Segre, Cesare (ed.)
1965 *Strutturalismo e critica.* Milan: Il Saggiatore. New edition, with new Preface—Milan: Il Saggiatore, 1985.

Gianfranco Bettetini (b. 1933) is chairman of the Department of Communication and Media Studies, Film and Video at the Università Cattolica del S. Cuore (Milan), as well as scientific director of Instituto di Ricerca Agostino Gemelli sui Problemi della Comunicazione. His principal research interests include semiotics, sociology, and models of communication. Among his publications are *Cinema, lingua e scrittura* (1968; English translation The Language and Technique of the Film, 1973), *L'indice del realismo* (1971), *Produzione del senso e messa in scena* (1975), *Tempo del senso* (1979), *Scritture di massa* (1981), *La conversazione audiovisiva* (1984), *L'Occmio in Vendita* (1985), *Il segno dell'informatica* (1987). Address: Istituto di ricerca Agostino Gemelli sui problemi della comunicazione, V. le Piceno 60, 21129 Milano, Italy.

René Thom's Semiotics: An Application to the Pathological Limitations of Semiosis[1]

Laurent Mottron

Principles of Thomian Semiotics

Scope of the Present Paper

René Thom's semiotics is a huge domain; in both the complexity of its mathematical foundations and the deep philosophical problems it faces, it far exceeds the scope of this article. Its latest formulation, if we except 'L'espace et les signes' (1980), is the 'Esquisse d'une sémiophysique' (1988).

Thom's often elliptical idèas in this field have been systematically developed by three authors (presented here in order of their relevance to the semiotic field). Jean Petitot, mathematician and philosopher, wrote (in addition to his own theories) a monumental account of Thom's work in *Les Catastrophes de la parole* (1985) and *Morphogénèse du sens* (1987). Petitot deepened the relationship between catastrophe-theoretic semiotic and structuralism, Kantian schematism, and other semiotics (primarily that of A.J. Greimas); he also achieved a didactic description of its mathematical grounds. His ambitious work gives catastrophe theory a unique status in the mathematization of *a priori* constraints on meaning. Catastrophe theory remains difficult to master because of its use of numerous disciplines and its extraordinary level of generality, but Petitot collects the various threads of Thom's theory and develops them to their ultimate epistemological consequences.

Wolfgang Wildgen, a linguist, took catastrophe theory in a different direction, developing the extraction of archetypal morphologies from elementary catastrophes and their semantic applications. He also gave a critical overview of the relative importance of catastrophe-theoretical semantics with respect to other formal semantics and other linguistic applications of dynamic and stochastic models.

Jean Largeault, philosopher and logician, wrote extensively about the importance of Thom in the realist stream; though he did not focus on semiotics, his works are nevertheless fruitful for semioticians. While Petitot and Largeault differ in critical orientation from Wildgen regarding the maximum extension of Thomian

thought, the work of these three authors faithfully corresponds to the subject of this article.

My own contribution, which cannot be compared with the three previously mentioned, expands on a limited area of the theory—namely, how catastrophe-theoretical models for semiotic classification may be confirmed by pathological (autistic, schizophrenic) or developmental (ontogenesis of semiotic junction) limitations of the possibility of semiosis.

After a brief presentation of Thom's semiotics, I shall limit the scope of this paper to an examination of the threshold of complexity that distinguishes sign use in an autistic subject from that in a normal subject, and I will relate this to the threshold of complexity separating the categories of semiotic junction in Thom's theory. I will not discuss the inclusion of semiotics in a more general *'sémiophysique'*, though such an argument for the universality of Thomian semiotics would correspond to the 'all is semiotic' of C.S. Peirce. In order to avoid misleading the reader into thinking that our catastrophe-theoretical application is equivalent to Thom's in its level of generality, I would like to emphasize this author's argument that classifications for signs are not restricted to signs, but are valuable for any conflict of *'prégnances'*[2]—i.e., to morphologies created by conflictual dynamics, or investment of a domain by an energy.

For René Thom, the relevant semiotic for human language is included with zoosemiotics in a more general semiotic called *'sémiophysique'*; the latter is in turn included in the more general mathematical concepts of dynamics and singularities. The 'biologization' of semiotics is only one aspect of Thom's more general geometrization of abstractions. As with C.S. Peirce, Thom's classification of signs and sign-processing must be included in a common list of categories, because the classification itself has a universal value, and because Thom conceives the human mind as a tracing, a simulation, an 'exfoliation' of the outside world, constrained by the same *a priori* laws as that world. Thom uses ontogenetic examples to show that *a priori* semiotics and its psychological realizations overlap, supporting a realist philosophical position. This analogy cannot be reduced to a linear causality, in the sense that the human mind should be governed by the same laws as the world because it comes out of the world; rather, it is explained by the universality of laws governing abstract and concrete dynamic conflicts. In catastrophe-theoretic tradition, a classification is justified by the generality of its application, not by quantitative validation.

I intend here only to give factual reasons in support of a part of this magnificent theory, reasons that may in turn shed some light on a few extremely important questions in normal and pathological cognitive psychology—for example, the profound nature of the differences between normal adult thought and animal thought, or normal thought and autistic thought, or between a recall from episodic long-term memory and one from semantic long-term memory. The difficulty in establishing clear boundaries, in normal subjects, between intermediate levels of complexity in the 'black box' of cognitive and semiotic processes—in the sense that the subject presents only the result of his mental operations, and offers no hints on the simpler units with which he works (or which he has to bypass) to think in a normal adult way—may be overcome by looking at what does *not* develop in autistic thought. It can be shown that autistic semiosis, 'subtracted' from normal semiosis, makes visible intermediate levels of complexity that are invisible in normal thought. If it is possible to compare pathological semiosis and the limitation of complexity between elementary catastrophes, we will, from a semiotic point of view, have gone one step further in the justification of the 'phaneroscopic' categories of Firstness, Secondness, and Thirdness; and from a catastrophe-theoretical point of view, we will have found a new field of application. These categories would constitute the *envelope* of a pathological syndrome—i.e., that which governs its symptomatic components as a morphological cause between the *causa efficiens* and what can be phenomenologically classified.

Four Principles of Thomian Semiotics

Following are four Thomian principles which I shall try to justify by reference to the psychopathological limitations of semiosis:

—*PRINCIPLE I:* The unit of a semiotic process, the configuration, is defined by its effect. A subjective categorization of a configuration is the identity of subjective effect produced by a family of shapes objectively connected by contiguity and similarity.

—*PRINCIPLE II:* Meaning is the effect of a configuration on a given subject. This configuration is then said to be invested with a *prégnance* which spreads over space and time, through contiguity and similarity, to other configurations.

—*PRINCIPLE III:* The different ways for a configuration to produce an effect (i.e., the different kinds of signs) may be classified by the number of configurations joined by an effect.

—*PRINCIPLE IV:* There is a threshold of complexity between two different kinds of effects, grouping one, two, three, or four configurations. A resistance that maintains the homogeneity of each kind of sign has to be overcome in order to jump from one kind to the other. The maximum complexity for junctions between configurations is defined by the highest number of conflicting states in elementary catastrophes, as in the general case of morphologies created by an energy transfer or '*diffusion de prégnance*'.

PRINCIPLE I: Definition of Categorization and Application to Ontogenesis

For René Thom, the unit of a semiotic process is a domain of space, and not an abstract unit logically defined by its possession or lack of a particular characteristic. He interprets Jakobson's distinctive feature as being a class of effects on an organism, rather than membership in a set. In its simplest, unitary form, which constitutes the foundation of semiosis ontogenetically and phylogenetically, a configuration whose spatio-temporal determinations are fixed is identified by its effect. This effect is produced by phenomenal characteristics of the shape, as in Lorenz's 'releasers'. Effect and shape are necessarily related for a particular species. Nevertheless, this phenomenal characteristic does not coincide with the appearance of the shape. Category has a subjective definition, a deformation or simplification of the visible outline. Category is a relationship of equivalence between shapes which produce the same effect (Thom 1988); these shapes are joined together by a junction that occupies the second place in Thom's classification. As the effect of a shape may spread to other shapes by contiguity or similarity, a shape can only individualize itself by an 'effect conflict' with other shapes. Two conflicting dynamics create a boundary that organizes—'structures' in the strong sense—a kind of junction between two configurations.

In a way closely related to Jakobsonian structuralism, as Petitot points out, Thom's semiotic unit is obtained by the division of an upper level, which results in several lower units related by reciprocal dependency of a nature specific to the complexity of the considered level. Its opposite would be the aggregation of the elements of a pre-established lexicon to obtain a superior level.

Categorization is more than just the basic element of semiosis. While units are required to join units, the junction may also create units; therefore, it does not occupy the lowest position in the classification of semiosis. Categorization has, as a necessary condition, a 1-semiosis, the mere production of an effect by a shape. Nevertheless, even if the effect is generated by a domain of space, this domain has no boundaries until it comes into conflict with another domain producing another effect, whether the same or different. Categorization has to be stabilized by an effect junction with another—the 2-semiosis junction. We shall see later how the creation of a new category from existing ones necessitates a still more complex junction, the 3-semiosis junction. Just to have a categorization, mental functioning of the highest complexity is required.

