PROJECT FOR A COMPREHENSIVE ANALYSIS OF BEHAVIOUR

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FOREWORD

This work is the result of my own reflections after 30 years of clinical psychiatry and psychotherapy. To respond to my patients during these years, I have had to deal with several evolving ways of seeing the human mind: phenomenology, biological psychiatry, behaviourism, psychoanalysis, cognitivism, group and systemic theories. I have had to change places according to the circumstances, to see the same phenomena from a different perspective. It was not a problem of eclecticism, but of dissatisfaction: by itself, no theory could explain or predict the strange phenomena I dealt with.

Fifteen years ago, I started using psychodrama. As I had not adhered to a special new theory, I was surprised to see supposedly familiar phenomena in a completely new way. Thus, it is not so much the theory as the setting that conditions our vision. Clearly, there is a heuristic problem that is difficult to resolve exclusively from within our praxis. I think this is why there is such a prodigious number of psychological theories, even without taking into account religious ones.

We need external criteria. I chose them from recent interdisciplinary systemic and communication theories. I discovered that the psychological movement known as constructivism has followed the same path. There are also similarities in recent developments of sociological theories. However, my main debt is to Popper philosophy. I think it is finally freeing us from the tremendous legacy of Descartes.

Then, this work is no more than a heuristic proposal. I think it can be developed in several ways. We can pick out some examples of these developments in the literature of the 80's and 90's. However, I haven't explored these paths in detail. I tried to be comprehensive in order to verify internal coherence. For that, I had to be concise.

The study is composed of 4 parts. In the first part, I will try to develop a systemic approach to the concept of *state*. There is also an attempt to make this concept operative and to supply some examples.

The second part points to the complexities of the human states. This is the problem of partial (impulsive, cognitive) and global (emotional) states, levels of complexity, and learning. In addition, the input-output is conceived under the perspective of 4 eco-systems: internal, territorial, interactive and interior environments.

The third part concerns interaction. The point is to understand the way in which relationships, communication and meaning, can be born from free interaction.

Finally, the fourth part develops the notion of personality and consciousness in the light of previous concepts. An appendix will give some additional information about the philosophical background of the study.

Project for a comprehensive analysis of behaviour - Part I: STATES

FROM CARTESIAN DUALISM TO POPPER'S TRIALISM

Cartesian dualism separates extensive (in space) matter - *res extensa* - from thinking spirit - *res cogitans*. This view of the world was very useful for scientists who started studying freely and clearly material things, including the human body. However, the concept of spirit, soul and mind continued to be nebulous, and scientists of the mind have not an easy task. This is the present state of affairs, in spite of the general concern that time is more important than space when we are dealing with mental phenomena.

In fact, at the beginning of the XX Century, Bergson [1907, 1927] was claiming that spiritual states were ***durable*** (in time) in the same way that material things were ***extensive*** in space. At the same time, Saussure [1915] and Peirce were studying language which is a product of the human spirit. They defined the concept of ***sign*** that has a ***signifier*** material face and a ***signified*** or ***meaningful*** spiritual face[1]. By means of this last face, signs are shared by a community of people.

The recent approach of Popper's ontology is based on the vision of 3 worlds. World 1 corresponds to the material and extensive world of Descartes, including the living things that Darwin postulated to be subject to natural selection. Popper was concerned with products of the human spirit - language and scientific theories - which he believed to be subject to the same natural selection. They belong to World 3, which basic pieces are the signs studied by linguists and semiologists.

Between World 1 and 3 there is the World 2 of Popper. Despite not being the main concern of the philosopher, it is obvious that he speaks about the same phenomena that Bergson spoke about, although Popper extends it to animal behaviour [1956,1982 :116] (and Bergson would be able of supporting this idea). If we define it as the world of durable (in time) phenomena, we can include in it energy and *entropic* change, in the same way that growing up and learning behaviour consist of *negentropic* change.

Popper's	World 1	World 2	World 3
defined by	*Descartes*	*Bergson*	*Saussure*
Substance	***matter***	***energy***	***information***
Systems	***physical***	***dynamic***	***abstract***
Elements	***things***	***states***	***Signs***
Ground	***space***	***time***	***Sharing***
Categories of knowing	***unity variety quantity***	***identity diversity quality***	***equivalence contrast meaning***

Fig. 1. Synopsis of the 3 Worlds

When Berthalanffy published his General Systems Theory, he distinguished between *matter*, *energy* and *information* as having different but integrated consequences upon systems. This trilogy converges with the 3 worlds of Popper. On the basis of these, we can distinguish between 3 kinds of systems: 1. *physical or material systems* (generally considered the structural aspect of the system); 2. *dynamic or behavioural systems* (the functional aspect of the system); 3. *theoretical or abstract systems*. Although this classification can correspond to different views of the same basic systems, I will try to show that it has some heuristic advantages.

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[1] **Note on signs.** There is some confusion about the double face of the sign between linguistic schools [Eco, 1973: 21-26]. In the original view of Saussure, the "signifié" is equivalent to the concept and not to the referent [cf. Saussure, 1972 (1st. Ed.:1915): 441, note 132]. Saussure asserts that it is of a psychological nature. In the same way, also the "signifiant" is an acoustic image [idem: 98] and not a material thing. However, this image reproduces (and is equivalent to) its material form. An iconic image and also the referent are interchangeable with the verbal sign [Eco, 1985: 11-52]; so they are, at least, anchored in the external world. Since there are no adequate words in English, we will speak about all these material forms (and their mental images) as the *signifier* forms of signs (as opposed to *signified* or *meaningful* part of the sign), the *signifier* (a translation from the French noun "significant", as opposed to *signified*) or *sign* (as opposed to *meaning*). I will return later to the question of the signified face of the sign (note 6).

THE HIERARCHY OF SYSTEMS

Since systems are open to input and output, they tend to interact and organize themselves in hierarchical levels. The hierarchy of natural systems is well known: atoms, molecules, (organelles), cells, (organs), organisms, (social institutions), communities. This hierarchy concerns open material systems which have been selected by evolution. Some of them are autonomous systems, being macro or micro systems, depending on the point of view. Thus, a cell can be a ***micro-system*** in the organism but a ***macro-system*** of molecules. Some other are not completely autonomous, since they depend on the macro-systems: this is the case of cellular organelles, animal organs and community institutions. So, we can consider them as ***sub-systems***.

There exist a special group of sub-systems which have a particular interest since they result from and regulate the interaction between other systems or sub-systems. I think that we can find them at each level, but a few examples are enough: RNA and DNA systems including genes, endocrine and nervous systems, and social and political institutions. At the elementary level, if they result from (and regulate) the interaction between two systems, we can define them as ***meta-systems***. However, they themselves tend to be organized on levels, in order to control the whole macro-system. This is the case of the Central Nervous System and political apparatus of the State, that we can name as ***supra-systems*** [Morin, 1977 :133-134].

Meta and supra-systems are composed of material and *signifier* faces of ***signs***, if we can generalize the definition of signs. Thus, like books in a library or documents in a State archive which regulate communities, genes or CNS are the material support of the rules and algorithms which regulate the functioning of cells, organs and organisms. In the same way that the function of genes can be translated and described by words, the laws of the state can be translated and recorded on computer chips. And the central neural network is nothing more than a great set of very sophisticated computer chips [Popper and Eccles, 1983 :236]. Despite the different information supports, the most important fact is the signified (meaning) shared by several elements, be they molecules, cells, organs, organisms or organizations.

From this point of view, considering both signifier and meaningful face of their elements, meta and supra-systems have the characteristics of Popper's World 3. Once they are systems of signs, they can be considered as abstract systems that also tend to be organized in hierarchical levels. The hierarchy of the CNS is an example. But we can find other examples in scientific theories and other products of human functioning. Language, for instance, has the levels of (phonemes), words, (phrases), propositions, logical chains of propositions, general ideas.

Summarizing, biologists agree about the hierarchical organization of open and natural systems belonging to World 1. Mathematicians, linguists and epistemologists are beginning to look to the hierarchy of open systems belonging to World 3. However, we have sparse information about the organization of open systems belonging to World 2. Since we are influenced by Cartesian dualism, we have no consensus about the identification of these latter systems. But when we speak about the set of states of an atom or molecule, forms of energy, the typical behaviour of a cell, the temper of an animal, the personality of a human, or the economic system of a community, we are speaking about open systems of World 2, at several levels. This work is an approach to this question which is intended to apply to the human behaviour. The notion of hierarchical levels of World 2 will be permitted by the central definition of complex states (page 15).

BEHAVIOUR AS A SYSTEM OF STATES

We have seen that World 2 is durable in time. World 2 elements are states, defined as different but stable forms (configurations) of a material system. The succession of states corresponds to the functioning of the system, whether it is growing up, behaviour or any other form of behaviour such as moving or thinking. The complexity and the whole functioning of natural open systems (which is different from the sum of the parts) prevent us from viewing it in a mechanical and deterministic way (the linear causality paradigm), as we can do with mechanic and closed systems. On the contrary, we have to consider the relationship with other similar systems and look at their output, which can regulate their behaviour (in the form of input and feedback). This is to say, we have to view them in relation to meta and supra-systems of World 3 which materially belong to their environment (or ***eco-system***).

I think that a good first approach to behaviour is the one that Turing applied to his imaginary machine. This model is nowadays applied to robotics [Aleksander and Burnet, 1983] and linguistics [Chomsky, 1957], and it was the basis for the construction of computers. It can give rise to a matrix or graph, and it can be analysed by mathematical procedures belonging to stochastic processes and Markovian chains. The idea of applying it to human mind is not new [see Fonseca, 1971, et al., 1988; Minsky, 1986; Kidd and Wright, 1986].

Thus, the organism can be conceptualised as an open system having a numerable set of discrete states. A ***state*** is a configuration of the system which can be identified[2] without ambiguity. States tend to be stable and discontinuous, and they are associated with ***characteristic output*** which allows them to be identified.

A ***response*** is the transition from a specific state, *i* , to another state, *j* , including the transition to the same state, if *i=j*. A specific sequence of responses defines a behaviour. Transitions of state (or responses) are determined by input. In fact, open systems are subject to a great deal of environmental input. However, depending on the construction of the system, their limits and gates, only a special set of patterns of input are relevant as determining responses in each state. So, each state is open to a specific set of ***relevant patterns of input*** and, within this, each subset of input determines a specific transition. Subsets of relevant inputs and responses in each state have a hierarchy of probabilities that can be measured. We will see that this whole organization of input and responses depends on the construction of the system (by means of internal meta-systems) but also on learning (by means of supra-systems), at least as open and natural systems are concerned.

AN HYPOTHETICAL EXAMPLE

No matter how many states there are, the whole behaviour of a system can be described in a squared table. In each cell we can put either the subset of relevant patterns of input which determines transitions, or the proper responses which depend on the initial state (on Y axis) and the final state (on X axis). Figures 2 and 3 show a table describing a single hypothetical organism in which we may identify 4 states: *resting* (including sleep), *curiosity*, *desire* and *fear*. We can easily assume that these states can be identified without ambiguity by means of the appearance of the eyes, number of body movements and measurement of postural tonus.

	Resting	**Curiosity**	**Desire**	**Fear**
Resting	harmonious stimuli	time	internal stimuli	strong dissonant stimuli
Curiosity	monotonous stimuli	ambiguous stimuli	harmonious stimuli	dissonant stimuli
Desire	close harmonious stimuli	ambiguous stimuli	harmonious stimuli	strong dissonant stimuli
Fear	strong dissonant stimuli	-	-	dissonant stimuli

fig. 2. Table of relevant inputs of an hypothetical organism

In one of these states - resting - the eyes can be closed, and this implies that the admitted (and relevant) input will not be the same as that of other states[3]. Different states may have different patterns of relevant input that are associated with each specific response. Thus, in a state of fear, only threatening stimuli (dissonant) are scanned. Some of them determine transition to resting state after

[2]**Note on identification and reversibility**: To tell the truth, there is no reversibility in time when open and growing systems are concerned. So, each state is different from a previous similar state. Several factors impinging upon micro-systems determine this difference, which is more important in learning systems. For instance, each new sadness or loving passion is different from the previous sadness or passion, since we have learned with the past; however we can identify this new state as a sadness or a passion, and we usually say that these states have come back. Thus, reversibility is a theoretical construction based on identity. And identity is the possibility of classifying a state or a thing without ambiguity, in order to say that they are the same that appeared previously: It is based on the replication of effects that can be simultaneously compared on a record sheet or on a neural network where the previous effects were memorised.

