Maurizio Calvesi, prestigious art historian, was decisive, together with the ideas contributed by Ceccato, in the elaboration of criteria of “Visual Education” in the form of two texts: *L’Immagine* (Parini & Calvesi 1970) and *Il linguaggio visivo* (Parini & Calvesi 1980). These texts were later widely circulated in the operational didactic groups (Parini 1961, 1963; Beltrame 1970; Glasersfeld 1998; Bettoni 1989).

At a distance of many years, together with stimulating reflections that I made when re-reading and meditating on the works of von Glasersfeld, I unexpectedly find a surprising convergence of his analysis of cognitive processes with my experimentation. This convergence is particularly interesting because of the implications it could have in the field of didactics.

I find inspiring, exhaustive illustrations that must undoubtedly be exploited. And when offering my availability to closely examine them, I introduce in synthesis some of my analyses for detecting and comparing some concepts that could be developed.

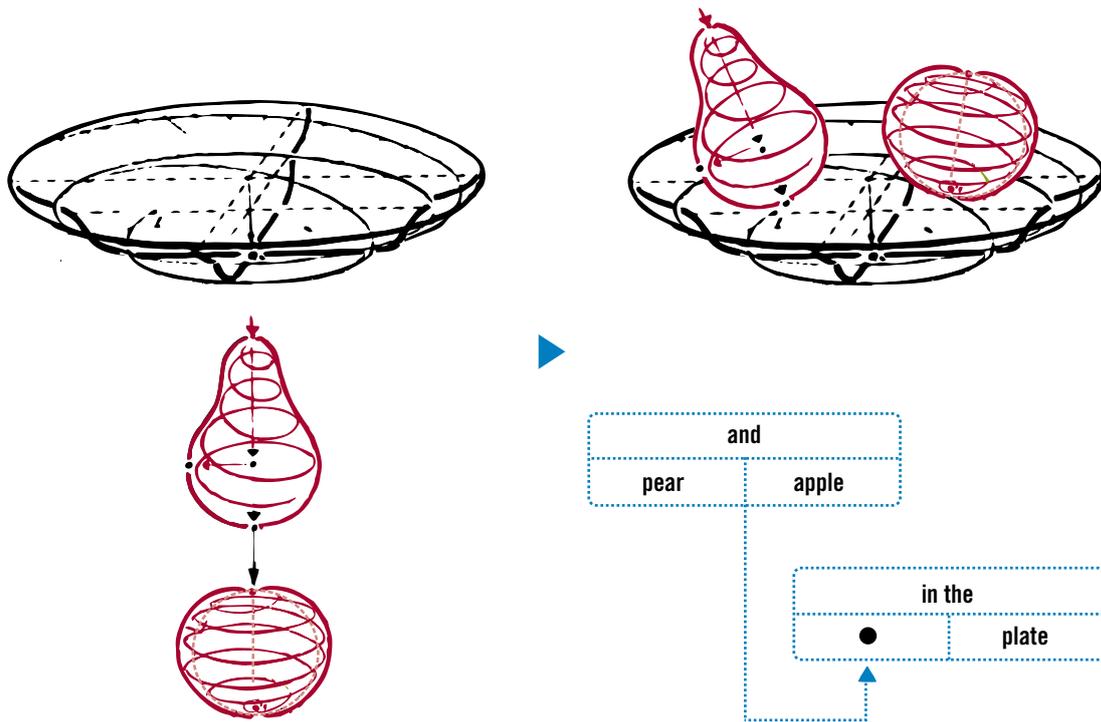


Figure 5: Process of semantization.

Alternating figures

I demonstrate the simplest of the “alternating figures” that I usually make use of in my didactic demonstrations by means of the picture shown in Fig. 6. Through my awareness of the interactive relationship between observation and language I introduce, therefore, an analysis of the fundamental components of figuration, starting from the “point” and the “line.”

We are still dealing with the task of overcoming the prejudice of a self-existing “reality.” Performance of this task is now available to us through the synthesis that Ceccato

offers us with his “unified model of man” (Ceccato 1983) and von Glasersfeld with his definition of the “experiential world.”