The Classification of Semiosis. Let us examine the three kinds of semiosis—1-, 2-, and 3-semiosis junctions.

1-semiosis: Shape 1 produces an effect A (Figure 1).

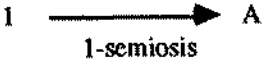


Fig. 1. 1-semiosis junction

2-semiosis: Shapes 1 and 2 both produce an effect A. There is an effect junction between 1 and 2. A 2-semiosis relates two 1-semioses, but the 2-semiosis cannot be reduced to the 'sum' or the 'aggregation' of two 1-junctions. They are of a different nature, since the production of an effect differs from the relationship of equivalence between the production of two effects (Figure 2).

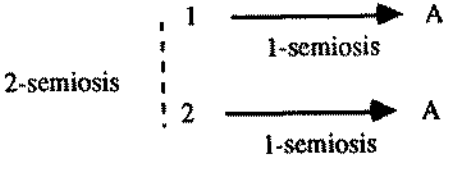


Fig. 2. 2-semiosis junction

3-semiosis. Shape 1, producing an effect A, transmits shape 2 to shape 3, which in turn produces effect A. Although 2 is part of both 1 and 3, 1 and 3 are essentially different. This process creates a new category in the sense that effect A, even though it remains unchanged during this transformation, becomes attached to a new configuration. The effect A produced by family 1 and the effect A produced by family 3 are considered *different categories.* Instead of a relationship of equivalence between two shapes *vis-à-vis* an effect (the categorization according to its true meaning), or already there (2-semiosis junction), the 3-semiosis junction is the act of creating a new category by transferring an effect to a new configuration.

A 3-semiosis junction cannot be reduced to the sum or the aggregation of two relationships of equivalence, between shapes 1 and 2 and between shapes 2 and 3. It is the process of transformation of an identity effect between 1 and 2 to an identity effect between 2 and 3 (Figure 3).

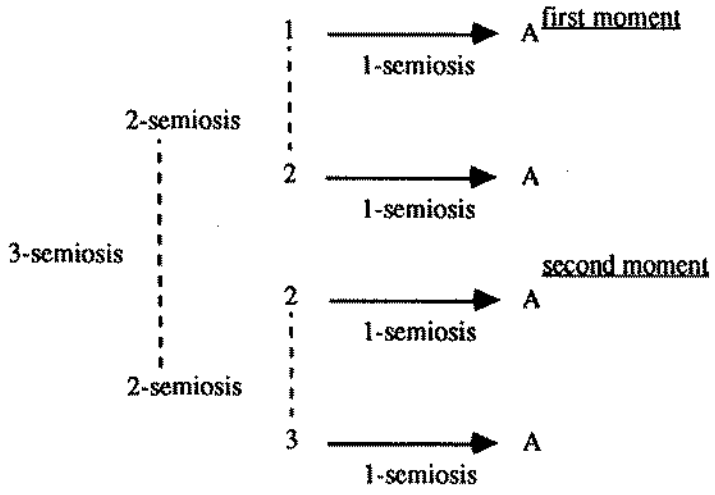


Fig. 3. 3-semiosis junction

A strong kinship links semiotic category (defined as the identity of effect produced by its members) and prototypicality in psycholinguistics (Thom 1988). Even after minimal variation, the stability of a configuration that evokes the same effect has something in common with the identity of concept under its different recalls and recognitions. Even if we do not accept the idea of a mnemic trace remaining identical between recalls (Tulving 1983), the regulation responsible for

the functional identity of a semantic long-term memory unit during its combinations with others corresponds to the extrinsic definition of a category by identity of its effects over time. Similarly, Peirce (*CP* 2.228) considers the stability of an idea over time to be the foundation of representamen.

The Processing of Variation. The Thomian definition of category helps us understand how variations in an already known shape are processed during developmental evolution by the normal and the pathological subject. This evolution concerns the ontogenesis of categorization from the maternal source-shape and its inborn releasers (how to recognize shapes differing from innate schemes) up to and including the development of semantic memory (how to reduce to their prototypes shapes which differ slightly from them).

When a shape produces an effect, a slight modification of this shape may result in different characteristic situations. If we interpret the 'swallowtail' catastrophe as a schematization of both privative opposition (A/O) and qualitative opposition (A/B) (Petitot 1983) with the following conventions:

—a variation 1′ from the shape 1 is represented by the variation of external variables of the unfolding, corresponding to a particular path; and
—A and B, two effects of a different nature, are represented by the two minima of the internal space function,

these situations may be classified in the following way. After the encounter of the modified shape, any of three options may occur:

—Another effect B, if 1′ already has its own effect; in this case the system possesses two different 1-semioses.
—The same effect A; in this case the system possesses a 2-semiosis, but only one category.
—No effect at all; such a system possesses only a single 1-semiosis.

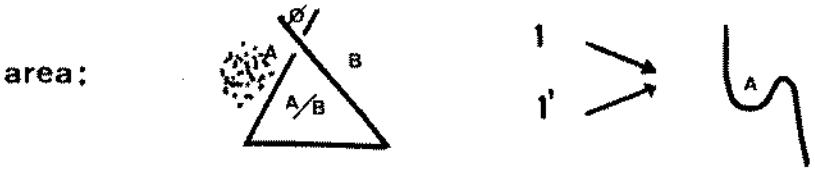
To create new categories, the subject needs a variation-processing system able to 'choose' to either transmit the effect of an already known shape to a neighboring one, or keep the effect tied to the first shape—a system able to choose between the two moments of a 3-semiosis junction. Later we shall see that the autistic subject, in contrast to the normal subject, resists the modification of encountered

shapes by strong emotional effects called 'sameness', and how his perceptual field is invaded by the recognition of a unique shape. The autistic subject processes variation in the second and the third way as illustrated in Figure 4; his ontogenesis of categorization is thus disturbed.

(a) The system already has two classes of effects: $1 \rightarrow A$ and $1' \rightarrow B$.

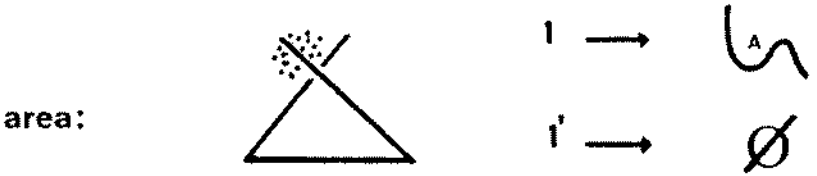
If it always chooses this first solution (each shape is followed by a different effect), its production system branches out infinitely, and there is, strictly speaking, no category (i.e., there is no junction between two shapes producing the same effect). In addition, it presupposes that the system takes care of the variation 1′, that it anticipates it by already possessing the capacity to produce a different effect B. For the system, this is not an opportunity to acquire this capacity.

(b) Extension of the class of shapes producing the same effect: $1 \rightarrow A$, and $1' \rightarrow A$.



If it always chooses this second solution (any shape produces the same effect), it only possesses one category, infinitely extended (i.e., it does not ramify its conceptual system); but at least it pays attention to all shapes.

(c) Effect limited to only one category: $1 \rightarrow A$ and $1' \rightarrow 0$.



If it chooses the last solution, it pays attention to one shape only, precluding the possibility of creating a new category.

Fig. 4. The three processings of variation according to the 'swallowtail' catastrophe

The slight perturbations that do not change the qualitative type (that is, the number of critical points) of the function that represents a certain kind of semiotic junction correspond to the small differences between two tokens of a prototype, processed by a 1-, 2-, or 3-semiosis. The structural stability of a given junction results from the fact that it is not modified by minimal perturbations of the shapes processed or of the different effects produced by the different shapes it encounters (see Principle IV). The discontinuities structuring the configurations joined by a semiotic junction are stable (Thom 1983: 91). In my opinion, therefore, stability is equivalent to the persistence of a more or less complex system for the processing of identities or differences between configurations encountered by a subject. This Thomian idea seems particularly innovative and fruitful in its application to the ontogenesis of human semantic memory, in that it binds the condition of possibility for categorization to a 'bypass' of the emotional system (Mottron 1989b). The system that stabilizes the differences between categories, the condition of possibility for semantic memory, is manifested by the occurrence of emotions, as when emotional parameters for recognition or attention to novelty make a categorization visible. It combines at least three basic emotions related to novelty and relevance of encountered shapes: attention, recognition, and anxiety. Let us consider these three ways of reacting to novelty. If a child has already encountered a shape 1 and then meets another shape 1′ which is slightly different, he may:

—be interested in novelty, in the difference between 1 and 1′ *(attention to novelty)*—1 produces A and 1′ produces B;
—take no notice of this difference and react to 1′ as he reacted to 1 *(recognition)*—1 and 1′ both produce A; or
—take no notice of the modified shape, or present a 'sameness' reaction to novelty *(anxiety)*.

To obtain a new category B, another 1-semiosis, an effect A must be present, and *A must transmit its effect to B* (3-semiosis). Entertaining a categorial relationship with A by a 2-semiosis is not enough. The genesis of 3-semiosis, as has been pointed out (Wildgen and Mottron 1987), may be explained by the transmission of an original releasing shape to others. If 1 is the mother, 1′ the mother pointing to an object, and 2 the object considered independently from the mother, we may conceive of the creation of an object's own effect according to Figure 5.