[3]**Note on filtering input.** This assumption is important and well known by psychotherapists. Each psychotherapist is aware that his client filters and remembers only a part of the messages he sent to him. We can understand that these relevant messages depends more on the particular emotional state of the client than on the intention of the therapist. As hypnotherapists know very well, the important thing is to put the client in a state where messages will be relevant.

the response of flight. Other determine transition to greater fear, i.e., panic response. We can postulate that curiosity and desire can transit to each one of the other states and admit 4 subsets of relevant input. Resting can also transit to all states but some transitions are spontaneous. In this latter case, we may admit the presence of internal (corporal) stimuli or, merely, time passing.

	Resting	**Curiosity**	**Desire**	**Fear**
Resting	sleepiness	awakening	awakening	awakening
Curiosity	sleepiness	playing	attraction	alertness
Desire	consumption	stopping?	approaching	aggression?
Fear	flight	-	-	panic

fig.3. Table of responses of an hypothetical organism

In the same way, we could consider putative responses (figure 3). We may name them in several ways. We may also use the same names for different responses. However, their names are conventions, and are less important than the specification of the initial and final state. So, the awakening response is different, depending upon whether we are considering a transition to curiosity, desire or fear.

These sets of relevant inputs and responses are hypothetical. However, we can test them by studying the system empirically. In fact, if we could identify the states, we can list their succession and put the number of transitions in each cell. For instance, if we observe the system at intervals of 1 hour during a day, we could identify the following sequence:

R (resting) - R - R - C (curiosity) - C - R - R - D (desire) - D - C - F (fear) - R - R - C - C - D - D - D - R - R - D- R - F.

We can verify that resting transited 6 times to resting, twice to curiosity, twice to desire and once to fear. We can easily verify the numbers in the cells of figure 4. However, an interval of 1 hour is not a good approach to the true transitions[4]. An interval of 5 minutes can be better and it would give us the numbers of the figure 5.

	Resting	**Curiosity**	**Desire**	**Fear**	Sum	Sum out diagonal
Resting	6	2	2	1	11	5
Curiosity	1	2	1	1	5	3
Desire	2	1	3	-	6	3
Fear	1	-	-	-	1	1
Sum	10	5	6	2	23	

Fig. 4. Frequency of succession of states (24 records)

	Resting	**Curiosity**	**Desire**	**Fear**	Sum	Sum out diagonal
Resting	150	6	4	3	163	13
Curiosity	2	44	4	4	54	10
Desire	6	2	30	1	39	9
Fear	5	1	1	4	11	7
Sum	163	53	39	12	287	39

Fig. 5. Frequency of succession of states (288 records)

The results argue against the hypothesis that the state of fear does not transit to curiosity or desire. We might look again to our work in order to consider whether the interval is suitable, whether there are other states present, or whether there is the possibility of these transitions, in spite of the probability being slim. Moreover, the table describes the whole behaviour of the system and characterizes the dynamics of each state. To have more information, we can operate on this table and transform the crude frequencies into probabilities of transition in each state, either considering or not the results of the diagonal (see note 4).

Fig. 6 shows the results of this latter operation. They were obtained by dividing the frequency of each cell by the horizontal sum of the cells without the values of the diagonal. At the top right we included the ***variability***, which is the difference between the minimum and the maximum values of the

[4]**Note on determining transition of states.** Succession of states is easier to verify than the real transition. However it is only an approach to this latter. To magnify this approach, we can determine the interval after which the numbers outside the diagonal stabilize when we made records at shorter intervals, in each system. If we take records at this *optimal interval*, the relative numbers outside the diagonal come very close to the true transitions. The numbers in the diagonal (transitions for the same states) correspond to the stability of each state (in units of the optimal interval) + the number of transitions to the same state. We can either use or omit this last information for future operations, according to the objective of the study.

probabilities we found. These results can give rise to the graph shown in fig. 7, where smallest probabilities were omitted.

	Resting	**Curiosity**	**Desire**	**Fear**	Sum	Variability
Resting		.46	.31	.23	1.00	.23
Curiosity	.20		.40	.40	1.00	.20
Desire	.67	.22		.11	1.00	.56
Fear	.72	.14	.14		1.00	.58
Sum	1.59	.82	.85	.74		

Fig. 6. Probabilities of transition in each state (without diagonal)

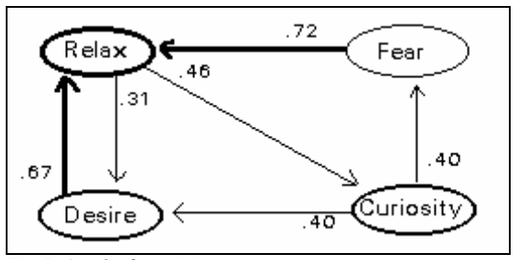

Fig. 7. Graph of transitions

CHARACTERIZING STATES

Once we have numerical description of dynamic behaviour of states, it is possible to make comparisioons and classify the states with less ambiguity. Classification and definition of states is currently made in psychiatric and psychological literature, although rigorous criteria is lacking. The tables we have seen permit operative definitions. There are a lot of possibilities, but I will limit myself to a few illustrative examples which will be useful for future explanations.

Dominant vs. evanescent states. The sum of columns (and rows) in the frequency table distinguish between more and less frequent states in the context in which we studied them. However, since the values in the diagonal are inflated by the value of stability, *dominance* will be better defined as the greatest sum out of the diagonal. The *evanescent states* are defined by the smallest sum of columns or rows.

Rigidity vs. flexibility of responses. Each state can equally distribute transitions for all the states on the matrix or, on the contrary, concentrate them in one or a few responses. We can consider these alternatives as criteria to states of *flexible* vs. *rigid responses*. The values of variability, as defined above, can account for this difference. Since they vary between 0 and 1, these extreme values define the maximum flexibility and rigidity of responses in each state.

Tense vs. relaxed states. Current literature reports some special states which have importance in learning and psychopathology. They can be caused by the basic necessities of the organism and they do not transit to other states as long as the specific pattern of input is not reached (as fear, hunger or thirst). So, they put limits on our behaviour. We can call these *tense states*, and define them as the states that admit fewer patterns of input in order to transit to other states. If this pattern is not available, they tend to transit to the same state. In the tables above, they have rigid responses but are also characterized by the irregularity of diagonal values in different contexts, and by the possibility of receiving transitions from all other states (greater values on the vertical sum of probabilities). On the contrary, *relaxed states* admit many patterns of input. They have flexible responses but receive few transitions from other states.

Usual responses and complementary states. Besides the output by which we can identify states, they are also characterized by the *usual response*. This is the more frequent (and probable) transition in the row. If this response can be detected without ambiguity, the final state of the transition will be considered as the *consequent state*. Two states reciprocally consequent can be defined as *complementary states*. To generalize, all the states in a sub-matrix (the whole of which defines a complex state) are complementary among themselves.

OTHER APPLICATIONS OF THIS STUDY

The previous approach can be applied to a number of situations. In practice, at this elementary level, we can work in special contexts that correspond to sub-matrices. In this case, all the transitions fall within a small range of specified states. If this condition is verified, all the elementary states together can be considered a complex and higher level state. A similar analysis has been made by Fonseca et al. [1979, 1980] in the context of a simple problem-solving situation involving cognitive states in different groups of patients, and, more recently, by Horowitz et al. [1994] that detected emotional states of patients in different phases of psychotherapy. In this section, I will illustrate other possible applications.

1. Sleep studies. An example is the complex state of sleep. By mean of EEG records, neurophysiologists have identified 5 elementary states besides the vigil resting within sleep: stage 1, 2, 3, 4 and REM (rapid eye movements). Fig. 8 shows the probabilities of transition of states recorded from two hypnograms (at intervals of 10 minutes) considered as normal. From this table we can derive the graph of the fig. 9, which shows graphically the normal transitions of the sleep stages.

	VIG	S.1	S.2	S.3	S.4	REM	Sum	Variability
VIG	-	1.00	.00	.00	.00	.00	1.00	1.00
S.1	.00	-	1.00	.00	.00	.00	1.00	1.00
S.2	.19	.05	-	.38	.00	.38	1.00	.38
S.3	.00	.00	.62	-	.38	.00	1.00	.38
S.4	.00	.00	.00	1.00	-	.00	1.00	1.00
REM	.12	.25	.63	.00	.00	-	1.00	.63
Sum	.31	1.30	2.25	1.38	.38	.38		4.39

Fig. 8. Probability of transitions (without diagonal) in each sleep stage

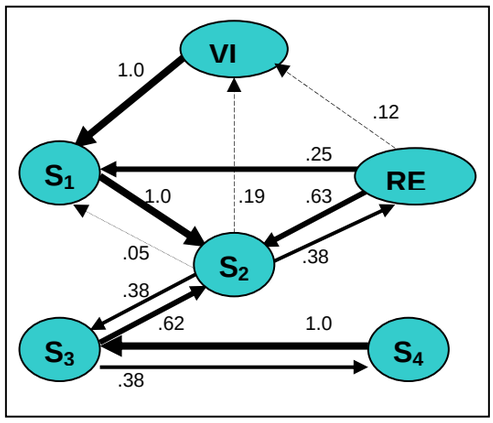

Fig. 9. Graph of transitions of sleep stages.

2. Postural changes. If we see a fast motion video record of a person (for instance during an interview), we can be surprised by an odd effect: the individual "skips" from posture to posture from time to time. Interestingly, he frequently returns to a previous posture, in a way that we can identify a small number of different video shapes (generally no more than 10) during all the interview. We may not know if these postural changes correspond to emotional or spiritual changes. However, it is possible to verify the same rhythm of similar postural changes when, during a familiar interview, two members of the family are emotionally identified.

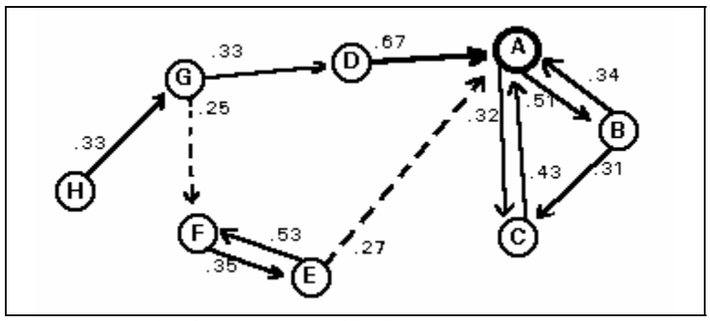

Fig.10. Graph of transitions of bodily postures

Since the posture states can be identified, it is possible to study the transition of states and derive from this a number of observations (for instance, about corporal rigidity or flexibility). Fig.10 shows the graph made from identified shapes of the video, recorded in each second during an interview of a paranoid patient. On the left we can see the shapes that correspond to the time he was speaking and on the right when he was listening.

3.Music. Music has a strong effect upon mental states. Music is also durable in time, and Bergson points to it as a close analogy for mental states. It is possible to conceive of the same study being applied to the dynamics of both entities.

Occidental heptaphonic scale is organized in such a way that the seven notes in a tonal key correspond to a compromise between regular progressive interval between their wave-lengths and a numerical relationship between these lengths[5]. Thus, each one of the seven notes is more stable than the sounds between them. In this sense, they are true reversible states, although some of them are more stable (tonic and dominant) and some of them more tense. They can have a rhythm and evolve to a great complexity, just as mental states can do.