Consider Fig. 6. Any pupil who is requested to establish the central point in this figure is able to indicate it without the help of the typical mark with which it is normally visualized.

He/she will understand therefore how the point is, in reality, nothing other than the pure dynamism of attention that focalizes on that particular place.

In a different way, it is due to the switching of attention and to the relationships that

are created if the radius and the diameter are established in the same figure.

This demonstrates further that the meaning of “stroke” and “line” in substance corresponds to pure attentional dynamism and that only due to a lack of awareness is it improperly attributed to the physical appearance of the layout.

Finally, to discover the constitutive operations of surface, volume and figurative spaciality it is sufficient to prod the observer into seeing the same figure alternatively as a “ring,” “circle” or “sphere” (Fig. 7).

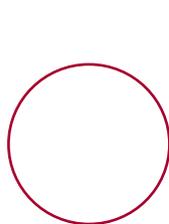


Figure 6: Alternating figure: “point” or “line.”

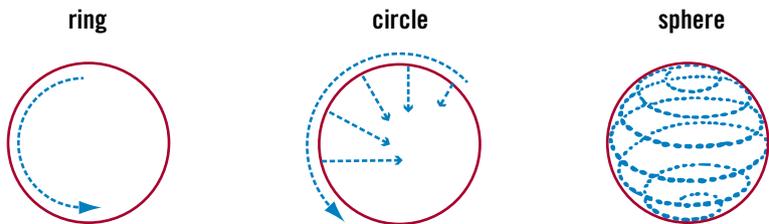


Figure 7: Alternating figure: ring, circle or sphere.

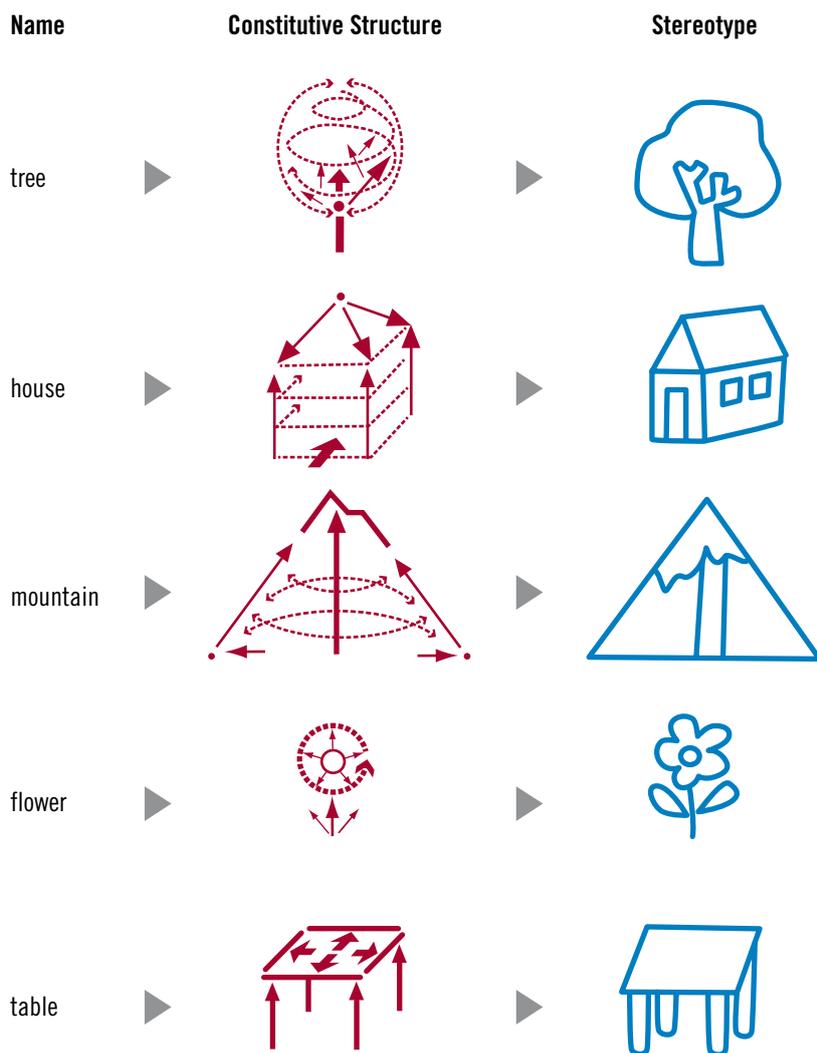


Figure 8: Recognizing things.