A new category of shapes produces an effect A by a feature completely different from that in 1, on the condition that interest exists for the difference between 1 and 1′.

Finally, if the phenomenal difference between 1 and 1′ produces an anxiety-to-novelty response, the effect of a configuration cannot permeate an essentially different configuration, and the processing system for variation is reduced to a 2-junction, linking together everything that resembles or is contiguous with a shape that produces a 1-semiosis without being sufficiently different to produce a sameness reaction.

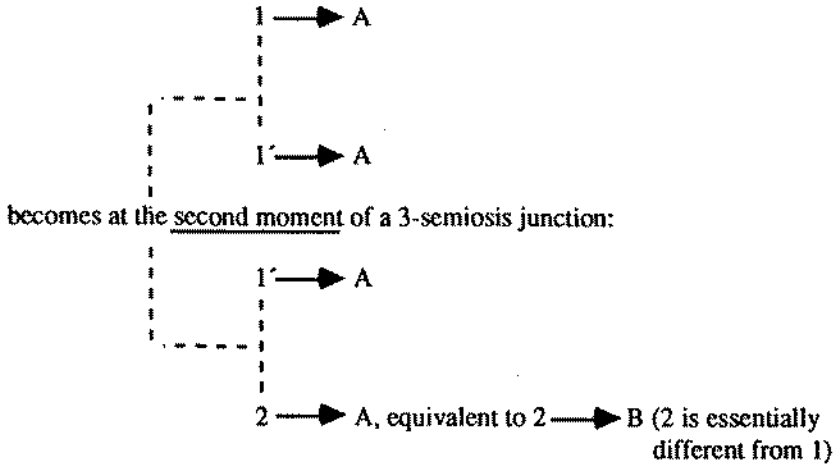


Fig. 5. Creation of a new category by a 3-semiosis junction

Thomian semiotics seeks to demonstrate that the category-skeleton of semiotics originates in man's animality by giving us a conceptual support to describe the dependency of variation-processing on basic emotions. Consequently, we can understand why alterations in semiosis complexity may be concomitant with disturbances in emotions, as in autism.

Principle II: Meaning is the Effect of a Configuration

Configuration's Effect on Man and Animals. Thom connects man's semiotic function, or semiosis, to the effect of a configuration on animals, a set of behavioral and emotional reactions produced by the encounter with a biologically effective configuration. This, *mutatis mutandis*, is the same as Lorenz and Tinbergen's releasers, Pavlov's unlearned stimulus, and Freud's instinctual object. The profound identity between object-produced and sign-produced effect persists even if the processing of the shape occurs after its encounter, and regardless of whether or not there is a memorized sign for the particular shape. Nevertheless, *human* semiosis requires the simultaneous consideration and individualization of (a) the configuration invested by the *prégnance*, (b) its sign, and (c) the effect on the subject, by a 3-semiosis junction *comprising three configurations*.

The fact that Thom sees a difference between animal and human semiosis does not prevent him from rooting human semiosis in animal semiosis by common descriptive tools and common constraints over phylo- and ontogenesis. The energy whose diffusion produces meaning and the concepts of threshold, conflict, and configuration are superordinate to the different levels of complexity for men and animals.

Memory and Effect of a Configuration. The first simultaneous production of sign and meaning is the duplication of a shape invested with *prégnance*, when a configuration tied to an emotional reaction is memorized—the 'now print' phenomenon. The mnemic analogical duplication of the encountered object joins the releasing shape or its effect in a 2-semiosis way. Only the simultaneous consideration of these two junctions will result in a 3-semiosis junction. In Thom's terminology, the *prégnance* of the source-shape has invested the target-shape, its mnemic trace, which still has an iconic dependency on the source-shape in a 2-semiosis junction; in comparison, source- and target-shapes are *essentially different* in the third type.

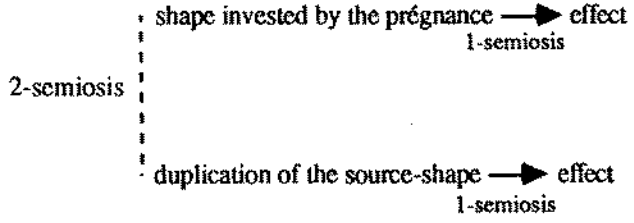


Fig. 6. 2-semiosis junction between a source-shape and its duplication

The memorization of the source-shape produces a duplication of this shape, which in turn may produce the same effect. This effect is the production of another duplication, an emotion, or the transfer of this effect to another configuration. If the target-shape itself becomes a source-shape for another target-shape, there is a chain of 'factorized' junctions between configurations, by *prégnance* diffusion. This model may depict the transformation of an unlearned stimulus to a conditioned stimulus in animal conditioning or the associative links between the 'nodes' of the episodic long-term memory network in cued recall.

In the framework of identification of meaning with a configuration effect, the recognition and the stability of recall (i.e., *the type of mnemic complexity)* are conditions of possibility for semantization of the world. Thom's semiotic concepts naturally find their equivalence in terms of cognitive psychology, perhaps more easily than those of Peirce, and assuredly more easily than those of Greimas. They allow us to go beyond causalist psychological reductionism by means of their specific ability to superimpose boundaries of semiotic and psycholinguistic concepts:

Prégnance, the effect of a configuration, becomes the emotional reaction produced by the matching of feature chunks with long-term memorized configurations (usually attributed to the hippocampus in neuropsychology—Karli 1976). The stability of shape recognition becomes the extraction of a cluster of characteristics in the sensory register or iconic memory by the same matching that occurs in short-term memory (Dick 1974, Long 1980). In cognitive psychology, a picture also becomes a cluster of features regulated by their matching with long-term memory.

Categorization is based on the inborn property of features and clusters of features detection, which releases the first differentiation effects in newborns. The same mechanism would then engender the individuation of secondary source-shapes (objects in the world, words, animates)—every shape whose categorization stability and recognition by normal adult subjects permits a system which is sufficiently stable to be shared by a community.

The ultimate nature of 1-semiosis is the interdependency of shape recognition and its production of an effect, in the sense that no effect can be obtained without recognition, and that effect reinforces recognition and corresponds to the feedback loops in the attention-emotion-memory system.

The threshold between 2- and 3- semiosis junction overlaps the split in long-term memory (LTM) into episodic and semantic memory (Tulving 1983). In episodic LTM, recalls are obtained by partial identity of two linked configurations (the cue and the episodic unity); in semantic LTM, however, the junctions are logical, by inference or by class inclusion, all of which are 3-semiosis junctions.

Gestalt-theory Grouping and Semiosis Complexity. The idea that there is a correspondence between phenomenal features and configuration processing models is not a new one; it is an important principle of Gestalt psychology. The relationship of the simultaneous presence of 1-, 2-, and 3-configurations in a mental operation of given complexity is linked to the relationship of lateral dependency between parts and the whole in a Gestalt (Smith 1988: 34-37). But Thom adds a biological finality which was not included in the 'good form'; his *prégnance* is founded on biology, a Gestalt-theory concept which had until then been abstract. Thom's geometrization of meaning becomes that of mental computation, in the sense that this activity is considered to be a sort of grouping that originates in the biological finality of shape recognition. *Grouping* is a mental activity that cannot be separated from space and time, since we group spatio-temporally contiguous features, and since similarity is a phenomenological concept. 'There is always an element of spatial localization in a signification' (Thom 1983a: 152).

Principle III: The Classification of Semiotic Junctions According to their Number of Configurations

For Thom, meaning is a spatio-temporal event, the transfer of so-called *prégnance* from one support to another. This occurrence is considered to be the ramification of an energy or a flow. It can be described by the catastrophe-theoretic classification of ramifications, like the abstract concept of event in other catastrophe-theoretic applications in linguistics, case-grammar, actantial grammar (Petitot 1982), and semantic events (Wildgen 1982). What applies to configuration grouping in general, and to classification and rationalization of the limitations of verbal valences (in one of Thom's oldest ideas concerning language) in particular, should also apply to the different classes of signs, to *classify the cognitive processes according to their dominant composition in a particular type of sign.*

Thom limits himself to classifying semiotic processes according to their complexity, without including cognitive processes. But we need only a substitution for the 'actantial variable' to move from one to the other. I think this is faithful to Thom's ideas, as can be seen in his table of correspondence between

Peircean category	example	cognitive process	psychism/prégnance relation	prégnance diffusion	number of conflicting states
FIRSTNESS	'it'	exposure to the stimulus	prégnance invades psychism	A encounter	1
SECONDNESS	'it smells'	stimulus identification	issuing of an utterance labeling the invading prégnance	A invades or emits B	2
THIRDNESS	'it smells fragrance'	conceptualization of its origin	recognition of the kind of prégnance and its conceptualization	A transfers B to C	3

Fig. 7. Correspondence between Peircean categories and catastrophe-theoretic classification (from Thom 1988)

Peircean categories and catastrophe-theoretic classifications (Figure 7). Just as 'the important cases of declensions may be associated with particular singularities in the unfoldings of elementary catastrophes' (Thom 1983a: 139), it must be possible to classify the cognitive processes which allow this semantization according to their complexity. The idea of reducing psychological processes to their *a priori* constraints, identical to mind and signs, is illustrated in Peirce's table of categories; Thom (1983a: 88) admits that Peirce preceded him in this domain. He develops the correspondence according to Figure 7.