As we have music written in scores and partitures, it is easy to count the transitions from one state (or note) to another. We can study it at the level we want. With short songs it is possible to detect the elementary level, considering only the upper notes that define the melodic line. Fig. 11 shows the melodic structure of two cradle songs, by Schubert and Brahms. Fig. 12 shows the melodic structure of two songs composed by a schizophrenic patient, one before the first psychotic outbreak, the second after it.

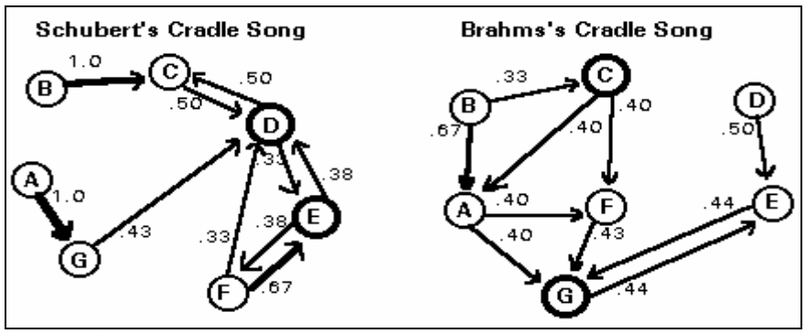

Fig.11. Graph of transitions of two cradle songs

[5] This organization, after the modern temper, permits simultaneously melody and harmony [Graça, 1970]. It was deeply exploted by Bach in his Fugues [See Hoffstader (1979), pp.717-719, and his reference to "Shepard-tone scale].

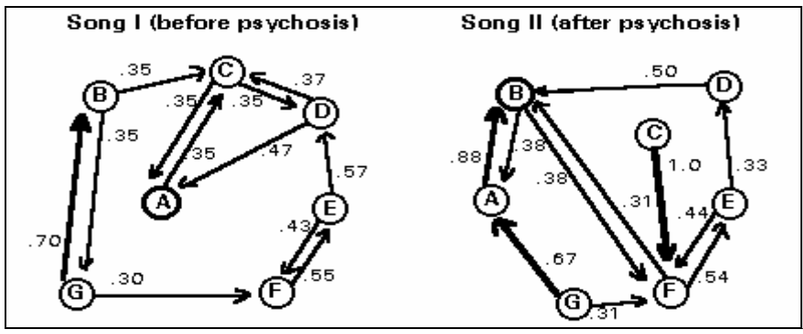

Fig.12. Graph of transitions of two songs from a psychotic patient

An alternative way in the study of music would be to consider each musical phrase as a complex state defined by its own pattern of transitions. Then, we could study the transitions from one phrase to another. Surely, each phrase occurs several times during the melody, in spite of slight variations and different tones and notes. However, we recognise them, as the same phrase, because they have an equivalent pattern of transitions.

DETECTING PATTERNS

In the examples above, as we detected the structure of transition of states, we were detecting patterns of behaviour, whatever the specific content of the states. We can detect these patterns in several instances of internal states, postural changes or music. Despite different contents, it is possible to detect isomorphisms, then indicating a certain regularity. By means of this regularity we can recognize personality in several ways, just as we can identify the personality of a composer by listening to his music.

Also in psychopathology, the form is more important than the specific content of the experiences [Jaspers, 1987 (1959): 76]. So, these patterns are the key for psychopathological identification. They seem to correspond to the "pattern" of behaviour which has been recognized by cognitive psychotherapists [Mahoney, 1991 :281].

Fig. 13 shows two different patterns involving 5 states. In the first, rigid responses are associated with all the states, defining a closed circular path. We can see this typical pattern of behaviour and thinking in obsessives. In the second, a dominant and tense state "attract" all transitions. This is frequent in hysterical pathologies.

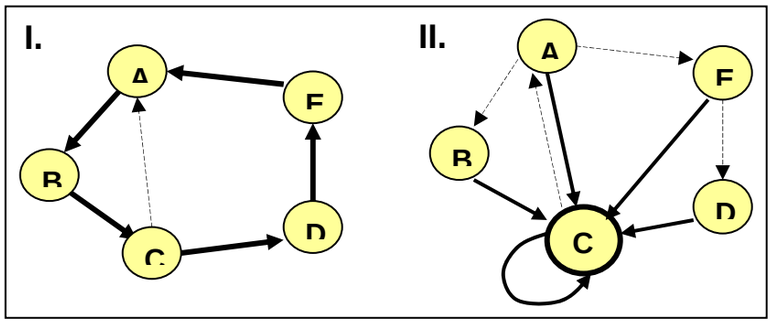

Fig.13. Two different patterns of transitions.

Project for a comprehensive analysis of behaviour - Part II: COMPLEXITIES

COMPLEXITIES OF THE HUMAN STATES

The theory of automata, from which we started, may not be applied to human behaviour without considering a number of singularities and complexities. The first question arises from the level at which the states are identified. The human organism is composed of organic sub-systems which contain several states. Their detection depends on the instruments we have at our disposal: EEG, ECG, laboratory tests, visual or auditive inspection.

However, human beings have long recognized their own states and states of other people. This self-knowledge is expressed by psychological and psychopathological terms such as ecstasy, delusion, hallucinatory, manic or neurotic states, sadness, passion, etc.. Such a list includes several levels of complexity, and this complexity demands a general classification which has been tried by phenomenologists. Based on them, I will discriminate between 3 kinds of states: impulsive states, cognitive states and emotional states. In spite of the wholeness of organism behaviour, which is apparent during emotional states, the polarity between cognitive and impulsive states can elucidate human states.

IMPULSIVE (AND INSTINCTIVE) STATES

Human sub-systems, like organs, have several states - physiological states - which are caused by internal patterns of input. These states are co-ordinated by internal meta-systems in order to maintain homoeostasis. In the final analysis, autonomic and central nervous systems are the meta-systems that organize this integration.

These internal states are generally outside consciousness and will. So, we can consider them as belonging to automatic behaviour. However, sometimes they set limits to conscious and voluntary behaviour, or they impose a specific behaviour, such as the demand for water, food, sex, violence and a lot of instinctive and pathological behaviour. In these circumstances, they have an interface with the external environment, and we can be aware of them. In this case we call them impulsive or instinctive states, depending on the biological value they have.

We tend to think about instincts and impulses as drives which compel the individual to stereotyped behaviours. I prefer to consider them as a rigid sequence of tense states, beginning with the "appetence state" of the ethologists [Bally,1958 (1945) :18]. They are manifested in several forms but have a hierarchical organization. Lorenz [1979 :99] speaks about the "great assembly of the instincts", and empirical researchers classify them as a hierarchy of impulses [Max Scheeller, Jaspers] or necessities [Maslow, 1977]. This hierarchy goes from the tenser and more urgent states to more relaxed and comprehensive states. At the top of the hierarchy, they lose the characteristic of the impulsive states and can belong to the cognitive group.

Since these states are determined by internal meta-systems, we can follow their hierarchy by following the hierarchy of the Central Nervous System. Such a hierarchy has been hidden by the complex telencephalization of the superior mammals, but it can be disclosed at the first stages of ontogenetic [Lemire et al., 1975] or phylogenetic [Arien Kappers, 1929] evolution. As we can easily see in these stages (specially in fish), C.N.S. is composed of 5 successive bulges or "swellings": mielencephalon, metencephalon, mesencephalon, diencephalon and telencephalon.

The ***mielencephalon*** is the lower swelling of the C.N.S., ending the spinal medulla. Inside it, there are the nuclei which regulate at the highest level the activity of organic sub-systems: digestive, cardiac and respiratory. In developed species, they are linked to the telencephalic lymbic system (medial septum and amigdalae) by way of the Shultz bundle. It is now well accepted that they impose tense states on the organism that maintain the vital homoeostasis.

The next bulge - the ***metencephalon*** - is composed of the cerebellum and annexes. Its function is to ensure muscular co-ordination, balance and unity of action, without which it is impossible to do anything (except maintain homoeostasis). However, in primates and especially in

Man, these fibres, which are linked to the striated muscles, are strongly telencephalized, permitting voluntary actions and, as we will see, symbolization.

The ***mesencephalon*** is the next swelling. In developed animals, it seems to lose importance, since their neurons are linked to the diencephalon and telencephalon. Such telencephalization is not present in fish, which process all visual information at this level (tectum opticum). This information is vital to inform the animal about imminent danger, particularly the presence of other predatory animals. Its relationship with structures that process acoustic information, which resulted from a migration of metencephalic parts, permitted the survival of mammals during the long glacial night [Jerison, 1973]. And despite the telencephalization of optic and acoustic bundles in mammals and Man, a lot of aminergic neurons which may be important in defense processes, originate in the mesencephalon. Thus, the search for safety can still arise at this level.

In Man, the ***diencephalon*** is occupied by the thalamus and hypothalamus. These structures are mainly relays of ascending fibres to the telencephalon (neocortex and lymbic system). However, in more primitive animals, it is mainly connected to two diencephalic glands: the hypophysis and epiphysis. This last gland is nowadays considered important for biological rhythms and related functions, like sex, reproduction and energetic modulation. The diencephalic habenulae, certain hypothalamic nuclei and the hypophysis cooperates in the rhythmic activities. These functions together converge to define the spontaneous organization of inter-individual relationships, including power and the "hierarchical structure" [Vieira, 1983: 357] of groups. I think that it is not necessary to invoke Freud to assume that these neural structures together may regulate interaction. It has been suggested that a disfunction of these structures may contribute to manic-depressive psychosis [L.Ibor, 1950: 363-431].

Finally, the ***telencephalon***, which includes neo-cortical, lymbic and striatal structures, is the upper swelling of the C.N.S.. It is very complex in Man, since it is occupied by neural networks resulting from ascending fibres of the lower structures (the so-called telencephalization), which carry visceral (interoceptive), muscular (proprioceptive), acoustic and visual information. In Man, these neural networks cooperate in the exploration of environmental space and in the organization of territory. In lower animals, this function is ensured by olfaction, of which fibres link directly to the telencephalon, and fill it.

In conclusion, we can draw up a hierarchy of the impulsive states in the following order of priority:

1. Achieving homoeostasis of the internal medium (mielencephalon): thirst, hunger, breathing, excreting, avoiding distress.
2. Achieving equilibrium and co-ordination of the body (metencephalon): standing upright, freeing muscular restrictions, equilibrium and co-ordination of movements.
3. Achieving safety (mesencephalon): fear, flight, fight, violence, avoiding threats.
4. Achieving interaction (diencephalon): sex, domination, submission, protection and care, cooperation, intimacy, loving.
5. Achieving exploration (telencephalon): activity, curiosity, collection and property, knowing.

This hierarchy is only a suggestion, and it includes both states and responses. It is difficult at the moment to establish a consensual classification of impulsive states, since they are manifested in many different ways, either normal or pathological. Learning can modify them to an extent, and human learning of impulsive transitions may be private and random.

Since human beings live in communities, family and society supply all they need to regularly satisfy their basic needs. Thus, impulsive and instinctive manifestations are generally ritualized into a relaxed game in the face of external stimuli that promote desire. Only in exceptional and pathological conditions, or if the family and social support is not adequate, the impulsive states manifest themselves as blind and tense. Apart from these exceptional conditions,

impulsive states tend to be connected with relaxed cognitive states. This is particularly true if the level of priority is lower, as it is the case of telencephalic impositions.

COGNITIVE STATES

In cognitive states we can include thinking, perception and representation (including remembering, conceptualizing and imagining). They are largely influenced by learned external symbols, and are mainly regulated by the telencephalon. The absence of impositions from the lower stages of the C.N.S. is generally a prerequisite for their existence. Typically, they are relaxed states.

Furthermore, at least in the form by which we know them in the human mind, they need to have access to a system of signs. The usual system of signs is language, which is shared by the community, but it can be composed of other signifier forms, like bodily postures. In the last analysis, all the systems of signs that we use are produced by movements of the body. Thus, we have to admit that cognitive states are linked to some moving parts of the body, particularly those which have a great cortical representation: vocal apparatus, eyes and fingers.

