THE DYNAMICS OF BEHAVIOR
****

AND MOTIVATION
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MODERE (MOtivation, DEsire, REality), the model described in this paper, is the result of an interdisciplinary cooperation between a System Dynamicist and a specialist in applied Social Sciences.

This model is based on several current theories of human behavior and motivation, some of which were developed several decades ago, others more recently, but all of which have proven in daily practice to be helpful in the analysis and understanding of human motivation and corresponding behavior in the context of real environment.

Although well developed and thoroughly described and analyzed, however, these theories have not been formalized in a way that could help elucidate and understand the complicated dynamics of human behavior. Each of these theories, in fact, mentions at least one "vicious circle", one ".feedback loop", different in each case but never formalized, never thoroughly studied and never combined with each other. One reads excellent descriptions about regulated structures, or stabilized situations, or matters becoming "worse and worse", all qualitative descriptions which have a very precise meaning to a System Dynamicist. To the best of our knowledge, these feedback loops - i.e. theories - have not been connected together and made to work simultaneously. In fact, each of these theories, even when expressed individually in the best conceptual way possible, does not appear to have been formalized in a manner which would allow a simulation of possible dynamic behaviors.

A simulation model representing all of these theories (loops) together by means of a coherent set of relations would help to :
> - analyze real situations in - among others - a working environment
> - view the time evolution of such situations, of behavior modes resulting from a changing environment, from decisions or proposals arising from management, etc...

Thus the present work constitutes an attempt at a formal analysis and unification of several theories describing human behavior in response to outside stimulus, a formalization which is not an aim per se, but must be considered as complementary to the usual qualitative human discourse.

The paper will have three parts:

- a general description of the problem, combining several theories or approaches to the social sciences, and leading to a general causal diagram (itself a first step to understanding).

- the model with its relationships and basic explanations.

- some basic simulations and examples of practical use of the model, a part which is likely to grow in the near future as new applications will be asked and offered.

I - CAUSAL ANALYSIS - The Basic Loops

We shall describe five main loops, each corresponding to fundamental if different theories of human behavior.

I - 1   The Problem consists in an attempt at explaining what pushes humans (individuals or groups) to act in response to a new course of action proposed or imposed by management, or when subjected to a change of environment (Fig 1).

Fig 1
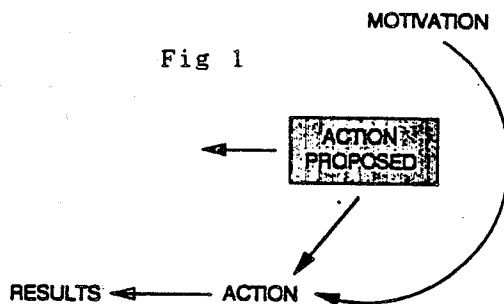
Let us call "motivation" in general the process which will lead one to decide to act. What variables influence motivation?

I - 2   The Satisfaction of Needs loop (Fig 2)

It corresponds essentially to the stimulus/response theory of the behaviorist school, appended and modified by elements of Maslow's well known theory of needs.

The human being is supposed to act only in a state of need, i.e. when the reality which is perceived is not at the level of one's aspirations. The satisfaction of such needs becomes the main mobile of all action, hence an essential element of motivation.