We may extend this correspondence to certain psycholinguistic processes (Figure 8).

number of patterns concerned	psychological process	subsystem of memory used
1	chunking, perceptual categorization	sensory regis. ➡ STM ⬅ LTM a recognition
2	unitary recall, grouping of two clusters	a cued recall in episodic LTM
3	inference, conditional association, grouping of two clusters under the dependency of a third cluster	an encoding process in normal, adult memory

Fig. 8. Correspondence between psycholinguistic processes and the catastrophe-theoretic classification for semiosis

Like Peirce, Thom does not suggest a psychological reductionism to explain the semiotic classification by its psychological conditions of possibility; rather, he proposes a superordinate grouping of psychological processes according to their common constraints by the same dynamic structures, deeper than the syntactic 'deep structures' (Thom 1983a). Let us note, however, that Thom himself accepts a genetic determinism in the upper limit of complexity for semiotic operations. He expresses this principle by comparing the human mind to an 'obstacle' to the flow of a stream, whose shape (the *'préprogramme'*) determines the complexity of the divisions of that flow (Figure 9).

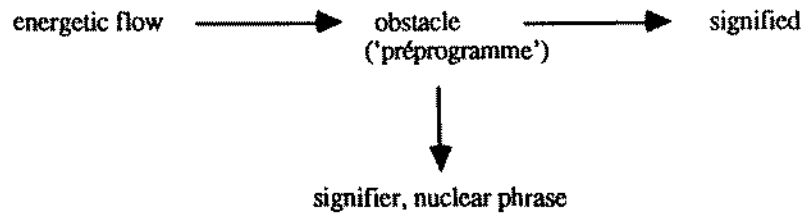


Fig. 9. The inborn constraints on semiosis complexity (from Thom 1988)

Principle IV: The 'Realist' Nature of Thomian Classification Is Shown by the Resistance of a Given Type of System to Passing through a Threshold of Complexity

The classification of archetypal morphologies does not mean that it is more 'difficult' for a phenomenon to be regulated by a 3-state (butterfly) than by a 2-state (swallowtail or cusp) catastrophe, but rather that a threshold of complexity separates the morphologies. This threshold may consist in a *tendency for the system to remain at its initial level of complexity*. For example, we must add a dimension to the control space (the codimension) to jump from two to three states. An increase in the number of control parameters governing the evolution of the system also increases the unfolding complexity (see Figure 10). This increases the number of conflicting local states, and the number of distinct paths in the unfolding space in which states separate or melt into other states. The resistance of a 2-system to transformation into a 3-system may be described by three different catastrophe-theoretic representations:

—The impossibility of increasing the number of conflicting spaces without also increasing the number of dimensions of the morphology regulating the system (Figure 10).

—In the framework of a regulating morphology with a maximum of three conflicting states (the butterfly), with u and t constant and negative, the variation of v and w leads to the bifurcation of the third state when we cross a catastrophic line (Figure 11).

catastrophe	germ	unfolding	archetypal morphologies	remarkable paths[3]	number of conflicting states
fold	x3	x2 + ux 1 parameter u		1 → 0 0 → 1	1
cusp	x4	x4 + ux2 + vx 2 parameters u, v		1 * 2 → 1 (2) → 1/2 2 (1) → 2 * 1	2
swallowtail	x5	x5+ux3+vw2+wx 3 parameters u, v, w		1 → 1/2 → 2 (1)	2
butterfly	x6	x6+tx4+ux3+vx2+wx 4 parameters t, u, v, w		3_1*2 → 1*3 → 1 3 — 1 Ø 3_2*1 → 2*3 → 2 3 — 2 Ø 1 — 1 3 — 2 2 — 3 1 — Ø	3

Fig. 10. The increase of unfolding's complexity with the increase of the number of external variables (adapted from Petitot 1982: 755)

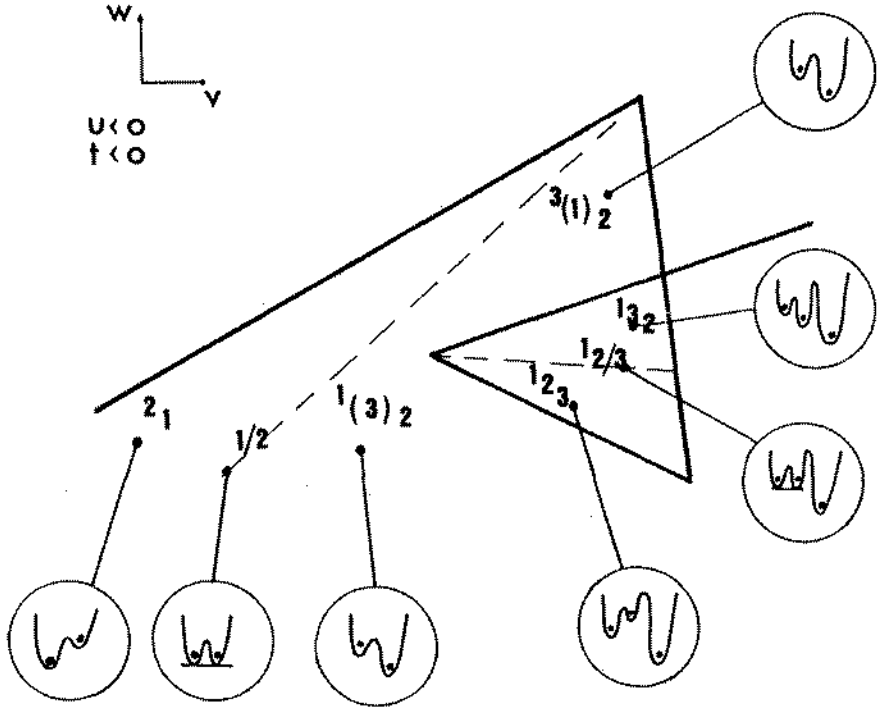


Fig. 11. The bifurcation from two to three states in the butterfly catastrophe, with u and t constant (adapted from Petitot 1982: 737-50)

—In the framework of a given regulation catastrophe, with a maximum of three conflicting states, if u is varied, we go from a moment of unfolding with a maximum of two conflicting states to another moment in which one of these conflicting states divides into two (Figure 12).

Recently, Thom (1988) has explained the ramification of semiotic processes during phylogenesis by the increase in the complexity of their regulating catastrophes. This threshold of complexity may be conceived as a limit maintaining the system at a given level of complexity, according to the principle that the simplest regulating morphologies are also the most probable. Similarly, catastrophes are 'contagious', in the sense that an analogy would permeate human psychism because of the identity of the archetypal morphologies of its various supports ('canalization' of the *prégnance* diffusion). The multiplication of events

regulated by the same morphology is more probable than the increase in this morphology's complexity.

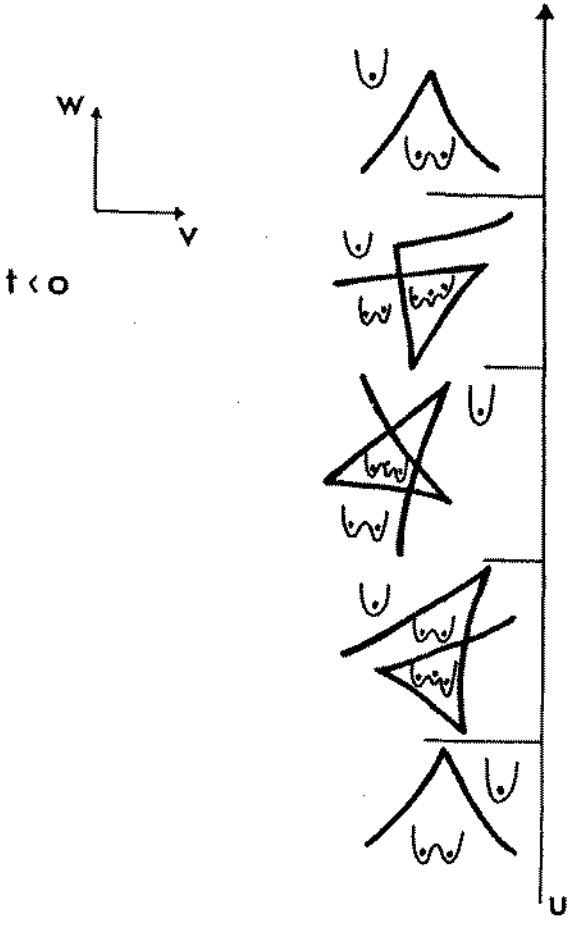


Fig. 12. The appearing-disappearing of the area within three states for $t < 0$ when u is varied

In conclusion, there are two different complexity limits: a relative one for the threshold between two morphologies, two moments, or two areas in an unfolding; and an absolute one, limiting the number of conflicting spaces for a system occurring in our universe to four—'there is an *a priori* limitation of the local complexity of actions [associated with task achievement]' (Thom 1988).