Figure 9: Line, wave or distinct spots?

Glaserfeld investigated in depth, plays a determinant role. In this process the generative nucleus must at any rate be seen in its constitutive structure. A synthetic visualisation is shown in Fig. 8.

Concordance with radical constructivism

Von Glasersfeld's systemic research in his lifetime aimed to integrate the presupposed theories and methods of the Operational School with contributions from the constructivism of Jean Piaget. At this point it becomes understandable how this research can now offer new instruments in research and experimentation, not only to scholars of cognitive science but also to pedagogues. Indeed the most immediate contribution lies in the analysis by means of which von Glasersfeld, with great efficacy, succeeds in explaining that everything that we see and imagine is our own mental construction. It refers, in fact, to bringing every cognitive experience back to the activity of memory and attention. In this connection, there are some significant demonstrations that he presented in his book *Radical Constructivism: A Way of Knowing and Learning*, and to which my own reflections mainly refer. A simple graphic illustration has an immediate communicative effect (Fig. 9) that he makes use of in order to promote the awareness that the appearance of things is the result of the *conceptual structures* with which the mind categorizes the *experiential world*, and not the passive reflection of a preconceived reality of which we would otherwise be passive observers (Glaserfeld 1995: 165).

Following his words precisely, he demonstrates how the sequence of points may be viewed not only as a single linear trend, but also as three bumps with two concavities, and finally as a myriad of small and quite distinct spots.

Looking at this analysis, what has impressed me is its conformity with the teach-

When seeing the ring, our attention, by following the layout, constitutes the "roundness," assigning a minimum volumetric consistency to it.

In the "circle" it is instead the area inside the layout itself, which is constructed by attention in the articulation of two-dimensional geometry.

In the "sphere" finally it is the mental construction of the volume in its three-dimensionality which freely prevails.

The surprising consideration of the mental activity as constitutive of figurative spaciality and of volume soon caused me to radically change my criteria in the evalua-

tion of the stereotypicality predominant in children's graphic expression. Quite often negatively considered, these same stereotypes now allow a more careful investigation of cognitive processes. For example, it is possible to understand that the simple linear design by which a child renders the image of a small ball or a balloon, or even that of the sun or the moon, is certainly not a flat representation. The volume as seen above with the "sphere", is our mental construction and this is also true for all the images that a child spontaneously designs.

This is a process in which "the experiential activity of recognizing things" that von

ing illustrations that I have always proposed in my visual education and theory of perception courses, first to my high school students and then to those in the faculty of Fine Arts (Parini & Calvesi 1970, 1980; Parini 2002). Among my analyses I therefore choose the “Line” in order to demonstrate that only the agreement of the results and of the criteria of investigation, which have united us in our experiences, can guarantee the validity of the method. Von Glasersfeld himself would confirm its “viability.” A graphic exemplification allows this claim to be verified (Fig. 10)

The layout offers many alternatives, which are presented here described by six different adjectives. It is to be noted that it depends on the various ways of composing or decomposing the elementary strokes of the curve, if what is obtained is what has been defined by von Glasersfeld as “unitary items” (Glaserfeld 1995: 165).

The same outline may be seen in various ways, depending greatly on the different articulations. Among these the contraposition between the “soaring” and the “flabby” definitions is certainly surprising. Being antithetical definitions, they cannot be attributed as intrinsic properties of the layout. The contradiction resolves itself in the demonstration that it all depends on the mental operation concomitant with the path of sight.

Finally, in this same line, in order to see it as “beautiful,” one has to establish the rhythmic correspondences between the various lines in which it is articulated. This requires the awareness of operations that constitute the aesthetic attitude and it is precisely in von Glasersfeld’s texts that one can find precious cues of reflection useful for deeper research on this controversial problem. An analysis of the dynamics involved in a simple linear trace is particularly interesting (Fig. 11).