In the animal, these are stereotyped needs (hunger, thirst, safety, group belonging, sexuality, etc...) which are essentially moved by instinct. Within the human being, however, which Konrad Lorenz calls an animal with "regressing instinct", desires are much more diversified and of socio-cultural type, taking the form of aspirations.
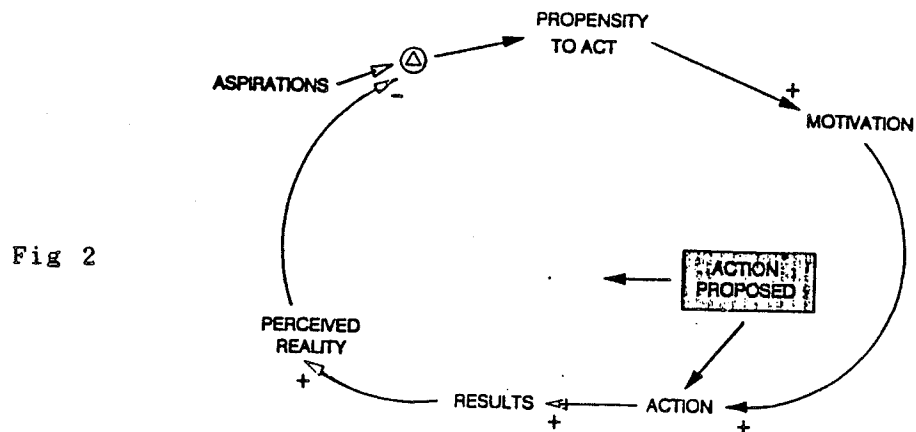
Fig 2

I - 3   The <u>Desire</u> loop   (Fig 3)

        This loop, its corresponding set of variables and
specific   dynamics,   are representative . of the human being,
although the latter does retain a minimal kernel of desires which
express his physiological needs. Essential aspirations result
from the socio-cultural environment and, according to the
anthropologist René Girard, are amplified through mimetism, thus
developing a large diversity of "desires" which Maslow calls
<u>needs</u> and which he classifies along a hierarchy probably
representative of the American type of behavior. In his
complementary approach, F. Herzberg shows the self-amplifying
effect of certain desires which he calls motivation factors. As
we all know, "desire stimulates desire".

        Thus the desire loop corresponds to a positive
feedback, and is piloted by desire itself, in as much as the
latter is not too disconected from reality.
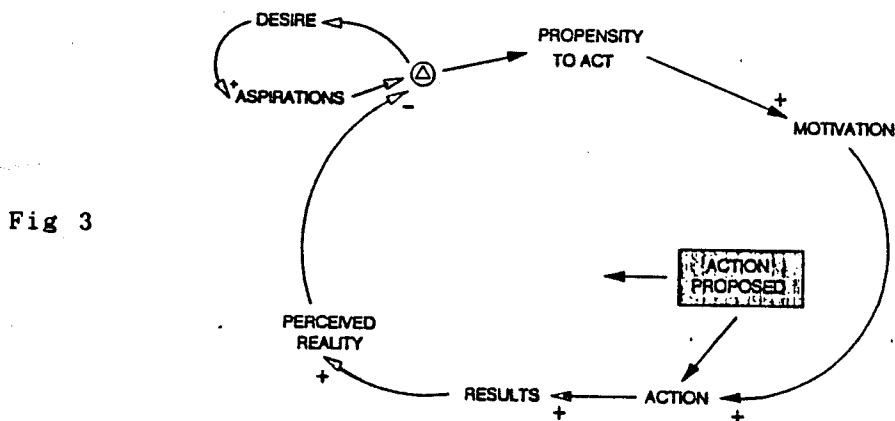

Fig 3

I - 4   The <u>Anticipation</u> and <u>Learning</u> loops (Fig 4)

        Once again, these loops are specific of the human
being, even though they can exist in the animal in a rather
simplified form. Man is perceived as a conscious actor, master of
his behavior, capable of anticipating the likelihood of future
results and comparing them with the desired goals. Furthermore,
and depending on the efficiency of his actions, man learns as he
acts, which justifies the Learning loop enclosed within the
Anticipation one.

This behavior model, known under the name of Expectation (or Process) Theory, owes much to American Sociology and was formulated by Porter and Lawler some twenty years ago. It represents the conscious and thought-out mechasism of action.