The interpretation of these limits relative to the pathological limitations of a semiotic production system is directed by the notion of the 'germ' of a function, which contains, *in potentia*, the complexity of its unfolding (i.e., the last two ways to represent a state's bifurcation—Figures 11 and 12), but which does not contain the superior codimension function.

A limitation with a permanent nature is best represented by a codimension limitation: a given system is regulated by one given catastrophe, and not by another (Figure 10). On the contrary, a limitation of a transient nature (transforming over time) is best thought of as a path in the unfolding of a particular catastrophe (Figure 11) or as the transformation of this unfolding due to changes in one of its control variables (Figure 12). These paths are dependent on the evolution of variables that must be discovered for a given system.

Semiosis Limitations in Autistic Subjects

An Introduction to the Autistic Syndrome

Infantile autism, as first described by Kanner (1942-43), includes heterogeneous signs whose combination distinguishes autism from adult schizophrenia and from mental retardation or isolated language disabilities. According to the most recent synthesis on this subject (Rutter 1988), it includes the following:

—A special defect in the pragmatic function of language, which begins with nonverbal joint-attention and includes echolalia and pronoun reversal. Syntax and semantics may be normal or even highly developed.

—A disturbance in emitting and receiving emotional signals and in their coupling to cognitive processes. Particular mention should be made of anemotional voice, lack of orienting reflexes, and 'sameness' reactions. This disturbance begins with an absence of recognition-smile and develops in parallel with the course of the disease, sometimes attaining the high intellectual level reached by some autistic subjects, the 'Asperger's syndromes' (Wing 1981).

—An apparently normal memory, as for instance excellent rote memory of visual configurations or 'blocks' of oral language, but restricted to isolated domains, the 'special abilities' (Shah and Frith 1983).

—Abnormal movements of various sorts (stereotypical gestures, tiptoe walking, skipping, hand-clutching).

—An association with purely medical defects, such as seizures beginning around puberty, with a normal brain at post-mortem examination.

—A different reaction to drugs than is seen in other psychiatric syndromes.

A particular variety of 'special ability' is called hyperlexia. Not all autistic subjects are hyperlexic, and vice versa; but the majority of hyperlexic children present an autistic syndrome. Hyperlexia consists in an early and dramatically developed ability (or obligation) to spell or to read written language word by word, without understanding its meaning or with an understanding level poorly related to this reading ability. The appetite for reading in such subjects is much greater than in normal children: they spend their day reading any sort of printed matter on any topic, and may present intense emotional reactions when someone tries to disturb them from this occupation. Hyperlexia illustrates in a particularly salient way our theory of limitation of complexity for autistic semiosis.

An Introduction to Autistic Limitation of Semiosis Complexity

Autistic subjects can do some things, but are unable to perform others. A theory explaining the difference between what they can and cannot do would shed some light on the underlying mechanism involved. An autistic subject can cross a city like Paris by bus all alone and find his way back, even after a single exposure, while the rest of his abilities remain below the two-year-old level. Another subject can draw a car engine perfectly after looking at it from an unusual angle for only two minutes, but has the speaking ability of a five-year-old boy; a third one knows every general from the Second World War, but remains encopretic.

The difference between what autistic subjects can and cannot do has never been systematized from a descriptive point of view, and the reasons for the grouping of their incapacities remain unknown. The cause of their heterogeneous signs is unknown, as is whether or not they share something in common, even in the restricted cognitive area. The constellation of signs under the common label of social competence failure that prompted the first description of autism has been abandoned, because subjects also present paradoxical emotional reactions, and intense affective demands which are very hard to interrupt once begun. I feel that they are only able to accomplish feature groupings of the first and second types, but are not equipped for 3-semiosis junctions. Their impairment would constitute an argument in favor of the psychological reality of the semiotic difference

between 2- and 3-semiosis junctions. In the classification of its production, nature would follow an *a priori* constraint separating successive junction types with thresholds of increasing complexity. Various etiological factors would result in a stabilization of these types: the phenomenological level of the disease would depend more on the intrinsic stability of these states than on the causalist level.

How these junction types resist distortion can be seen in autistic ontogenesis. The increasing number of different operations (paralleling exposure to more and more numerous objects in the course of ontogenesis) would result not in a ramification of the junction type, but in an indefinite extension of configuration classes recognized and processed by a junction type. Its development would produce an increase in memory span on the one hand and in mnemic storage on the other hand, without modifying the types of operations possible on this mnemic short- or long-term content. For example, if an autistic subject uses labels, he will use more and more labels as he grows older, without changing this limited type of reference. The stability of this impairment, in spite of an increase in the number of encountered and processed shapes, is an argument in favor of a pathological limitation of the complexity of memory processing, rather than of the local span or the global content of memory.

Is This Limitation of the First or the Second Type?

1- and 2-Semiosis in Pathological Cognitive Processes. We defined the psychological equivalent of 1-semiosis as the encounter of a configuration by an organism, and the production of an effect. Its psycholinguistic equivalent is the parallel processing of features composing a configuration up to but not including its recognition. The 2-semiosis relationship of equivalence between two configurations *vis-à-vis* the production of an effect comprises the junction between an encountered shape and its stored duplication (i.e., its categorization and its recognition); while the effect of mnemic storage of an encountered shape is a 1-semiosis, its recognition (after two encounters, in Hebb's theory) is included in the second type. The recognition of configuration presupposes interest for and recognition of its features, until the system finally decides that a particular grouping has already been encountered (Treisman and Gelade 1980). The generalized renunciation of sequential bottom-up models does not involve the notion of stable, stored configurations, allowing a final same/different decision; the recognition and

production of regular configurations is a fact, whatever its explanation. A configuration can be recognized only by matching a cluster of features, processed serially or in parallel, with a stored configuration. The ability to produce a duplication of an encountered shape (imitation) makes visible the 2-junction between a shape and its stored analog. I see a strong equivalence between the ability to reproduce an encountered shape (echolalia) and a signal that it has been recognized. Moreover, it is difficult experimentally and conceptually to separate recognition and silent rehearsal. (See Figure 13.)

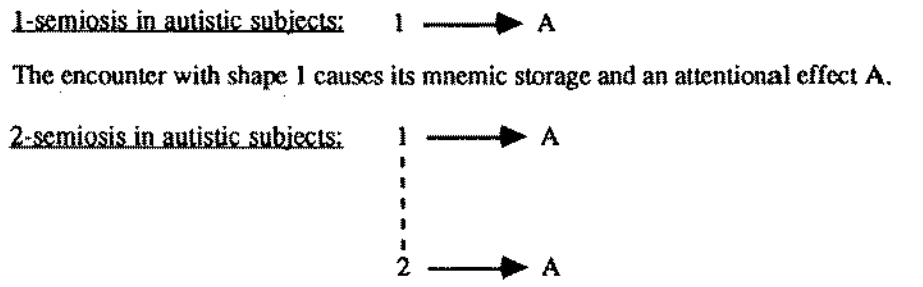


Fig. 13. 1- and 2- semiosis in autistic subjects

Autistic subjects are able to recognize feature groupings, as shown by their ability to read (hyperlexia) and to reproduce (echolalia) these groupings. The specific characteristic of autistic production and recognition of groupings is its rigidity: echolalia may even imitate the accent or the prosodic features of the initial utterance, and the modification of one of its parts produces 'sameness' reactions. An often quoted example gives an idea of the enormous span of these visually memorized configurations: an autistic child once had a tantrum in front of a bookcase where one volume was missing.

It is worth noting that autistic echolalic duplication can be obtained after an encounter with only a part of what is to be repeated. In the auditive sphere, the production of a verbal sequence may occur after hearing a part of it, or part of its context of occurrence: it seems that the context of occurrence is, for the autistic subject, a genuine part of a multimodal configuration including the sentence itself

(Prizant 1983). The child may also force his family to engage in a second, strict repetition of an initially incomplete sequence. In the motor sphere, stereotypical repetition of a motor sequence may begin as soon as one of its parts has been encountered. A 2-semiosis junction joins the parts of a configuration together as a relationship of equivalence in the production of the same effect; the various parts are equivalent in being capable of producing the repetition of the whole.

The Limitation between 2- and 3-Semiosis. What defines these acts of information processing as 1-or 2-semioses, instead of their equivalent in the normal subject in which memorization cannot be isolated without categorization, and categorization without a 'complete' 3-semiosis? Let us call 1 the encountered part, and 2 the missing part; when an autistic subject adds 2 to 1, 2 is fully determined by 1. There is no context influencing the choice of 2 (instead of something else) to combine with 1, as proven by the fact that there is no occurrence where 1 is associated with something other than 2. The subject cannot change the encoding scale and decompose the encountered configuration (Prizant 1983), just as he cannot combine it with other configurations. The autistic subject recognizes a shape by one of its parts, since he emits or provokes the emission of a missing part to complete it, but he cannot associate to a part of a configuration something other than that which completes it. Configurations are not decomposable in the sense that there are no isolated occurrences of one of their parts in the child's discourse, and that an emotional effect resists its fragmentation or modification. If the modification is too great, the child is not interested in the new shape. Sometimes he cannot complete it alone, and one witnesses pathognomonic scenes in which he takes the adult's hand to make him finish the incomplete action evoked by one of its parts. Later we shall see how autistic intentionality is also limited by the complexity of its semiosis.