In fact, it is difficult to consider cognitive states without the great organization and specialization of the telencephalon (which results from ascending fibres of diencephalic, mesencephalic and metencephalic structures, i. e., telencephalization) in developed animals and particularly in Man. Among this organization there is the hemispheric differentiation: the so-called dominant hemisphere (generally the left) is related to signs and their syntactic rules. The non-dominant (or minor) hemisphere seems to be related to spatial and temporal continuity of forms, particularly if they imply bodily movements of recognition [for revision, Popper and Eccles,1977 :312-354].

The information we have about the specialization of cerebral hemispheres came from research done after comissurotomy and unilateral lesions of the brain. This interesting investigation is still on going. On the basis of present knowledge, we can formulate the hypothesis that the dominant hemisphere deals with signifier forms of the signs, while the minor hemisphere deals with their use, i.e., their signification or meaning[6]. We can observe the dissociation between the two faces of signs in the aphasic patients that have a lesion in the dominant hemisphere: they are completely unable to name the object we present to them; however they know its signification, since they are able to use it or represent its use gesturally. As the codified signifier face of the sign is lacking, they produce a gestural movement as an alternative to it. Once we can understand this gestural movement, we can say that it is an alternative signifier form, with the particularity of being symmetrical to the meaning, or identical to its use.

Generally, signifier forms complement the movement (actualized or virtual) of its use, which we can consider as the meaning (see note). Thus, the meaning of a ball or its signifier substitute (including the verbal sign) is the actual or virtual movement of supporting or throwing it. I assume that cognitive activity and consciousness is a reflexive movement between signifier and

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[6]**Note on Meaning.** Signification and meaning are important but open questions in the humanistic sciences (see also note 1). The problem seems to arise from different perspectives of Peirce and Saussure, and also from the different cultural and philosophical backgrounds of several schools. It would be interesting to know the different uses and translations of the following pairs of words: 'sense'/'meaning' (Engl.), 'Sinn'/'Bedeutungen' (Germ.), 'sens'/'signifié' (Fr.), 'sentido'/'significado' (Port.). English speaking scientists tend to use *meaning* as the referent or as the horizontal relationship between other signs. This tendency has led to narratives in Psychology [Bruner, 1990] and semantic networks in Artificial Intelligence [Hand, 1985: 35-43]. However, Saussure [1985 (1915): 159] distinguishes clearly these horizontal relationships from the "signifié". In their turn, Continental phenomenologists have focussed upon meaning, as a pre-objective intentionallity that gives signification to the world. Both Husserl and Merleau Ponty issued relevant questions for the theory of sign [Eco, 1973: 120-121]. In an outstanding article ("About the Phenomenology of Language"), Merleau Ponty [1960 :89-104] sustained a tense but complementary relationship between language and "intentions significatives", which are "fecundated" at special moments that I call the anchorage points. It is difficult to operationalize the "intentions significatives", which we can translate by meanings, but we can link them to Piaget's schemata [Piaget and Chomsky, 1975: 51-62], as a sensory-motor and pre-verbal construction of meaning. As we can see in "circular reactions" [Philips Jr.,1977 :46-54], these schemata correspond to internalised patterns of bodily movements which are related to the objects of the world (including parts of the baby's body).They are both symmetrical (identical) and complementary to them (if the movement forms a whole with the object). Later, I will try to describe this in terms of the pattern of transition of states.

signified (meaningful) forms, to reconcile the two. This process corresponds to Jaspers's description [1987 (1959): 254-256] of passive (mechanical and logic) and active (creative and goal-directed) processes of thinking. It is also compatible with the metaphore of the two computers described by Minsky [1986: 56-63].

Speaking about forms is justifiable because we recognize these processes as linked to forms of the external world (including our body-as-object). However, each one of these elements is, indeed, a neural and bodily state which correspond to the production of the considered form. And we can provisionally ascribe these signifier and meanignful states to the dominant and minor hemispheres respectively. Moreover, by combining signifier and meaningful states and their transitions, it is possible to describe normal and pathological phenomena of cognition [Pio Abreu, 1994].

Signifier and meaningful processes have different rules of transition and so, they are partially independent. However, they have points of interference, leading to temporary stabilizations (the "anchorage" points), or driving the course of one or another of these processes. If the leadership belongs to the signifier process (transitions regulated by learned logical and syntactic rules) the individual is ***reasoning***. If the leadership belongs to the meaningful process (transitions regulated by learned associations of spacio-temporal continuity or similitude), the individual is ***remembering*** or ***imagining***. As Jaspers describes, ***thinking*** is a complex organization of both processes.

Meaningful processes are more fluid and influenced by bodily movements. However they can be stabilized by a recursive process between signifier and meaningful states (i.e., anchoring in the signifier). This is the case for concrete nouns, whenever the referent is available (and usable). Verbs have a more complex and dynamic signification: the changing of the state of an object. They may also be associated with a movement of the body. Adjectives are linked to evanescent states that represent marginal but common ***signified*** aspects (and uses) of several objects. Abstract nouns and concepts relate to redundant relationships (and transitions) between sets of the states above. Thus, signifier forms of abstract concepts stabilise the cognitive states at a higher level of complexity and subsumption. The levels of complexity, which range from concrete names to general ideas, are theoretically (but not practically) unlimited. However, this is a matter for neurolinguistics.

Cognition includes conceptualizing, reasoning, remembering and imagining. The elementary states behind all these operations are the anchorage between a sign (generally linked to the bodily movement that produces a word or symbol) and a state of meaning (generally linked to a virtual or actual posture or movement that represents the use of the object that the sign refers to). We can call this elementary state ***representation***. Representation is also related to perception. However, this relationship, which is important for illusions and hallucinations, is a controversial point.

The classical view, which is supported by empirists, assumes that perception does precede representation. Phenomenologists (and, recently, constructivists) have argued against this view: the individual is not impressed by external forms, but reaches them according to his intentionality. In this line, Piaget [1973] demonstrated that adequate perception of the external world is preceded by active organization of sensori-motor schemata.

Recently, Marcel [1983, 1983a] brought new insights to this question. He demonstrated experimentally that there are two kinds of perception: (1) a primary unconscious, semantic one, concerning the automatic response to a stimuli, which can be subliminal; (2) a secondary conscious one, which is linked to iconic short-term memory and depends on a lot of conditions, including pre-disposition and conscious activity. Once more, we can see the double face of the signs. However, only when the iconic memory is present, can we speak about perception, in the usual sense that we, humans, know it. Thus, the higher kind of perception implies a previous reflexive activity between signs and their meaning (i.e. representation), which is tested against the resistances of the actual and reminded sensory impressions. So, ***perception*** is also composed of representation plus a

sensorial comparison. It does not create new meanings, but rather corrects or amplifies previous meanings.

EMOTIONAL STATES

The division between impulsive and cognitive states can be relevant in pathological conditions, but it is not well defined in normal people. The cognitive states, which are linked to the great development of the neocortex (particularly due to the telencephalization of the visual, auditive and proprioceptive neurons), are, in fact, a result of the phylogenetic evolution of the impulsive states. They are submitted to the demands of the lower impulsive states, and only when these later do not impose their restrictions, can they develop completely. And it is also true that cognition also determines impulsive states. Thus, in normal people, there is a complex relationship between cognitive and impulsive states. We consider emotional states as the global result of this complex relationship.

During its history, the matter of emotion has been hotly debated. One of the best known controversies is the central-peripheral debate, in which Canon and James were protagonists. Such a dichotomy seems to call the attention to the double involvement of cognitive and impulsive (physiological) states in emotions. In fact, this discussion ended with the incorporation of the two points of view in a cybernetic model, which is nowadays applied to the conceptualization and therapy of panic attacks: bodily responses can be a consequence of fear, but they also feed a state of fear, creating a vicious circle [Clark, 1986]. This vicious circle, which can start by fearful cognitions or by bodily changes, develops by itself and leads the individual to a self-fed emotional involvement that submits all the new cognitions and bodily changes to it.

This conceptualization of the panic attack can be a paradigm for the emotional states. Sartre [1965 :104] emphasized this global and unitary involvement of the body and cognition: emotion changes consciousness in order to transform the unattainable real world into a magic world, using the body as an instrument of incantation. And this can occur either because of the individual impossibility of coping with the real world, or because the world presents itself to him as a magic world. This later form consists of the emotional - and corporal - resonance of cognitions, which occur in affects and feelings.

Thus, emotions are global states, unlike cognitions and impulses which are partial states [Minsky, 1987]. In each emotional state, impulses and cognitions do co-exist. However, their content and transitions are submitted to a specific pattern, depending upon the quality of the underlying emotion which is active. And, just as we can consider the emotions that are more restrictive - or tense - with respect to the small number of cognitions that they admit, we can also consider the relaxed emotions, like curiosity, which permit a great deal of cognitive states and a flexible pattern of transitions. This is to say that it is theoretically possible to ascribe a particular emotional state to each moment of the individual life, including the cases in which there are not special manifestations of physiological tension. So, emotions reflect the global and purposeful quality of human behaviour. They are the general and true states of the organism.

Emotions can be very complex and may include conflicting elements, as it is the case of compulsive behaviour and other pathological situations. This complexity reflects the multiple possibilities of interaction between cognitive and impulsive states, and the learnt patterns they can present. However, there is a surprising amount of agreement between empirical researchers that try to classify them. No more than a dozen of basic emotions with similar names are quoted by these authors [Plutchik, 1980; Ekman, 1982]. More complex emotions, such as the pathological ones, can be considered as a learnt evolution of the basic emotions, or as a composite of elementary emotions, which includes the pattern of transition between them. Analysing compassion, Bergson [1929: 22] tried to decompose it into elementary emotions, including in it the pattern of transitions between them. I think that this analysis is virtually possible in the more complex human states, and the methodology supplied in this work is adequate for such an analysis.

LEVELS OF COMPLEXITY OF THE STATES

It is time to put some order into the statements above. Cognitions and impulses are partial states. This is to say that they are related to sub-systems of the organism and not to the organism as a global unity. However they have mutual interferences between them. The organization of these interferences is crucial, but there have been only a few suggestions about the hierarchy of impulses, the complex organization of cognitions, the restriction of cognitions by the active impulses, and the links between some cognitions and impulsive states. The number of possibilities would even seem to predict a chaotic organization.

However it is not chaotic. Nowadays, we can explain this on the basis of the self-organizing properties of the near-chaotic systems. It is also possible to try some elementary explanations on the basis of learning, interaction and organization of local feed-backs. What is important is that this complex organization converges in global states which we defined as emotional states in the broadest sense. In spite of the necessity of covering relaxed emotions, I think that the number of these states in their elementary form is countable and not very great. Each of them comprises a set of cognitions and impulses, and can transit to other elementary states.

Thus, these basic emotional states can transit from one to another, defining a specific pattern of transitions (see pgs. 5-9). Between the multiple possibilities of this pattern, there is one of special interest. This is the case in which the pattern is closed (i.e., there is a small number of states with transitions between them and not to other states), and the responses tend to be rigid (i.e., the variability is near to 1)[7]. In this case, once the individual enters one of the states that belong to the pattern, the rest of the sequence is predictable and it can be identified as a complex state. So, a ***complex state*** is a stereotyped composite of elementary states, and it can also transit to other complex states of the same level. Then, at this new level, we can also detect a new pattern of transitions between complex states. If this new pattern satisfies the conditions above, we may even consider a new complexity at a higher level. Fig. 14 illustrate these propositions.