Fig 4
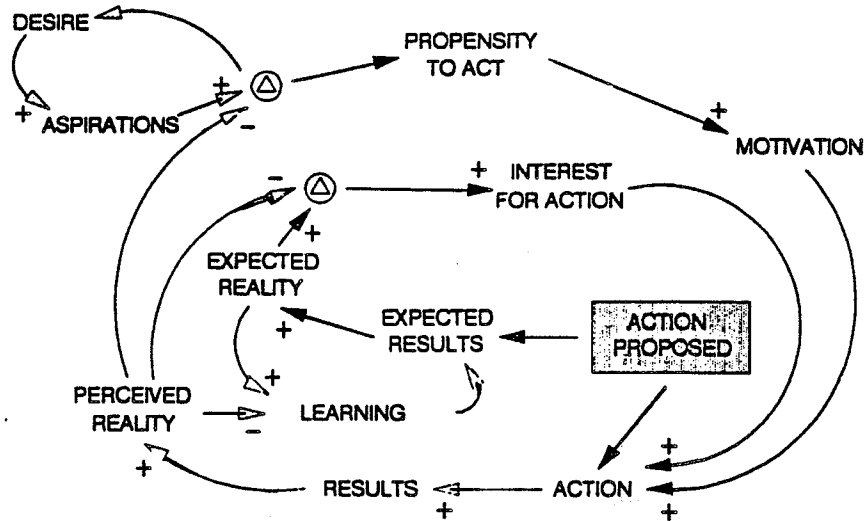
I - 5   The Inhibition Loop   (Fig 5)

It results from the work of Henri Laborit on the behavior of the brain and suggests a neural model which Laborit called the "Action Inhibition System" (S.I.A.).

Laborit notices that beyond a certain level, the inadequacy between desire and reality does not favor action but rather creates some frustration, progressively leading to resignation, demotivation and even, after some time, to depression and pathological attitudes.

Inhibition then slows any propensity to act and can even lead to total demotivation.

Fig 5
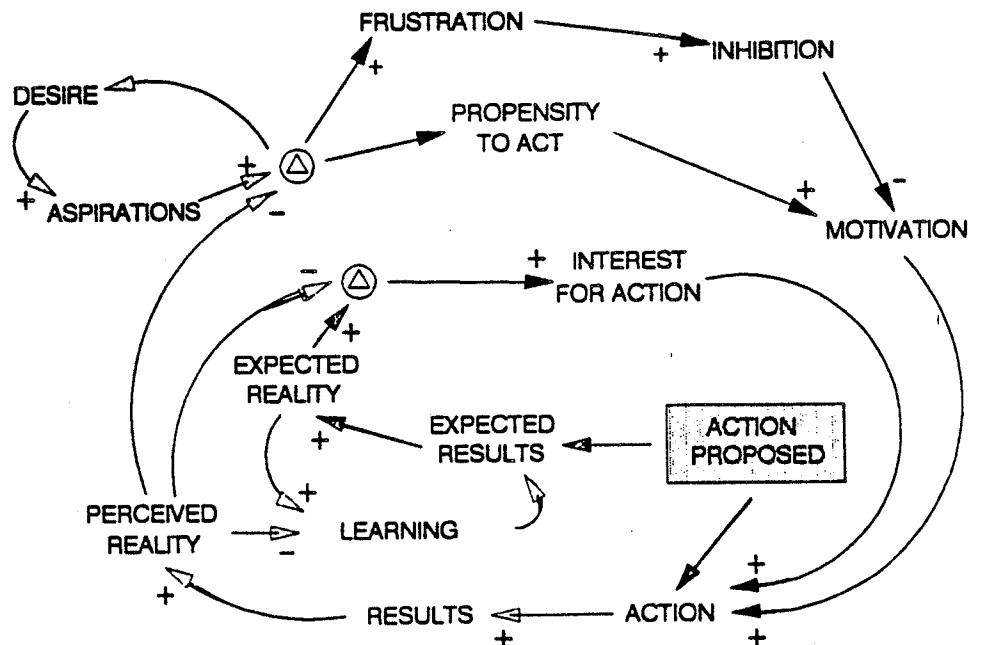
I - 6   Thus the complete model draws on seven theories
of human behavior, namely :
          - neuro-biology :   stimulus/response and the Action
Inhibition System of H. Laborit
          - psychology : the human needs theory of Maslow and
Herzberg
          - psycho-sociology :   the expectation theory and the
learning process
          - antropology : the mimetic desire of R. Girard

II   The MODEL

We shall now describe in more details the elements and
dynamic behavior of each of the main loops suggested in part I.