Faced with an already encountered configuration that may be followed by a motor sequence (as filling cups when seeing a faucet running), the autistic subject may choose from among several paths (see Figure 14).

Variations, Categorizations, Prototypes. This limitation of autistic semiosis to recognizing and producing configurations may attain an amazing precision in 'idiot-savants' (Treiffert 1988). To explain it, we (Mottron and Nadel 1988) oppose a model of analogical storage reproduction to a model of sequential motor memory (O'Connor and Hermelin 1987), as can be shown by the lack of determi-

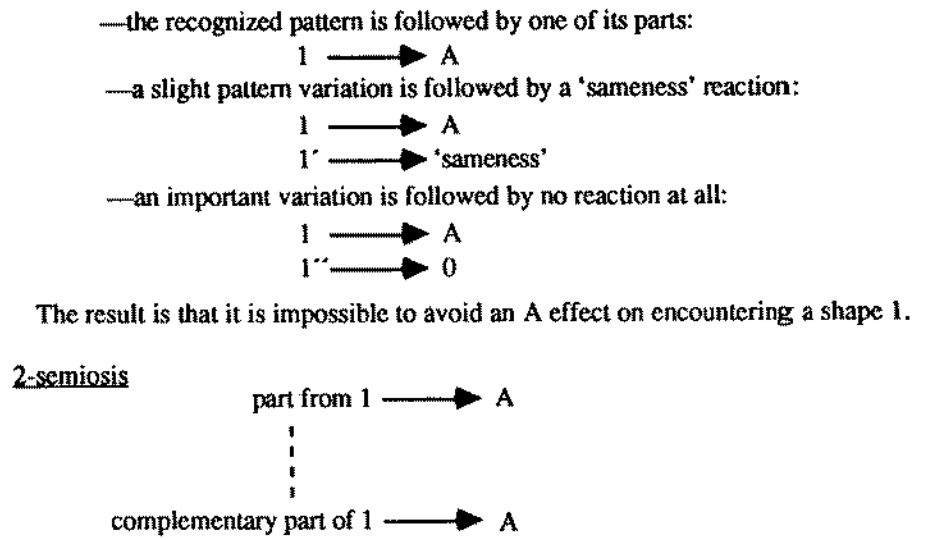


Fig. 14. Different paths in 1- and 2- semiosis in autistic subjects

nate order for the restitution of graphic features. This precision illustrates the basic rule that human semiosis loses in precision what it gains in complexity. Normal subjects cancel individual differences between 'tokens' by deciding that they are irrelevant to prototype recognition, but can combine them with other prototypes to construct complex semiotic operations. In contrast, autistic variation processing does not allow the inclusion of slightly different shapes under a common prototype with a common name (Figure 15).

The limitation between 2- and 3-semiosis would have, as a visible counterpart, a lack of interest, or, on the contrary, an emotional reaction following the encounter with a shape slightly different from its mnemic double. This prevents the autistic subject from finalizing a categorization as in the normal subject's 'Thirdness', when 1′ is reduced to 1 by a 3-semiosis junction, because the variation of 1′ is not relevant to distinguishing the coupling 1-2 from the coupling 1-3, even if this variation is perceptible.

Consequently, autistic subjects cannot combine or substitute. Even if language appears, it develops without real use of a syntagmatic combination axis (sentences are rigidly fixed) and a paradigmatic substitution axis (the subject resists synonymy and periphrasis). *The combination is fundamentally different from completion:* the first is above the scale of configuration (3-type), the second is at the level of configuration itself (2-type) or under this level (1-type).

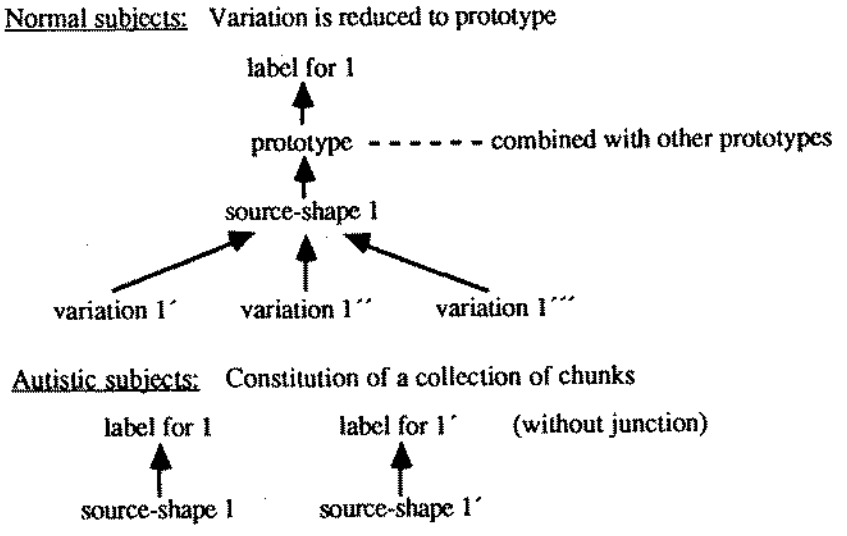


Fig. 15. Variation processing in the normal and the autistic subject

Of course, the phenomenological level is not sufficient to differentiate these types. A combination is only a combination if the combined part depends on the inclusion of the whole in a third configuration. Behaviorism cancels this difference (Parret 1983). It is not enough to study the distribution of a configuration to exclude it from combination. The simultaneous presence of a discourse unit (recognizable as such by the normal subject) in several partially equivalent acts of autistic verbal communication does not prove that this 'unit' is actually combined with its context. One must study the ontogenesis of sentences, and find the particular sequence alone before its appearance in context, as in the case for 'pivots' which appear in several two-word contexts before they combine in longer sentences. In contrast, the autistic subject begins his language by using long sentences—which may, of course, contain parts which are common *for us.* In the proposed model, such parts are not used because they are common; instead of modifying their production by successive additions, autistic subjects store fragments of syntactic productions taken from other people's language. With a few changes, and in the absence of span limitation, they succeed in producing a syntactically correct language that labels its reference. However, it will always suffer from a lack of flexibility in the substitution axis.

Arguments from Pathological Cognitive Psychology

Complexity Limitation of Mnemic Encoding in Autistic Subjects. A number of experiments and observations from the psychopathological literature show that autistic subjects are able to recognize and duplicate configurations without joining them to a third one taken from context or from semantic long-term memory, as in normal subjects. Frith (1984) summarized this specific impairment in terms particularly pertinent to our model: autistic subjects suffer from 'a specific failure to recall small units as parts of a bigger meaningful context'. Similarly, some years before, Prior (1979) wrote: 'items that suggest their own solution and do not require analytic and sequential processing are those solved most successfully by autistic children'.

Experimental findings supporting this conclusion include the following:

—Autistic subjects memorize words exposed as isolated units more easily than they do words presented as parts of a sentence (Hermelin and Frith, cited in Frith 1984).
—They repeat an ordered sequence of digits no better than they do a randomized sequence (Hermelin and O'Connor 1970).
—They succeed better than normal subjects in detecting embedded visual figures, because they are not distracted by matching between parts of these figures and parts of the context (Frith 1984).
—The figurative aspect of a configuration has less influence on reproduction precision than in normal subjects (O'Connor and Hermelin 1987).

With respect to hearing, various experiments demonstrate that an auditive configuration is heard or echolalically reproduced independently of its context of utterance or junction with another semantically associated configuration.

—Phonetic recall cues are more effective than semantic cues (Boucher 1978).
—Cued recall is quantitatively normal, but free recall (which implies a recall strategy) is reduced (Boucher and Warrington 1976).

In comparison to normal subjects, the ratio recency effect/primacy effect is higher (Boucher 1981a). It is almost as if the autistic subject's long-term memory were filled by the initial stages of processing in a sequential model—by iconic or 'feature' memory. As I have mentioned elsewhere (Mottron 1989a), autistic recognition would result not from linked associations submitted to a top-down constraint, but from any partial identity between the encountered and the stored configuration—as in episodic long-term memory (Tulving 1983).

Another elegant way to demonstrate that autistic subjects do not process visual configurations analytically, part by part, and do not join one part to its neighboring part on the one hand, and to the whole configuration on the other, is Shah and Frith's (1983) experiment. In the block-design test, where one must reconstitute a configuration by the juxtaposition of cubic blocks showing one-ninth of the picture on each side, Shah and Frith show that autistic subjects are not helped by the superposition of the cube outlines over the figures to be reproduced (see Figure 16).