He prompts us to notice how the same figure can be seen as a single unit if the attention holds it present for its entire path. But the same attention can subdivide it into two-thirds or four-fourths and so on in the articulation. These are the basic modalities on which aesthetic enjoyment is based and

Figure 11: Linear trace.

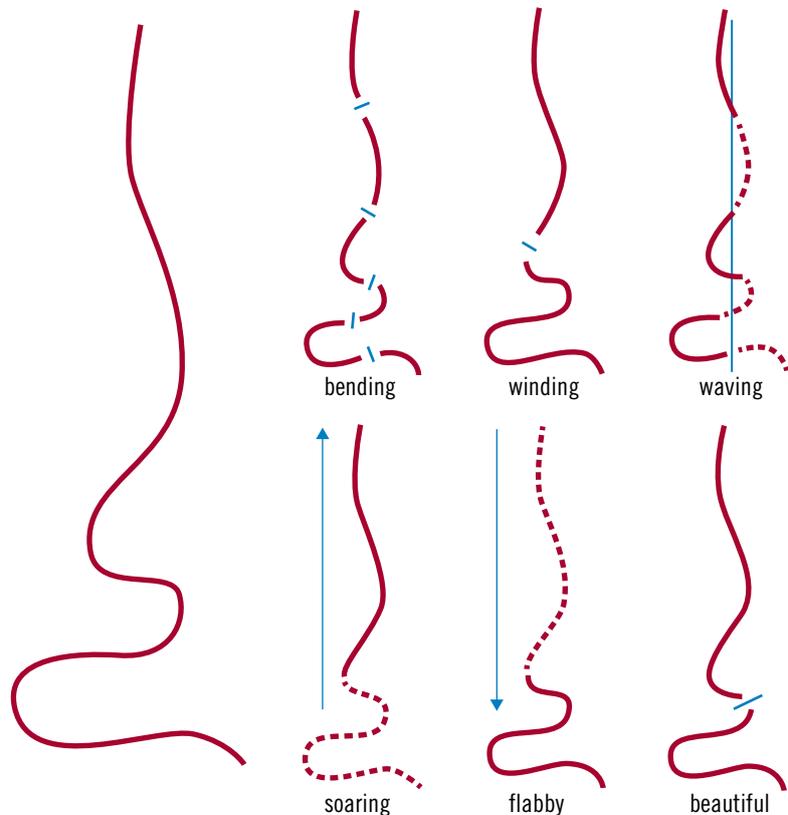


Figure 10: “The line.”

through which relationships referring to symmetry, balance, proportion and so on are built.

With this simple example, von Glasersfeld leads us furthermore to reflect on the autonomy of attentional activity, which allows to constitute the various units even without the *sensorial elements* that may solicit their distinction.

Nevertheless the clearest exemplification of the operational process of attention in segmenting the *basic units* that are constitutive of *experiential elements* is found in his fundamental essay “An attentional model for the conceptual construction of units and numbers.” In his text he states that *the experiential object* is the result of *attentional focalizations*, with which the single units are constituted, and that these eventually turn out to be delimited by moments of

suspended attention, which then determine their individualisation and separation.

These are the operations where our criteria of analysis coincide. Nevertheless I found it necessary for teaching purposes to translate my analysis in the specific language of visual communication.

And this has led me to visualize the attentional dynamism, resorting to various graphic signs such as darts and dashes, pointing out in my didactic exemplifications that resorting to these means is a purely instrumental expedient. This awareness leaves no room for misinterpreting the validity and efficacy of von Glasersfeld’s idea.