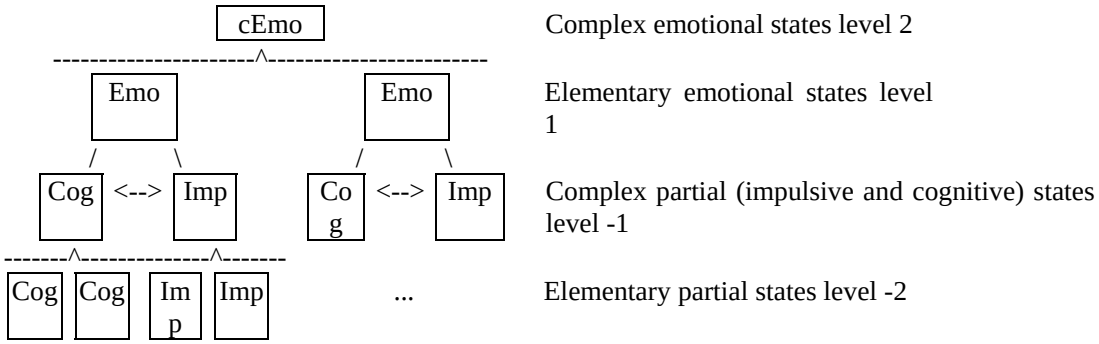

Fig.14. Composition and complexity levels of the states.

Although these assertions seem to be theoretical, they correspond to the usual description of human states. It is out of the question that each basic emotion includes active partial states, like impulses and cognitions. At most, we can say that impulsive states are more active in tense emotions like fear, while in relaxed emotions, like surprise and curiosity, the cognitive pole is then more active. At a second level of complexity, there are a lot of adult emotions that can be broken down into basic emotions. Bergson presented the example of compassion (a sequence of

[7] **Note on submatrices.** If these conditions are satisfied, we can work with sub-matrices. Each one of these is composed of (1) a sub-set of elementary states, $\{S_1, ..., S_i, ..., S_n\}$; and (2) a matrix of probabilities of transition between them $/P_{ij}/$. Since the Variability (pg. 5) is $V_i = Max\ (P_{ij}) - Min\ (P_{ij})$, the second condition is satisfied when $^{n}\Sigma_{i=1}\ V_i$ tends to n. However, these conditions must not be strict, but only probabilistic, in order to permit the transition to other submatrices. Having these elements, each sub-matrix can be introduced and simulated in a computer program. It corresponds to a complex state whose transitions to other complex states can also be detected and simulated in a new matrix of the level 2, eventually giving origin to complex states of a higher order, and so on.

displeasure, dread, empathy and humility), but we can find them in other self descriptions. A patient of Lopes Ibor [1950 :221] describes a kind of her anxious states as composed of the feelings of horror, fear, sadness and relief.

Moods and affects can be composed of a sub-set of complex emotions having a specific pattern of transitions. (We can consider moods as being more related to the dynamics of internal - impulsive - satates, and affects as being more related to cognitive states). So, they are also complex states of a higher level, in the same way as we speak of durable passions and loving states, a durable state of despair, hate or pervasive pride. At a higher level of complexity we can find neurotic, manic, depressive or psychotic states. The highest level defines personality.

Finally, we can also consider the same organization wherever partial states, which are linked to sub-systems, are concerned. Also they can present basic states which can evolve to complex states under the influence of learning and interaction. And sub-systems are also composed of elements, in which we can detect partial states with their own process of achieving complexity.

LEARNING

Learning is generally considered to be the changing of innate responses by way of two paradigmatic situations: Pavlov's *classical conditioning* and Skinner's *operant conditioning*. The criticism of these paradigms consist of detecting new forms of learning [Bandura, 1969; Bateson, 1971] and conceiving variants of both these paradigms, which include their unification. In the context of the hypothesis I put forward, it is possible to explain learning only by repetition of responses, that is, the tendency to maintain transitions which have been active. This tendency is generally found in living things, and what we know about plasticity of the nervous system [Eccles,1972] is compatible with such a tendency.

We have postulated that transitions of state depend on the availability of the specific pattern of input which determines it. Moreover, each state produces a specific pattern of output. Since we are dealing with open systems, we have now to admit that these patterns are not rigid, but they include some marginal randomized patterns. Then, if these marginal patterns of input are repeated (for instance, by systematic temporo-spatial continuity), they become linked to the previous admitted pattern, and eventually substitute it. This is what happens in classical conditioning. The more relaxed the state is, the more patterns of input (and patterns of marginal input) it admits. Thus, this kind of learning is more probable in relaxed states, and it tends to make them more relaxed.

As far as tense states are concerned, the output becomes more important. Patterns of output arise from transitions of state of the sub-systemic components, and they can constitute the signifier forms of input which may be used by the same or other components in order to perform future transitions. Randomized marginal output reflects some instability of these components during tense states[8]. Whenever these transitions result in randomized motor activity (agitation), they enhance the probability of achieving the pattern of input which is necessary to end the tense state (as reaching water is necessary to end the state of thirst). If these marginal transitions are repeated in a certain order, they tend to be more probable and so, they are learned. However, this order is prevented by further randomized responses, and it is only possible at the end of the state, just before the procured input (the reward) is obtained. This is what occurs in operant conditioning.

Later, while studying interaction, we will see other possibilities of considering repetition as the general source of learning. For now, it is useful to note that learning of new patterns of relevant input and of specific output converge in order to amplify the set of admitted patterns of input and to make the transitions more rigid. This is one of the conditions for organization of complex states. Thus, learning enhances the probability of organizing complex states at a higher level.

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8 An appearent contradiction arises from the possibility of maintaining a global state while the partial states of the components are changing. Modern Thermodynamic give us several examples of similar phenomena. In fact, this is a property of the self organized systems. Thus, a state of the organism can be maintained while organs and cells are moving within a certain range. This is a central point of systemic theory: the whole is different from the sum of the parts.

Moreover, learning is not only a property of the global state at one level. We have to consider that learning occurs at all the levels of the organism and its components, and involves all the partial states and transitions between complex states of higher level. That is, in the same way that transitions of state proceed by means of hierarchical levels of complexity, learning is also a hierarchical process that is linked to each of these levels. For example, in operant conditioning, the indices of the reward, and the reward itself, operate jointly at different levels. The precise definition of the levels at which several stimuli and external cues (for instance, context-dependent cues) operate in learning, is a matter for subsequent study.

ECO-SYSTEMS

The patterns of input, which each state admits to promote transitions, correspond to sentient and material things that exist in the environment of the system. In their elementary form, they are usually conceived as stimuli resulting from physical or chemical agents that react with the organism. However, to be relevant in promoting transitions, they must have a certain spatial or temporal pattern which is isomorphic with the objects of the world where they arise. The organism admits them in the form of images, sounds, pressures, smells, tastes and pains. And besides these sensory forms, we can assume that a number of other forms of interplay exist within the organism, especially where the sub-systems and partial states are concerned. These forms may not yet be known. The important thing is the specific pattern of input which is admitted by each state of the system under consideration. We can speak about stimuli, objects, message-cells, neurotransmitters, words, signs, messages and so on. All of them are sentient and material (physical and chemical) agents that are somewhere, in the environment (eco-system) of the focused system.

However, as far the human system is concerned, it would be a mistake to consider all these agents as belonging to the same eco-system. In fact, a number of these patterns of input connect sub-systems and exist inside the organism. Outside it, we must consider the differences existing between the world of things and the world of people. And, besides these, there is a special environment composed of signs and symbols that can be produced by the organism for its own private use. We will consider these four kinds of environment under the names of internal, territorial, interactive and interior eco-systems.

1.Internal eco-system. Cells and organs have transitions of state, relationships, communications and learning. So, each component of the organism has its own environment which is composed of organic fluids and neighbouring elements. It receives its input from this environment and sends to it its output. In spite of learning possibilities, the majority of interaction existing in the internal eco-system is not conscious. However, it can have access to conscious activity and be interfered with by it. This interference frequently disturbs the performance of sub-systemic behaviour, as it occurs in hypochondriac states. In the same way, emotions make the subject be aware of his internal eco-system. They can improve or disturb its performance, depending on the adequacy of the cognitive interference.

2.Territorial eco-system. Besides the internal eco-system, we can consider an external environment, where objects that promote global behaviour and learning of the system are deposited. These objects are not random, but they are organized according to the meaning they have before the animal's basic instincts. This leads it to choose and organize its territory, where vital things, both pleasing or painful, become predictable. Given the prematurity of human beings, instincts are modified by learning, and produced objects acquire meaning and mediate between vital things[9]. So, human territory is more constructed than chosen, but it is indeed a territory. Within it, there are meaningful objects that strongly influence our global behaviour and learning.

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9. Criticising Hegel, Habermas [1968 :11-43) presents interesting arguments about the opposite effects of working and using signs on human consciousness. Moreover, he considers also the differential importance of personal interaction. These distinctions are compatible with our distinctions between territorial, interior and interactive eco-systems. We join them the internal eco-system, in order to deal with clinical facts and according the original idea of Bermudez [1970] and Soeiro [1976].

3.Interactive eco-system. In the territory, things are static and predictable. This differentiates them from living things which are generally moving and unpredictable. If fight or flight and reproduction are instinctive and predictable (i.e. territorial) behaviours, coping with new living things implies a previous and learned interaction between them. This is even true in developed animals which live in groups and recognize each other individually [K. Lorenz, 1979]. This is even more so in human relationships, in which ritualistic behaviours, shared symbols and language make it possible to live in society. Thus, the world of people and living things (pets and computers seem to compete with people in active interaction) acquire an important place in human behaviour and learning.

4.Interior eco-system. A lot of symbols resulting from interaction - language, gestures, postures, iconographic and non-verbal symbols - can be produced by the subject itself. And we can keep them in a private space (e. g. a sheet of paper, the nervous memory, etc.) in order to use them when they are necessary to promote a certain transition of state. In this case, they substitute things and people when these are not available. This is why covert behaviour, fantasy, inner dialogue and thinking are possible in human beings. Since all these stimuli are kept and used privately, and are protected from exposure to other people, I define them as belonging to the interior eco-system. I call it Interior and not internal, because in spite of being protected from exposure, it is peripheral to the organism. Personal drawings, marks and writings also belong to this eco-system, but it is a matter of discussion if private books belong to it. Books and other cultural products link interior and interactive eco-system.

Core ordering processes. Starting from clinical and psychotherapeutic perspectives, constructivists propose the existence of four "core ordering processes" in human experience [Mahoney, 1991: 178-185]: (1) valence or value, (2) reality or meaning, (3) personal identity, and (4) power or control. Despite having different origins, these assumptions converge with the theoretical formulation above, since we can relate each of these processes with the input coming from each eco-system. Given this, it is possible to detect the more feasible ground of action in order to change each of the core ordering processes.

Thus, I assume that *power* is linked to the internal eco-system. Good organization of the organic sub-systems, and adequacy between these and cognition give us a sense of power and control. Propulsive emotions are the final result of this. So, exercising the internal eco-system by way of sports, gymnastics, dance and role-playing enhances the sense of well-being, as well the sense of control and power.

Reality and *meaning* are related to the territorial eco-system. The objective but meaningful world of things that are predictable, constitutes reality. It has a great value for survival. Working and dealing with things, constructing projects, solving problems in adventurous sports such as camping, mountaineering, cross country and travel enhance the sense of reality and promote autonomy.

Valence and *values* result from personal relationships, that is, interactive eco-system. Guilt and shame are basic emotions which signalize the transgression of values and of private personal spaces [P.Abreu, 1994: 114-115]. Personal interaction and social ritualistic activity are a great source of emotions, affect and motivation. Thus, valence and values can change in interpersonal therapies, group therapies, institutions and religious groups.

Finally, *identity* is largely the result of memory and knowledge which are created by means of self-produced stimuli belonging to the interior eco-system. We can hope that working in this environment can change or improve the sense of identity. This is the case of changing private

things, using mirrors, self-grooming, but also therapies based on self-reports, diaries and narratives [Gonçalves, 1992].

Project for a comprehensive analysis of behaviour - Part III: INTERACTION

INTERACTION

Living and open systems interact amongst themselves. This is why they become organized and give rise to new complex systems. This is also why they modify each other's behaviour, leading to learning and complex states. Interaction is a complex and circular process between two or more systems and can be divided into two basic processes: relationship and communication. These have been studied in several subjects such as linguistic, sociology, psychology and engineering, in spite of the tendency to unify the different aspects of this study in an interdisciplinary way. We will pursue this tendency.