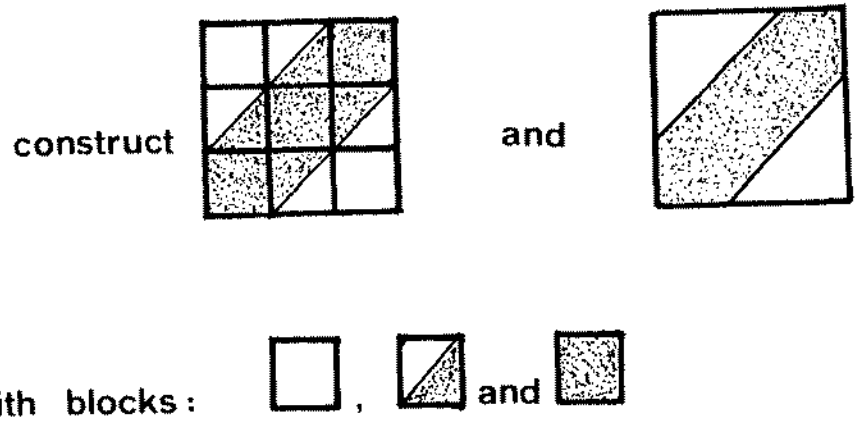


Fig. 16. The block-design test

In fact, autistic subjects perform better than normal subjects in the block-design test. This paradoxical superiority may be explained as follows: the ability to duplicate a configuration would result from parallel matching of each point of the figure, not from a decomposition into sub-configurations—facilitated by the superposition of the cube network, which prompts a particular processing by sub-configurations. Processing part after part increases the complexity of the processing; processing of the configuration as a whole reduces the matched configuration to a single one, while allowing good detail matching. Thus short-term memory is not disturbed by proactive interferences.[4]

If we accept the idea that boundary stability between configurations in visual or graphic fields (Thom's *'prégnance individuante'*) results from their encoding by a 3-semiosis (each shape is stabilized on the one hand by its conflict with neighboring shapes, and on the other by matching with its prototype), it is not surprising that autistic drawings stop at the edge of the sheet (Selfe 1983) without taking into consideration the outline of shapes, and that hyperlexic subjects elide spaces between words (Goldberg and Rothermel 1984).

'Overselectivity' (Lovaas *et al.* 1971, 1979), an autistic capacity (shared with very young children—Mottron 1987) to recognize a configuration based on a restricted number of features, may be explained by the matching of one part of the figure to another part without regulation by the whole. Here again, a 2-semiosis (memorized part/recognized part) replaces a 3-semiosis (memorized part/recognized part/complementary part of the recognized part). But it is hyperlexia that offers us the most convincing arguments: the ability to recognize words independently of their spatial orientation in the frontal plane can be understood if there is no matching between the recognized word and its context. The recognized configuration is not tied to the context facing the subject, leaving it free to take any spatial orientation without influencing its detection rate. No spatial rotation to connect the word to its context interferes with recognition. In addition, the majority of autistic hyperlexic children learn to read before they learn to talk. They cannot understand instructions, and usually learn to read on their own. They associate graphic features and phonetic features, as if only the behaviorist simplification of learning theory applied to them. Even if they can process units larger than words, their reading is essentially phonetic. The comprehension of syntactic regularities by increase in the span of the recognized unit does not allow them to attain the semantic component of reading, beyond labeling or thing-word junctions.

In conclusion, I would add that the absence of semantic matching constraints and the absence of context dependency during recognition are both 2-semioses.

Semiosis Complexity and Intentionality. Applying Thomian classification to autism does not lead to completely original findings. On the contrary, it converges with models like *orders of intentionality*, which come from various backgrounds. For example, Frith (1984), Baron-Cohen *et al.* (1985), and Baron-Cohen (1988) conclude that autistic children are incapable of engaging in pretended play or attributing facial expressions to partners' intentions. These authors think that such impairment reveals a more general inability to use second-order representations that is specific to autism. Autistic subjects would thus lack what Premack and Woodruff (1978) call a 'theory of mind'—the ability to think about thought, or modalize, which allows referential opacity (and therefore pragmatic functions) and reflexivity (and therefore logical reasoning). This aptitude is deeply related to the specificity of human intelligence.

The following classification of intentions comes from Dennet (1983), following classifications for levels of intentionality in humans and animals:

—*Zero-order intentionality* is the expression of a drive, without representation.

—*First-order intentionality* consists in desires and beliefs, without desires and beliefs about these desires and beliefs. The system possesses memorized pictures of whatever produces these desires, or the propositions (true or false, not modalized) which constitute these beliefs.

—*Second-order intentionality* possesses desires and beliefs on desires and beliefs (its own or others).

—*Third-order intentionality* can include a second-order intentionality in a modalization judgment.

Baron-Cohen (1988) demonstrates experimentally that autistic subjects cannot attribute a thought which is distinct from their own to a doll. They succeed in expressing a judgment on the world, but not in modalizing this judgment, or in distinguishing a proposition from an attitude toward propositions. For anyone who lives with autistic subjects, this is a striking observation. Although this is not the appropriate place to prove it, to me it seems to be true, *except with respect to its level of generalization.* I disagree with the primitive nature of such a classification. On the contrary, my examples, taken from visual and auditive autistic categorization, seem to demonstrate that the absence of a 'theory of mind' is a consequence, in the sphere of intentionality, of a much larger incapacity to use semiosis more complex than the second type. It is much more elementary than intentionality in that it is true for any kind of sign; *it organizes the configurations according to an archetypal morphology independent of its content.*

The level of generality of Thomian semiotics (independent of the substrate to which it applies) is related to the Gestalt characteristic of autistic impairment, independent of a specific modality, and *a fortiori* independent of the content of one of these modalities. Moreover, the two classifications are almost equivalent except for their ordinal (Figure 17).

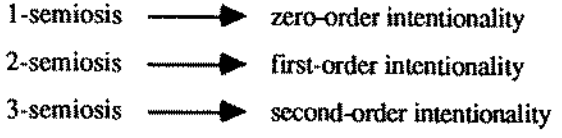


Fig. 17. Correspondence between the catastrophe-theoretical classification for semiosis and Dennet's classification of intentionality

A body of research concerning autistic categorization shows that 3-semiosis is a condition of possibility for second-order and higher intentionality. For Leslie (cited in Frith 1984), second-order representations appear at about eighteen months in normal children—an age at which normal and autistic children are already easy to differentiate. Our application of Thomian classification to the limitation of complexity in autistic semiotic operations confirms and expands Frith's theory by including it in a model of mental phenomena more general than intentionality. It also adds an upper limit of third-order intentionality to Dennet's model; the latter recurrently obtains fourth and fifth orders, etc., which he recognizes do not exist in human productions, without being able to rationalize this limitation.

Perspectives

I do not pretend to have mastered the field of Thom's semiotics; his theory offers such numerous landscapes, particularly with respect to *a priori* constraints and the epistemology of models, that I am only able to suggest their extent in a limited and cursory way. Excepting Petitot, there may be no mind other than the inventor's able to embrace all the mathematical, biological, and epistemological aspects of catastrophe theory in the same semiotic intuition. Like Peirce, Thom defies us to understand the real nature of what unifies his works in different areas of knowledge. Nevertheless, several prospective directions offer themselves in the

specific domain of language and interaction between semiotic and normal and pathological neuropsychology. Let me only mention here the recent modelization of shape recognition by equilibrium states (Hinton and Anderson 1981, Rummelhart and McClelland 1987), which expands the notion of structural stability and promises to introduce catastrophe theory into neuropsychology. Finally, what has been described here for autism may also apply to semiotic pathology in schizophrenia, in the sense of a dramatic decrease in the complexity threshold of semiosis (Mottron forthcoming), as well as suggesting developmental studies of verbal and gestural semiosis ramifications.

Notes

1. This work was prepared at the invitation of Thomas A. Sebeok and Jean Umiker-Sebeok, and was carried out in the second semester of 1988 with a grant from the Fonds Scientifique de La Chesnaie (Dr. C. Jeangirard, Director). It is based on data collected from autistic patients at the Centre d'Education et de Reéducation de l'Ouie et de la Vue (Tours, France), and at the Clinique Institutionnelle de La Chesnaie, in the preparation of a Thèse de Doctorat d'Etat en Linguistique and a Diplome d'Etudes Approfondies en Neuroéthologie. I wish to thank Professor Dr. Wolfgang Wildgen (Bremen University, Germany), Jean Petitot (Ecole des Hautes Etudes en Sciences Sociales, Paris), Jacqueline Nadel (Centre National de la Recherche Scientifique, Laboratoire de Psychobiologie de l'Enfant, Paris), and J.P. Laurent (La Chesnaie) for their help at various times during its writing. Special thanks go to C. Eloy. The English text has been reviewed by D. Schwartz. Mr. René Thom (Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette, France) furnished me with unpublished manuscripts and useful comments, but is not responsible for possible misinterpretations of his theories.
2. The Thomian term *prégnance* is not translated in the text. Its English homophone suffers from an unfortunate similarity with 'pregnant', and its content differs from the German word *'Pregnanz'*, which rather refers to (a) 'a tendency to regularity or lawfulness in our perceptual experience, and (b) a feature or features of the objects toward whose experience such tendencies might be said to lead' (Smith 1988: 61). For Thom, its significance is either (a) synonymous with energy, but including metaphorical uses of this term, as in Freud's 'free energy' or 'bound energy' or Lorenz's hydrodynamic model of drives; (b) a more restricted meaning of biological effect released by a shape (it is then synonymous with basic emotion); or (c) synonymous with meaning in general, regarded as the whole set of representations evoked by a single representation.
3. Petitot's notation for catastrophe-theoretic bifurcation of identities (Petitot 1982). Each number represents a minimum value of the potential function; they are numbered from left to right. Conflicting states are represented by /: 1/2 is the area of reciprocal determination of state 1 and state 2. The states resulting from the fusion of two states, where each state loses its identity, are indicated by *. 1*2 is the state resulting from the fusion of 1 and 2, in an area of unfolding where they have no differentiated existence. The dominance of one state over another is indicated by the height difference between the two digits representing the states: $^{1}_{2}$ means that the minimum 1 dominates (has a lower value than) the minimum 2. The birth of a state from another one is written (): 1(2) means that state 2 is emitted by state 1, or melts into 1, when the catastrophic line nearby is crossed. The catastrophic bifurcation, when a state melts into or arises from another, is indicated by an arrow. $1(2) \rightarrow 1$ means that 2 was emitted or captured by 1 when a catastrophic line was crossed.
4. In normal subjects these interferences probably occur mainly by partial similarity between prototypes, since two parts of the world cannot be exactly similar, except for words that may have a part of their semantic field or their signifier in common. In that case short-term memory can best use its ability to store visual or auditive pictures.