II - 1   SATISFACTION OF NEEDS (Fig 6)

Fig 6

ACC-OBS : accumulation with obsolescence
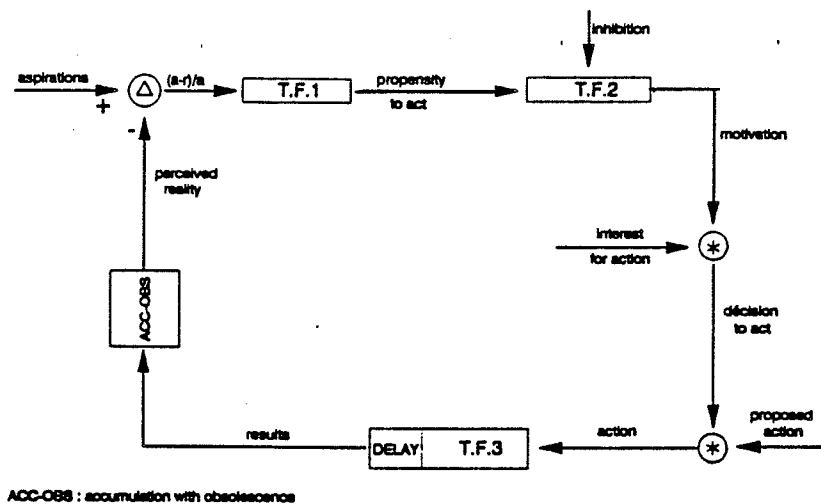
It is worth describing all the variables of this
diagram, since they will be found recurring throughout the whole
analysis which, as already mentioned, can be applied to
individuals as well as groups (psychological versus social type
dynamics).

In response to what we call a proposed action (by
management, or through changing environment, or through
innovative procedures, etc...) destined to bear results,
individuals or groups will act only in as much as they decide to,
that is if they are at the same time motivated and interested in
the proposed action, or rather in the hoped-for results.

At present, we write simply that

DECISION TO ACT = MOTIVATION * PERCEIVED INTEREST FOR ACTION

but if a specific application warrants it, this "logical"
equation could become much more complex, non-linear, etc...

Motivation is directly influenced by the Propensity to act which represents the average attitude at any time of the individual or group of people we are describing, and which depends on the adequacy - or rather inadequacy - between average aspirations and perceived reality. However, whatever the propensity - or desire - to act, it can be hampered by what Henri Laborit calls the Inhibition to act: demotivation leading in extreme cases to psychological breakdown (individual) or social troubles, strikes, etc... (groups).

Here again, the relation between motivation, inhibition and propensity to act is still very simple

Motivation = Propensity * (1 - Inhibition)

but could be changed if the complexity of reality justified it.

On the other hand, the transfer function linking the relative inadequacy - difference - between aspirations and perceived reality, to propensity to act is a non-linear relation which has to be redefined for every new case. The relation only says that the more we aspire to, compared with what we have (or feel we have), the more we are prone to act. But if all aspirations are satisfied, the need to act in order to obtain more is reduced or can even become nil.
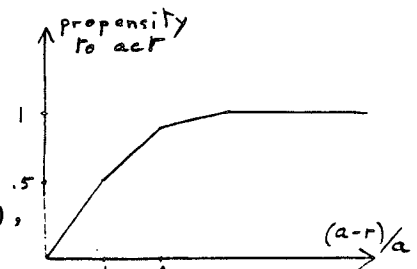
What now is Perceived Reality? It differs from Objective Reality - itself an integral of the results obtained after action - through the notion of obsolescence or forgetfulness. As a cumulative variable, Objective Reality can grow to very high levels; Perceived Reality, on the other hand, only deals with recent, not yet forgotten events. The difference between these two "Realities" resides in this notion of obsolescence of the past, the obsolescence Time Constant characterizing - among others things - the type of individual or group we are dealing with : dynamic, timid, or any grade in between.