The background for all the studies of informative communication is the paradigm of Shannon and Weaver [1949] that considers the simultaneous presence of a *sender* and a *receiver* linked by a *channel* where *messages* are circulating. It considers also the existence of a *transducer* that codifies the message, and a *referent or context* which is related to the message. Jackobson [1960] linked each of these elements to the known functions of language: emotive, injunctive, phatic, poetic, meta-linguistic and descriptive, respectively.

Thus, communication presupposes relationship, which we can provisorilly consider as a permanent sharing of channels and codes between the sender and the receiver. Studying human interaction, Watzlawick et al. [1967] related communication to relationship, and made a number of suggestions about the spontaneous organization of messages, codes and, implicitly, their referents. I will develop this approach as an extension of the concepts defined in previous chapters.

COMMUNICATION, SIGNIFICATION, INTENTION

Wherever communication exists, no matter if it concerns matter, energy or information, there is a change in the configuration of the receiver. In some cases, the received input does not affect the global behaviour of the system, but only certain sub-systems which we know as deposits [Miller, 1980]. In this case, the received input is not relevant to the organism in its present state, and it is stored in deposits (internal and interior eco-systems), waiting to be used as relevant input to promote partial or global transitions of state.

However, if the pattern of input is relevant to the present state of the receiver, it switches its state and shows a global response or behaviour. In this case, we can speak about significant communication. So, ***signification*** is the sequence of states of the receiver determined by the relevant pattern of input.

Generally speaking, relevant patterns of input correspond to messages. These can be material things or energy coming from the territorial eco-system or stored in the internal eco-system, or informative signs coming from the interactive or interior eco-systems. They can constitute systems in themselves (as in predatory activity); but, in general communication, they correspond to the output produced by other systems. This output is continuously produced and may not have a meaning in itself. Its meaning depends on the relevant aspects selected by the receiver in order to change state, or, as we have seen above, to start signification. And this selection, which is the breaking down of the continuity of the input[10], depends on the present state of the receiver. In other words, there is a sort of expectancy of the receiver that is prone to state transitions. This expectancy, which gives meaning to the output of the sender, is close to the ***intentionality*** of phenomenologists.

However, in human communication, messages are sent with a certain intention. In this case, the sender anticipates the results he intends before sending the messages. That is to say, he

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[10] **Note on punctuation of messages.** These statements deal with Watzlawik et al.'s concepts of punctuation of a continuous event (3rd. axiom), analogical / digital messages (4th. axiom), and the inevitability of the communication that depends on the meaning given by the receiver (1st. axiom). In fact, Continuous and analogical input coming from the environment has to be broken down and selected by the receiver, in order to be processed and manipulated as digital messages. Whenever a code is shared by the sender and receiver, the output includes codified signs to signalize punctuation, and the meaning of messages is less dependent on the receiver. This conceptualization links pragmatic and semantic aspects of communication.

makes a previous model of the intended effects of the message. And it is easy to verify in the most simple instances of imperative sentences (for example, when we ask somebody to open his mouth or to squeeze his hand, we tend to perform the same gesture) that this model is a sequence of states determined by the input of the interior eco-system. Since this sequence of states corresponds to the ***intention***, there is adequate communication whenever the intention of the sender is equivalent to the signification (the sequence of states determined by the message) of the receiver, i.e., if the result fits the model. Thus, intentional communication presupposes (1) the existence of an interior eco-system in the sender; (2) the possibility of equivalence between the states of the receiver and the states determined by the interior eco-system of the sender.

EQUIVALENCE

Equivalence is a crucial but difficult point in this conceptualization. Since we can empirically identify states by their characteristic patterns of output, it seems possible to base equivalence on these patterns. However, this identification is only possible if the systems are physically identical and the eco-system is the same. It would be impossible, for instance, to expect the same output in equivalent states resulting from interior and territorial eco-systems. An alternative way is to consider as equivalent the states determined by the same or an equivalent pattern of input. Although this is a linguistic method, it is merely postponing the problem. The equivalence of patterns of input depends on the available codes. However, these codes are only available to a small part of communication (for instance, dictionaries and syntactic rules in verbal communication), and they are not sufficient to deal with all the subtleties of translations.

Fortunately, The concept of complex states permits a new approach to the problem of equivalence. We have seen that each complex state has a specific pattern of transitions defined by the matrix of transition probabilities (pag. 15) between the elementary states it comprises. We can assume that an equivalent (complex) state has to have the same pattern. That is, two states (*A* and *B*) will be equivalent if $/P_{ij}(A)/\approx/P_{ij}(B)/$. In the same way, the elementary states that belong to this complex state will be equivalent term by term. In other words, the elementary states belonging to a complex state will be ***equivalent*** if they have the same probabilistic relationships of transition to the neighbour states.

These equivalences have to be probabilistic and maintain some ambiguity, which seem to be inevitable in communication [Hankamer & Aisen, 1984]. However, there is no better approach, and this has some advantages. For instance, it can explain the principle of isomorphism and the phenomenon of transposition described by Gestalt psychologists [Kohler, 1964 :198], and the direct impact of music. Some recent psychotherapies, which have originated from Eriksonian hypnosis [Cayrol & Saint Paul, 1984], deal with this direct impact of rhythms upon mental states. Rhythm is no more than a pattern of transition of states, whatever their specific components may be.

Once equivalence exists, we can speak about direct meaning, since we are dealing with equivalent patterns of behaviour independently of the messages that mediate them. In many instances of communication, messages are not well-defined and belong to several levels. In these cases, we may only know if communication has been adequate and if messages came from internal or interior eco-systems (in self-communication), territory, interaction, or from a combination of two or more eco-systems. But, as we can consider equivalence between states belonging to several systems, in spite of their differences and the different origins of messages, we can precisely define many concepts related to communication. We tried above to define signification, intention, significant and intentional communication. Moreover, considering the states of the sender and of the receiver in interaction (including the case in which the receiver is also the sender, in self-communication), and the combination of eco-systems where the messages are coming from, we can define unambiguously some psychological phenomena and communication attitudes[11]

11 To avoid overloading the reader with codified symbols and more detailed explanations, I will supply a list of the phenomena that I have been trying to define (and separate) unambiguously [Pio Abreu, 1994 :45-54]: transcendence, empathy, expression, exhibition (representative presentation), communication of contents, understanding, obedience,

SYMMETRY AND COMPLEMENTARITY

Symmetry and "complementarity" are geometric concepts. Watzlawick et al., following a suggestion of Bateson [1987: 170], applied them to the human interaction. These concepts have been intuitive and useful when applied to familial and group therapies. I think this usefulness can be extended to general behaviour which is interactive. However, since they are spatial analogies, we have to define them in terms of temporal behaviour. Once more, the definition of equivalence based on complex states will support this transposition.

We can give the name ***symmetrical reception*** to all the circumstances in which the characteristic output of a certain state (or a sequence of states defining a complex state) of the sender determines the transition to an equivalent state of the receiver. This corresponds to Bateson's descriptions when he refers to circumstances of aggression producing aggression, crying producing crying, etc.. This phenomenon produces imitation, comprehension, identification, depending on the eco-systems mobilized. It also promotes equality of behaviour and competition for the same place and functions regarding the macro-system.

Despite being intuitive, complementarity is more difficult to define. It exists whenever aggression produces passivity, submission produces domination, and so on. These behaviour pairs adjust mutually, as each one of the terms exists to balance the other. It is as each system can have both states well balanced (for instance, submission and domination to balance power) but, in the presence of another similar system, it alienates one of the terms to the other. So, we can explore the hypothesis of considering each of these pairs as constituting a complex state defined by the context of the activity (fighting, power). In this way, ***complementary states*** are those that result from the partition of a complex state. And we can give the name ***complementary receptions*** to the circumstances in which the characteristic output of a certain state of the sender determines the transition to an equivalent of the complementary state in the receiver.

We have been concerned with complex states composed of a pair of elements. However, the definition of complementarity can extend to all partitions of complex states, no matter how many states they have. So, we can consider a partition between two or more sub-sets of elementary states, or a partition of all the elementary states. In this case, each system differentiates in developing a particular state of the complex, and co-operates with other systems in order to produce the output (actions) which they have individually alienated. This is to say, a set of systems with complementary receptions co-operate among themselves in producing the general behaviour that before was performed by each one of them.

Bateson's idea of complementarity transcends the limits of any discipline [Watzlawick et als.,1967: 62]. It can be applied to societies, groups, elements of families and couples, and probably to atoms, molecules and cells. It can easily explain the differentiation of taking roles within a group. Recently, M. Barbiery [1985] proposed a non-Darwinian theory of evolution after collecting a number of biological facts and recent ideas of Thom, Prygogine and others. This theory consists in considering that organisms evolve not only by natural selection but also by a natural convention of achieving cooperation among them. Under a suggestion of Popper[12], he called it "The semantic theory of evolution".

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automatic obedience, observation, self-observation, remembering, imitation, automatic imitation, comprehension (in Dilthey and Jaspers's sense of empathic understanding), superficial ("adhesive") identification, identification, projection, commanding, controlling, learning, teaching.

[12]**Note on propensities**. One of the strong points of Popper's philosophy is the notion of propensities [1991]. According to it, the future (the organization of new and more complex macro-systems, such as human societies) is open and not deterministic, but it has in itself a certain range of virtual possibilities (propensities). The applied image is the empty orbit of an electron. And, as he describes in the experiment with dice, these propensities are inscribed in original beings. It would be interesting to know if complex states, once they have achieved adaptation, are not the matrix for propensities. In this case, the organization of new macro-systems would start when systems with an equivalent complex state proceed to partition this state by complementary receptions, and reproduce its function at a new systemic level. Besides the phenomenon considered by Kurt Lewin and Barbiery, this could also explain how successive generations of cells originated from a single ovular cell and evolved to different organic cells cooperating in organic functions of the embryo and the organism [Prochiantz, 1991].

RECUPERATION OF MEANING

While considering symmetrical and complementary receptions, we omitted the problem of messages (output and input). We will return to this problem. However, there are reasons to admit that symmetrical and complementary receptions are the primitive form of communication, and that they are the spontaneous form of achieving meaning. By this, I assume that it is not the message that achieves meaning, but it is meaning, obtained after complementary and symmetrical receptions, which selects messages.

The general tendency of systems to have symmetrical and complementary receptions can be a philosophical problem. We can find it in the tendency to have generations of similar living things descending from common progenitors (which is an aspect of symmetry). But we can also find it in similarities and adjustment of particles, atoms and molecules. Probably, we will have to go deeply into our common origin from the "Big-Bang". However, it is sufficient to have evidence of it: competition and cooperation, similarity and differentiation, attraction and repulsion are the general rules of the Universe. Probably, we can find this tendency in the mathematical possibilities of interaction between the more simple dynamic elements which have only two states. Whenever their transitions result from interaction, they may either fall into the equivalent (symmetrical) state or into the complementary one.

What matters is that feed-back results from circular interaction. In fact, if two or more systems have symmetrical receptions, after concluding the circle of interaction, each system will repeat the transition of states it performed before. So, this transition is learned and becomes more probable, just as output-input is learned (selected) and becomes relevant for the performed transition. The same consequence occurs when the symmetrical reception concerns a complex state expressed by a fixed sequence of elementary states. Each system repeats and learns this sequence, and thus their learned behaviour converge[13]. Ultimately, the systems become identical.

There is also a positive feed-back if two interactive systems have both complementary receptions or, if the number of complementary receptions is even, in an interactive circular chain of systems. In the case of more than two complementary states, we have to attend to each specific reception, but this general rule can also work (see fig.15). In all these instances, there is also a positive feed-back: each system repeats and learns the same sequence of states, as soon as it completes the circle of interaction. They differ from symmetrical receptions in that their behaviours diverge, becoming different but prone to cooperate.