References

Baron-Cohen, S.
1988 Without a theory of mind one cannot participate in a conversation. *Cognition* 29, 83-84.

Baron-Cohen, S., Leslie, A.M., and Frith, U.
1985 Does the autistic child have a 'theory of mind'? *Cognition* 21, 37-46.

Boucher, J.
1978 Echoic memory capacity in autistic children. *Journal of Child Psychology and Psychiatry* 19, 161-66.
1981a Immediate free recall in early childhood autism: Another point of behavioral similarity with amnesic syndrome. *British Journal of Psychology* 72, 211-15.
1981b Memory for recent events in autistic children. *Journal of Autism and Developmental Disorders* 11 (3), 239-301.
Boucher, J. and Warrington, E.K.
1976 Memory deficits in early infantile autism: Some similarities to the amnesic syndrome. *British Journal of Psychology* 67, 73-87.
Dennet, D.C.
1983 Intentional system in cognitive ethology: The 'panglossian' paradigm defended. *Behavioral and Brain Science* 6, 343-90.
Dick, A.O.
1974 Iconic memory and its relations to perceptual processing and other mechanisms. *Perception and Psychophysics* 16 (3), 575-96.
Frith, U.
1984 A new perspective in research on autism. In *Rapport sur les aspects cognitifs de l'autisme*, D. Chastenet (ed.). Paris: Roneo.
Fyffe, C. and Prior, M.
1978 Evidence for language recoding in autistic, retarded and normal children: A re-examination. *British Journal of Psychology* 69, 393-402.
Goldberg, T. and Rothermel, R.D. Jr.
1984 Hyperlexic children reading. *Brain* 107, 759-85.
Hermelin, B. and O'Connor, N.
1970 *Psychological Experiments with Autistic Children*. London: Pergamon Press.
Hinton, G.E. and Anderson, J.A.
1981 *Parallel Models of Associative Memory*. Hillsdale, NJ: L.E.A.
Howlin, P.
1982 Echolalic and spontaneous phrase speech in autistic children. *Journal of Child Psychology and Psychiatry* 23 (3), 281-93.
Kanner, L.
1942-43 Autistic disturbance of affective contact. *Nervous Child* 3 (2), 213-30.

Karli, P.
1976 Neurophysiologie du comportement. In *Physiologie, vol. II: Système nerveux et muscle*, C. Kaiser (ed.). Paris: Flammarion.
Largeault, J.
1985 *Principes de philosophie réaliste*. Paris: Klincksieck.
Lovaas, O.I., Koegel, R.L., and Schreibman, L.
1979 Stimulus overselectivity in autism: A review of research. *Psychological Bulletin* 86 (6), 1236-54
Lovaas, O.I., Schreibman, L., Koegel, R.L., and Rehm, R.
1971 Selective responding by autistic children to multiple sensory input. *Journal of Abnormal Child Psychology* 77, 211-22.
Long, G.M.
1980 Iconic memory, a review and critique of the study of short-term visual storage. *Psychological Bulletin* 88 (3), 785-820.
Mottron, L.
1986 La continuité thématique chez l'autiste. *Cahier de l'Institut de Linguistique de Louvain* 12 (1/2), 5-19.
1987 La diffusion de prégnance de R. Thom: Une application à l'ontogénèse des conduites sémiotiques normales et pathologiques. *Semiotica* 67 (3/4), 233-44.
1989a Modèles cognitifs et developpementaux de la mémorisation chez les autistes de haut niveau en lecture et en dessin. Unpublished manuscript.
1989b Le système émotionel responsable de l'ontogénèse des distinctions entre les signes. Unpublished manuscript.
forthcoming Certains signes schizophréniques sont-ils des marqueurs developpementaux? *L'Evolution Psychiatrique*.
Mottron, L. and Nadel, J.
1988 Developmental peculiarities of graphic recall in an Asperger syndrome with good visual memory. Poster presented at the NATO/ASI Congress on Social Competence in Developmental Perspective, Les Arcs, July 8-18.
O'Connor, N. and Hermelin, B.
1987 Visual and graphic abilities of the idiot-savant artist. *Psychological Medicine* 17, 79-90.

Parret, H.
1983 *Semiotics and Pragmatics: An Evaluative Comparison of Conceptual Frameworks.* Amsterdam and Philadelphia: John Benjamins.
Peirce, C.S.
1932 *The Collected Papers of Charles Sanders Peirce*, vol. 2, C. Hartshorne and P. Weiss (eds.). Cambridge: Harvard University Press.
Petitot, J.
1982 *Pour un schématisme de la structure.* Thesis for the Doctorat d'Etat es-Lettres, Ecole des Hautes Etudes en Sciences Sociales, Paris.
1985 *Les Catastrophes de la parole.* Paris: Maloine.
1987 *Morphogénèse du sens*, vol. 1. Paris: P.U.F.
Premack, D. and Woodruff, G.
1978 Does the chimpanzee have a theory of mind? *Behavioral and Brain Science* 4, 515-26.
Prior, M.
1979 Cognitive abilities and disabilities in infantile autism: A review. *Journal of Abnormal Child Psychology* 7, 357-80.
Prizant, B.M.
1983 Language acquisition and communicative behavior in autism: Toward an understanding of the 'whole' of it. *Journal of Speech and Hearing Disorders* 48, 296-307.
Prizant, B.M. and Duchan, J.F.
1981 The functions of immediate echolalia in autistic children. *Journal of Speech and Hearing Disorders* 46, 241-49.
Rummelhart, D.E., McClelland, J.C., and the PDP Research Group
1987 *Parallel Distributed Processing*, 2 vols. Cambridge, MA: The MIT Press.
Rutter, M.
1988 Diagnosis and description of autism: Current concepts and approach. Congress report, Third European Congress, Hamburg, May 6-8.
Selfe, L.
1983 *Normal and Anomalous Representational Drawing Ability in Children.* London: Academic Press.
Shah, A. and Frith, U.
1983 An islet of ability in autistic children: A research note. *Journal of Child Psychology and Psychiatry* 24 (4), 613-20.

Smith, B. (ed.)
1988 *Foundation of Gestalt Theory.* Munich and Vienna: Philosophia Verlag.
Thom, R.
1980 L'Espace et les signes. *Semiotica* 29 (3/4), 235-45.
1983a *Paraboles et catastrophes.* Paris: Flammarion.
1983b Animal psychism versus human psychism. In *The Origins and Evolution of Language*, E. de Grollier (ed.), 3-13. Paris: H. Harwood Publishers.
1988 Esquisse d'une sémiophysique. *Interéditions.*
Treiffert, D.T.
1988 The idiot-savant: A review of the syndrome. *American Journal of Psychiatry* 145 (5), 563-72.
Treisman, A.M. and Gelade, G.
1980 A feature-integration theory of attention. *Cognitive Psychology* 12, 97-136.
Tulving, E.
1983 *Elements of Episodic Memory.* Oxford: Oxford University Press.
Wildgen, W.
1982 *Catastrophe-Theoretic Semantics: An Elaboration and Application of R. Thom's Theory.* Amsterdam and Philadelphia: John Benjamins.
Wildgen, W. and Mottron, L.
1987 *Dynamisches Sprachtheorie.* Bochum: Brockmeyer.
Wing, L.
1981 Asperger's syndrome: A clinical account. *Psychological Medicine* 11, 115-29.

Laurent Mottron (b. 1952) is a psychiatrist and a researcher at the La Chesnaie Clinic (41120, Les Montils), and Professor of Psycholinguistics at Angers University, in France. His principle research areas are models of memory for autistic subjects, objectification of semiotic categories in ontogenesis and in the psychology of perception, catastrophe theory in semiotics, and the question of behavioral units of description. Among his publications are *Dynamisches Sprachtheorie* (with W. Wildgen, 1987), and several papers related to autistic children's language and perceptual behavior. Address: Clinique de la Chesnaie, Chailles, 41220 Les Montils, France.