His affirmation that attentional activity is independent from sensorial signs and that consequently the *partitions are a free creation of the perceiver* is certainly decisive and has been confirmed on various occa-

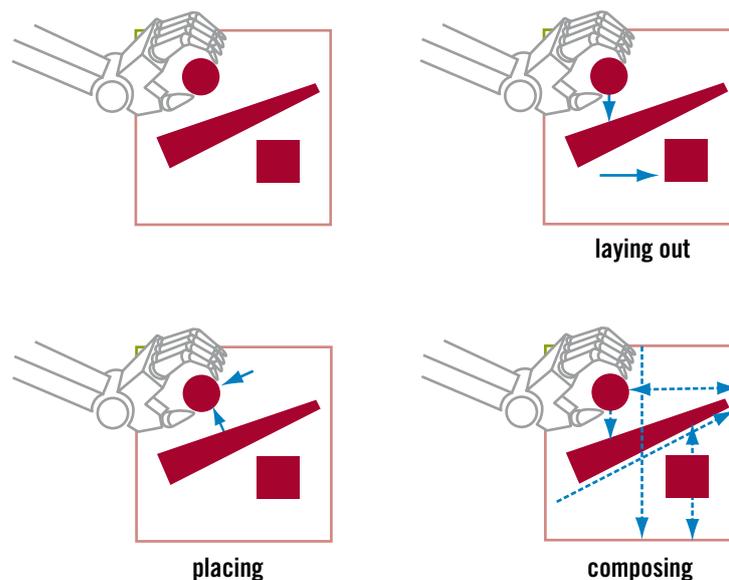


Figure 12: Same gesture – different meaning.

sions. This notion is sustained in the affirmation that geometric elements are *concepts rather than physical things*. We can have the most convincing evidence of this in the field of artistic expression through the awareness of mental processes at the base of perception and representation.

The analysis of the relationship of interdependence between observation-language will, at any rate, be the most effective means of becoming aware of cognitive processes and in particular those that facilitate visual communication.

We must at any rate keep in mind that communication, in its most widely understood sense, only takes place if the constitutive operations that are the foundation of all human activity are shared, either when dealing with a gesture or with a work of art itself.

In a painting “the rules of composition” do not impose themselves as something physical, because, as von Glasersfeld was to demonstrate, they are a conceptual construction created by ourselves. He himself has repeatedly stigmatized the dogma of behaviorists who hold as significant only what is observable.

This is the same attitude adopted by those who claim to be able to understand

a painting, for example, by limiting themselves only to its representation of the subject, precluding in this way the possibility to appreciate it for its aesthetic values based mainly on the compositional relationships.

To arouse awareness of this I often make use of a didactic performance, which I now propose again, also as a means of keeping discussion and research open (Fig. 12).

The performance consists of picking up objects one by one and then slowly putting them down on a table. The same actions are repeated three times.

Anyone observing the same repeated gestures is led to say that the meaning is identical.

The action is then repeated once again saying alternately and in sequence the words – I place – I lay out – I compose.

In this way it is clear to everyone that it is words that give meaning to our gestures and our behavior.

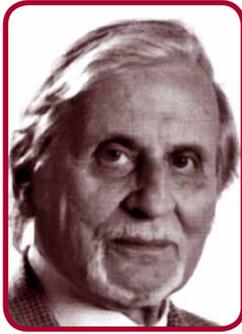
It is easier to show how during the “placing” action the subject tends to focus on every single item that will be perceived as isolated from the others. Instead, when “laying out” a distributive criterion tends to prevail which takes us back to habitual conventions.

It is precisely in the composing phase that one is induced to establish the multiple relationships between objects and background, that is, the reference to the principles of order, symmetry and proportion, as though it were a work of art.

This is certainly a stimulating introduction to aesthetic communication (Ceccato 1987; Amietta & Magnani 1998).

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PINO PARINI

Pino Parini received his diploma of professional master of painting from the Bologna Academy of Fine Arts in 1948. In May 1959 he presented in Milan his "Theoretical Painting Manifesto," exemplified by visualizations of Kant's Transcendental Schematism. This was the occasion that later brought him to the meeting with Silvio Ceccato, director of the Centre for Cybernetics, University of Milan. Thus began that lasting collaboration that led him to apply the analysis of mental activity in the field of art and aesthetic education.

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RECEIVED: 1 FEBRUARY 2011

ACCEPTED: 23 FEBRUARY 2011