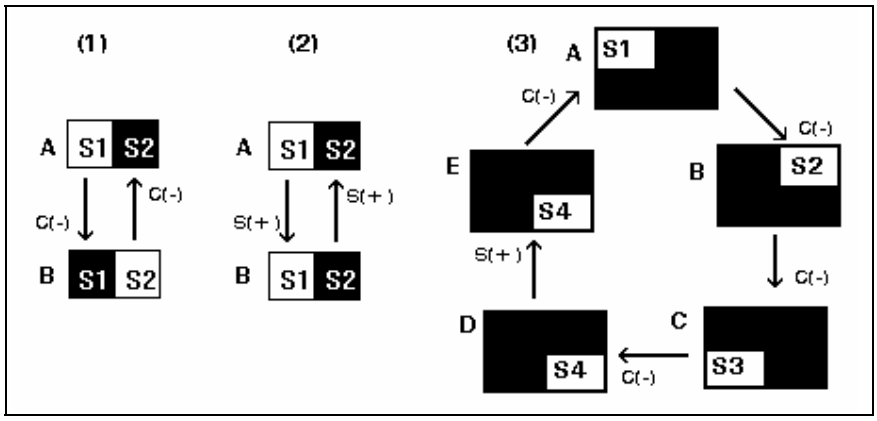

Fig.15. Three cases of recuperation of meaning involving systems with two [(1) and (2)] and four states [(3)]. There are symmetrical [S(+)] and

[13]**Note on non-conditioned learning.** This phenomenon can explain learning from a model [Bandura, 1969]. We can extend this process to conditions involving different eco-systems including the symmetry between states of the same system but determined by different eco-systems. This is the case of adequate self-communication (pag. 19) or self-training: we have firstly an intention (a cognitive model constructed from the interior eco-system); then, the intentioned sequence of states is transformed into an equivalent but active sequence of states determined by the territorial eco-system; if the result fits the model, this sequence (signification) is repeated and learned.

complementary receptions [C(-)]. We can verify that the behaviour of A and B in the case (2) and of D and E in the case (3) become identical. The behaviour of the remainder systems diverges in each round of the interaction.

In this way, whenever the interaction leads to positive feed-back, the last message (the input coming from the last system) results in the repetition of the sequence of states that began the interaction. This sequence corresponds to the signification of the message but also to a behaviour similar to intention (or intentionality). Since it is repeated, this behaviour is learned and the message is selected as relevant. So, we can speak of meaning, and I give the name ***recuperation of meaning*** to all the circumstances in which the system repeats an original sequence of states as a result of the interaction.

Recuperation of meaning is also the birth of meaning. It links the signifier message (the selected pattern of input) to its result (its signification or meaning). So, it gives rise to signs and meta-systems, that begin to be inscribed in the organism, eventually in its CNS. Whenever the selected pattern of input results from a symmetrical reception, the signifier becomes symmetrical to the signification or meaning (see notes on signs and on meaning). Whenever it results from a complementary reception, they become complementary.

When there is not a positive feed-back in the interaction, the original meaning is lost, and the signification of messages is randomly dependent on the receiver. However, we can also consider the possibility of a negative feed-back in the context of interaction with symmetrical and complementary receptions. For example, if one of two systems in interaction has symmetrical receptions, and the other has complementary ones, they will move from one state to its complement each time they receive input. With several complementary states, each system will alternate between elementary states as a result of interaction.

This negative feed-back permits the systems in interaction to maintain a certain balanced behaviour and to avoid rigidity, once meaning is recuperated. For having this flexibility, it is sufficient to change one of the symmetrical receptions in a complementary one or vice-versa. Analyzing Albee's play "Who is afraid of Virginia Wolf", Watzlawick et als. [1967 :145-157] shows that this change occurs in order to maintain homoeostasis within a couple at risk. And I believe that this is a frequent mechanism in nature.

LEVELS OF INTERACTION

As states and learning are organized into hierarchical levels, interaction occurs at several levels. Thus, each actual interaction acts upon a special level of organization which depends on a number of factors: physical constitution of the system, its limits and gates, previous interactions and learning. In short, the level of an actual interaction depends on the organization of internal and external meta-systems.

For example, a chemical system can modify our global state by way of smell and taste. But it can also modify it by the influence on organic sub-systems, if it is inserted into them by trans-cutaneous injection. And this is interaction because we also modify the organization of the chemical agent, unless it is not significant. Also, we interact with environmental machines (like computers) and living things (like pets). Each of these interactions has its own channels (interfaces) and changes our states at a precise level of complexity, such as the level of moods, affects, cognitions, impulses or basic emotions. These levels depend on previous interactions and learning, including the previous existence of positive feed-backs (recuperation of meaning). Probably, some meaningful interactions are genetic in origin. However, construction of new living systems is influenced by ancestral interactions from which macro and meta-systems emerged. In other words, natural evolution is no more than selecting meaning.

Different systems, such as humans, pets and computers, have different hierarchies of complexity. The level at which they achieve an interface is the level at which they can find an equivalence of states, thus recuperating meaning by way of symmetrical and complementary receptions. As long as systems are similar, the more levels they can find to achieve equivalence.

Thus, we can admit that human interaction is processed simultaneously at different levels (parallel channels). Verbal communication is placed at one of these levels, which acts on cognitive states[14]. But other kinds of interaction influence non cognitive (and not conscious) states and use other channels, messages and codes. Their recognition may help human change processes.

Complexity of the states (System A)	Levels of interation	Complexity of the states (System B)
Level 4		
Level 3		
Level 2	<-----top level----->	Level 3
Level 1	<------optative----->	Level 2
		Level 1

Fig. 16. Relationship between levels of complexity of states and levels of interaction.

COMMUNICATION, RELATIONSHIP AND CODES

We have seen how significant messages are learnt and defined in a temporal process of interaction (recuperation of meaning). Once this process occurs, a shared code arises in the form of relevant patterns of input which each system admits in order to change state. In spite of being virtual, it is a code (meta-system) which will punctuate and give signification to similar future messages. So, codes are not linked to a specific interaction, but they tend to be generalizable to other interactions. But codes can also be taught, since they exist in the form of culture, social rules or progenitor's habits (social meta-systems). Bringing up children is a process of teaching codes.

Codes are essential to significant communication, because they permit a shared signification and punctuation of messages. They break down the continuous (analogical) input that acts upon systems, and transform it into discontinuous (digital) messages. Once the system achieves the relevant pattern of input and its signification (transition of state), it is prevented from further but irrelevant continuous input. It is free to continue changing states and moving, and it can proceed with communication at the same or higher and lower levels.

But we can also consider a situation in which there is no code nor punctuation, and continuous output of the sender is maximized as the relevant input of each receiver. (This is a case of analogical messages and maximum empathy). In this case, whenever there is a positive feed-back of symmetrical or complementary receptions, recuperation of meaning is performed by paralysis of all the systems in a certain state, preventing them from further change or movement. This is to say, all systems maintain a certain and stable (physical) relationship between each other, and give origin to a macro-system. The systems involved in this interaction cannot change any more at this level, and new communication is only possible at lower and sub-systemic levels.

With the exception of mineral crystallisation, chemical auto-catalytic reactions, and some crowd phenomena or special circumstances of enclosure, this drastic process is not widespread in nature. However, it is a paradigm for spontaneous relationships, since: (1) they tend to use analogical messages with no previous code; (2) they tend to reduce the freedom of the systems concerning their possibility of changing states; (3) they tend to give rise to macro-systems (such as communities and social organizations). These conditions define the special kind of interaction and communication that constitutes a relationship.

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[14] **Note on language levels.** In fact, human language has several levels, coming from the high-priority (and tense) levels to the most general. Before the known functions of language, we can suppose the following hierarchy, which seems to correspond to its phylogeny: (1) emotive, (2) injunctive, (3) phatic, (4) poetic, (5) descriptive, and (6) meta-linguistic. For its part, descriptive language has also several levels linked to the organization of cognitive states (pag.) and studied by Logic. At the higher level of meta-linguistic function , we have to consider the influence of social meta-systems. The lower level of emotive function continues to impulsive states of organic sub-systems.

Furthermore, a relationship imposes conditions on all the interactions at lower levels. If it concerns identical systems, several channels become shared, but new interactions and recuperation of meaning have to respect the general rules of relationship. In fact, the relationship changes previous significations just as it gives rise to new significations. By itself, it can constitute a code (or a part of the code) of lower level digital messages.

Then, each relationship is a specific context of communication in the double sense of involving two or more systems, and acting on complex states that re-define the transitions of elementary states. It is the upper limit of communication, where we can find the codes of digital messages which circulate at lower levels. Culture, including language and social institutions, is a product of human relationships.

Project for a comprehensive analysis of behaviour - Part IV: PERSONALITY

PERSONALITY

In human psychology and psychopathology, we have to confront the question of personality, which is usually conceptualized as a thing - etymologically, a Greek theatrical mask - but which is rather a well-balanced set of typical experiences and behaviour. Therefore, it also belongs to the dynamic world of the succession of states although eventually regulated by the meta-systems.

Concerning personality, we cannot ignore the three Freudian instances that define it: the *ego*, the *id* and the *superego*. Other authors, such as Moreno, Bern and behaviourists[15] have considered this trilogy under different names and from different perspectives. Therefore, this convergence facilitates our vision. Thus, personality can be seen as something that is centrally defined *(ego)*, which balances social meta-systems that regulate duty *(super-ego)* and organism meta-systems that regulate pleasure and instinctive impulses *(id)*. I will approach this trilogy in terms of a reflexive construction that was foreseen by Watzlawic in the context of communication theory, and is patent in the writings of authors such as Pirandello and Sartre.

However, to transpose personality into a temporal dimension we have first to face the importance of future. In other words, we have to consider the importance of predictive and anticipatory abilities for the survival of living creatures.

PREDICTION AND ANTICIPATION

The introduction of time in the semiology of subjective phenomena seems to be a difficulty which psychopathologists have been trying to overcome with only partial success. Recently, Jean Sutter proposed the notion of anticipation to explain human activity, and this idea has been enthusiastically received by the continental European psychopathologists.

However, in 1955, George Kelly enunciated the Fundamental Postulate and First Corollary of his "Psychology of Personal Constructs". Those assertions, which have been widely accepted in the science and technology of Artificial Intelligence, are as follows: 1) "A person´s processes are psychologically channelized by the ways in which he anticipates events", and 2) "A person anticipates events by construing their replications". To this author, the necessity of prediction is the background for the development of anticipation abilities. Without prediction, behaviour would be chaotic: the person holding out his hand, would not be able to predict that the other will shake it; the animal going to the site of eating, could not predict that food will be there. All life is based on prediction, because without it there would be only chaos and death.

So, as Kelly says, each person acts as a scientist who constructs models of the universe and tests them against reality, in order to use them to predict events. Those "scientific" models of the external world do not belong exclusively to man: from the most complex to the most elementary, all living things, animal or vegetable, need them to survive, and have to contain such models - it does not matter where or how. What is important, is that they regulate behaviour, even if it is elementary, such as the growing of the root in search of water, or the blossoming of a flower in the prediction that an insect will land there. Since those models regulate behaviour, they are meta-systems. They are virtual rules that belong to World 3 but which can be materialized, for instance, in the form of chromosomes. Throughout phylogenetic evolution, they have been tested against reality, constantly being improved in order to constitute its algorithmic replication, by means of which predictions are made.

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[15] **Note on Freudian instances.** These instances (super-ego, ego and id) have a certain pragmatic value, and others authors have considered them under different names. Moreno's distinction between social, psychodramatic and physiological roles [1854] seem to correspond to these instances. In a simple language, E. Berne speak about the states of parent, adult and child. Modern behaviourists consider the existence of the character and temperament [Eysenk, 1976], as corresponding to attitudes and values (super-ego), and emotional and physiological dispositions (id), respectively. They had to join self-concept and self-image to explain self-dependent activities [Vaz-Serra, 1986]. However, before them all, Plato considered the existence of a courageous soul *(Thymos)*, a rational soul *(Logisticom)* and an avid soul *(Epitymia)*.

THE CONSTRUCTION OF PERSONALITY

We can say that personality (a system of behaviour patterns whose organization may or may not be harmonious) is constantly being constructed faced with the necessity of prediction. As we have to predict several types of events, there are several movements that are going to define personality. I can divide them into 3 categories: 1) the movement that goes from the individual to the environment, in order to predict environmental events; this has been studied by Gestalt Psychology and Ethology. 2) The movement that goes from an individual to another, in order to predict the behaviour of the latter; this has been studied by ethologists when they speak about bonds and attachment. 3) the movement that goes from an individual to another and is reflected back again as in a mirror, thus allowing him to predict his own behaviour; this third movement has been identified by phenomenologists, and its genesis is studied by communication theories and developmental psychology. These three types of movement can impinge differently upon the formation of each personality sub-system and upon the reflexive capacity of consciousness. They may have a phylogenetic order. However, they can overlap in the history of each individual and contribute indifferently to each level of depth of personality organization.

First movement: "I am what I am, and I survive". The models of reality that regulate behaviour in animals, are open to learning and are registered in the neural network of the nervous system. Since the different sensory and motor organs are articulated there, we can easily conceive its algorithmic form: *"if olfaction detects odour x and gluco-receptors are not stimulated, then move your limbs in the direction where the wind stimulates your tactile organs; you can start salivating because a meal will wait for you"*. It is not difficult to conceive a computer-chip with those instructions, and it is not impossible to conceive neural networks with more complex instructions, since we know that they were constructed and selected during the billions of years of the evolution of species.

However, this rough model will be tested, during the vital experience, against the reality of the meal. Thus, by the learning process discussed in chapter 2, odour *x* will become *x'* and new odours, *y*, *z*, ... can be added to it. These odours can prefigure a map where smells are located, and the space between them will be filled by locomotor activity. The typical case is the salmon that swims up-river, to spawn at the source, the opposite direction to the way it went during its infancy. Laboratory experiments have shown that this journey is determined by river odours that are recorded in its brain [Hassler & Larsen, 1975]. So, these records are the map of its territory - the river where it was born.

In this way, the map of the territory is the first model of reality that animals - and Men - contain. In truth, we must consider the existence of several maps, according to the different instincts presiding over behaviour. Without them, life would not be feasible. These models determine behaviour according to the phylogenetic propensity of the being, that is to say, according to its instincts or its "*id*". And this is the first movement that forms personality, from the individual to the environment.

Second movement: "I am as the other sees me, and we live together". The animal's territory can be invaded or shared by other creatures. In certain instances, they can be predicted basing on the hunting or sexual instincts. If they are predatory or in other way unpredictable, the instinctive reaction determines fight or flight. In all of these cases, in less evolved animals, the presence of such creatures belongs to the map of its territory, that is the most primitive model of reality.

There is a great difference between this and the species that form bonds, probably the animals with more intra-specific aggression - cychlids, geese, wolves, superior simians and, naturally, Man [K.Lorenz, 1979]. These animals live in groups and communities with individual differential behaviour patterns. They recognise each other individually and, to do so, they execute a sequence of interactive behaviour patterns that are known as "triumph" and "greeting" rituals. They become mutually predictable and acceptable by means of this ritualistic behaviour that is learned in each specific relationship. We can see in this behaviour the emergence of a social personality.

Although it can vary in each relationship, the animal has an identical and predictable behaviour in the presence of each member of the same group. The other already has its model and therefore recognizes it. Each animal contains in its neuronal network the model of the behaviour of individuals *a, b* or *c*, and, in their presence, it behaves according to the model that *a, b* or *c* has about it. Man also establishes bonds in the dual interaction, starting with family relationships. So, we become different in the presence of each intimate person, later transporting this behaviour to new contexts and people. Furthermore, we are influenced by culture that is first transmitted by our parents.

Thus, this new learned behaviour (eventually with some genetic influence) is shaped by the expectancies of others, beginning with our parents. In each meaningful dual relationship we adapt to the model that the others have about us. So, in this second movement, which came from the others to us, we get a social personality - the *superego* - that permits us to live predictably and peacefully with others.

Third movement: "I am as I see the others see me, and I empathize (I understand)". As we saw previously, Konrad Lorenz maintains that the ability to have meaningful bonds and ties depends on intra-specific aggression. In his opinion, Man is one of the most aggressive animals and therefore he is more able to love. Without contesting that great enmities and great passions keep pace with each other in the human race, we can argue that evolution is not linear and, more than aggression, the unpredictability that goes with autonomy may be the source of generalized ties and bonds.

In fact, Man came to the world without strong abilities to fight and to ensure his individual survival, but he has a great plasticity and communicative abilities. Universal exogamy actualized those capacities and it opened up the way to socialization. Language and culture were the emergent meta-systems that facilitated this path.

In the human community, the individual is not only dealing with people who share bonds with him, but he has to relate to others, some of whom are strange and unpredictable. Models he acquired in the dual relationship are not enough. Thus, from childhood, he has been trying out roles, essaying rules and making other experiments. While a little girl is playing, she imitates all things as well as other people[16]. She changes roles, playing mother, and putting her mother in the role of daughter. She provokes other people in order to listen to them speaking about her and to obtain their definition of herself [E. Erikson, 1963]. With all these elements, the individual finally gets the model of herself.

Since the individual can see himself reflected in the eyes of other people, he obtains his self concept or his *ego*. This model of himself is frequently devolved as a digital language, and this fact permits this model to be more flexible and more manoeuvrable. And this also allows Man to be reflected in his culture: in stories, novels or films that describe him or people with whom he may identify. But this digital language may also mislead him, and it can give him an image not compatible with the behaviour he develops from territory and bonds. However, consciousness and intentional activity, which are also possible from this moment, allow him the quest for knowledge that begins with the readjustment of self-knowledge and the re-definition of his own personality.

Finally with the model of himself, the man has neuronal models that allow him to do all sorts of simulations of reality, including the behaviour of an unknown person, his own behaviour and their consequences. Making simulations and making them alternatives, he can choose and have freedom. He will try to make the right choice for individual and communal survival. He constructs

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[16] **Note on imitation.** Both Piaget [1964] and Wallon [1966] emphasise the importance of imitation in the development of children. They argued about the genetic character of imitation, but non of them seem to consider the genetic tendency of the mother to empathic imitation of her child. Bion [1967 :101-110] gave relevant information about this question [A. Dias, 1988]. According Piaget, imitation is a form of biological accommodation, while playing games is a form of biological assimilation. To us, accommodation and assimilation may correspond to symmetrical and complementary receptions.

theories that are ever more adjusted and, with them, he overcomes the unpredictable events that remain.

REFLEXIVE CONSCIOUSNESS, AUTOMATIC BEHAVIOUR AND ECO-SYSTEMS

We can understand each of the described movements as a process of learning sequences of states determined by environment input. As far as territory and bonds are concerned (first and second movement), the input is continuous and analogical, but it is punctuated by the behaviour of the receiver (Chapter 3). In this way, the receiver inscribes fragmented images of the environment on its nervous system. These fragmented registers constitute the model of reality.

Such models are related to the territorial and interactive eco-systems, as I defined them previously (Chapter 2). They are inscribed as patterns of relevant input that are eventually accessible through experimental proceedings, as electric stimulation of the brain. However, in their whole, they are hidden to the subject, who only has access to them while he is in a state where each pattern of input is relevant for the possible transitions of this state (Chapter 1). Therefore, these models are rigid, and they can only be modified with learning through time.

So, in a sense, they are models inscribed in time. The animal cannot have access to them at any time, and it may not actualize or modify them without being in the presence of the input patterns. However, the evolved and plastic organisms can produce output that remains in the environment (for example, posturing shifts, emission of sounds or durable effects on the near environment) that can be learned as patterns of relevant input equivalent to the environmental input. This fact, which can be seen in the experiments of Kohler and followers about intelligence and language in primates, or in the first stages of child development, corresponds to the origin of the interior eco-system. As I discussed in chapter 2, it is made of patterns of input that were produced as durable system output. Since they can be produced at any time, the animal can use them to construct more flexible models that can be used at any time as alternatives to the environmental input.

This is also the origin of intention. When Kohler's chimpanzee and other superior animals hold-back before starting an "intelligent" action, they are developing an autonomous sequence of bodily states that anticipates the sequence of states they will try during the action[17]. So, that sequence is isomorphic and equivalent to the objective reality, and it is the first model of the world which the animal can actualize entirely. With this rapid, reversible and anticipating sequence of states, the barrier of time is finally overcome.

However, once the model of self has been created by the third movement, everything accelerates. While trying to know the subject, the other also becomes isomorphic to him, and sends back his image in the form of imitations, identifications, sounds and words. In all of these cases, the patterns of input fall within the range that the subject can also produce as output, even if they are not present outside. Therefore, the model of the self can be constituted, paradigmatically, from the interior eco-system.

Moreover, if the sender and the receiver can achieve a good adjustment in this symmetrical interaction, both of them learn the same rules of punctuation and organization of messages. Thus a

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[17] **Note on animal intentions.** Kohler's experiments about intelligent (or "problem-solving") activities of animals have been replicated and discussed all over the world. Osgood, [1953 :705-745] compares gestaltic and behavouristic explanations of problem-solving, and criticises the insufficient fundaments of both of them. The empirical material shows that: (1) Firstly, the animal tries ctions which approach the problem but are insufficient to solve it (trial-and-error). (2) The animal balks before the problem and turns its attention to other elements of the territory. Eventually it shows itself uninterested to the problem and "plays" with disposal material (bamboo canes), but this playing can be substituted by previous experiences with canes. During this period of "holding-back" before the goal, the animal shows explicit or minimal postural changes. (3) Then, suddenly, it skips to the objective and solves the problem correctly, as the solution had been previously formed in its mind. We interpret the second phase as an autonomous reproduction of previous states, combining them in several sequences and linking them to actual new states, in order to find the optimal sequence to solve the problem. In other words, this is a virtual (or interior) trial-and-error activity, combining postural states in several ways to find the successful sequence. Once it is fond and chosen, it constitutes the anticipatory intention. Although this is a Hypothesis, it is coherent with our theoretical ground. I think that it is a more substatiated explanation for the so-called "reorganization of the psychological field" of the gestalt psychologists.

meta-system or a code emerges. This code is the culture, and it is influenced by the pre-existing culture. This code is also language. So, the model of the self is made from digital messages which we can re-organize and compare in all ways. From its beginning, it is the most flexible model that we can have at our disposal.

As a master of language and its syntactic and semantic rules, Man rapidly constructs several flexible models of reality, including himself and also the world of others and the world of things. He verifies the equivalences, he rebuilds models with digital fragments and rapidly modifies them, he tests alternative models, he makes simulations, he predicts events and constructs hypotheses that will be invalidated or confirmed. This is the search for truth.

Man tests his hypotheses against the reality of things and against the reality of others, and this activity is crucial to his individual survival and the survival of his offspring. However, it is not so crucial to adjust his hypotheses against the reality of himself. It is not always vital to the individual to know himself adequately; he does not always have the opportunity to review himself in the eyes of others; frequently he dismisses this opportunity. Thus, his own image can be inaccurate, favouring an image that he has had since his youth. Such present inadequateness can prejudice the equivalences and it can infiltrate the process of knowing the world. Despite this, the individual can survive relying upon the more primitive models. In this way, territorial and interactive behaviour remain mostly automatic and not conscious, and the reflexive consciousness is confined to a deformed image of his own behaviour and to a partial image of external reality.

However, if the image of himself is adequate, the reflexive movement of consciousness will not stop: the interior eco-system can model the others, he can see himself from outside in different perspectives, and so on. Only in this way can Man discriminate between contexts and become predictable himself in the eyes of others, and also master of himself and of his initiative, if he so wills. Thus, the adventure of the human spirit and the re-formulation of his own personality begin. And all reality, including himself and his behaviour, can have access to consciousness.

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