Finally, after a delay, Action generates Results, the amount of which depends on the specific environment we are dealing with, and which can act as a filter (TF3) with various possible transfer relations - environmental efficiency -.

This loop describing the Satisfaction of Needs is a negative one, it tends to stabilize the behavior of the system : we react to whatever is proposed, suggested or imposed until the resulting Perceived Reality approaches whatever our Aspirations are. Our tendancy to act then decreases...., we "digest" the results until they tend to be "forgotten". Depending on our rate of forgetfulness and on the linearity of our Propensity to Act transfer function (FT1), we can stabilize into a state of constant minimum action in response to a constant level of newly "proposed action", or in the contrary show periodic bursts of recurring "hunger - digestion" sequences.

II - 2   <u>DESIRE</u>   (Fig 7)

        This loop - a positive one - characterizes the human
being in its ever growing aspiration for progress and change.

        The same signal (a-r)/a which creates a stabilizing
effect in the previous loop, stimulates
here the desire for more, by means of a
transfer function (TF4) whose shape
depends on the type of individual or
group involved. The greater the inadequacy
between aspirations and perceived reality,
the less we tend to increase our desires.
Conversely, the normally "ambitious" person who feels that
present aspirations are fulfilled, will tend to raise the latter.
This stimulation of desired improvement directly leads to a
relative change in the level of aspirations, noting however that
the latter can more or less accelerate or slow down the
stimulation itself (non-linear transfer function TF7).
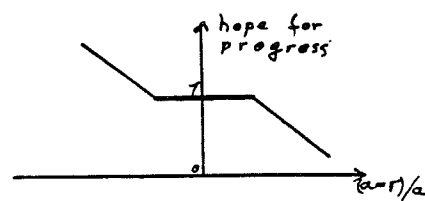
        We then determine the <u>Level</u>
of <u>Aspirations</u>, a cumulative variable
which depends on how much and how
quickly past ambitions were forgotten.
Here again, going from rate of change
to state level introduces the ever
present notion of obsolescence,
of forgetfulness.
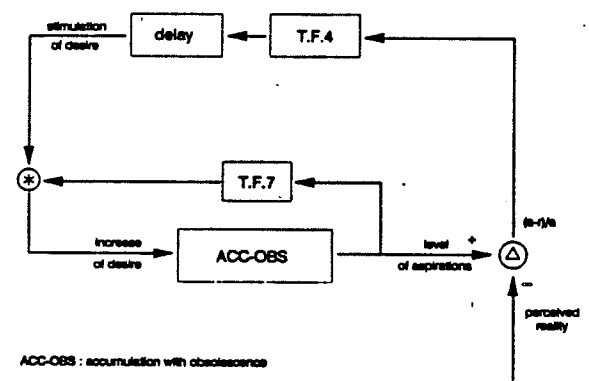
        This positive loop
characterizes "the more we have,
the more we want" attitude of the
human being, both as an individual
and in a social context.

Fig. 7

II - 3   <u>ANTICIPATION</u>   (Fig 8)

        As mentioned previously, this loop generates behaviors
which characterize essentially the human being. Its main output
is the variable which we call <u>Perceived Interest for Action</u> and
which, combined with <u>Motivation</u> will generate a <u>Decision to Act</u>.

        This variable depends on how much improvement is
anticipated as a result of the proposed action. The greater
this improvement (expressed as a relative difference between
expected and perceived realities), the more one sees an interest
in acting as suggested (TF7).

        The expected reality is itself the cumulated
consequence - again with the notion of obsolescence - of
those results immediately expected from the proposed
action. There are differences between anticipation and
reality, namely:

- anticipation is immediate, reality occurs after some delay.

    - anticipation results directly from the Proposed action, whereas reality is influenced by the real action and only in as much as the latter can be really effective.

    - In case of prolonged discrepancy between reality and anticipation, the latter becomes "corrected" through a learning process which we shall now describe.

Fig 8
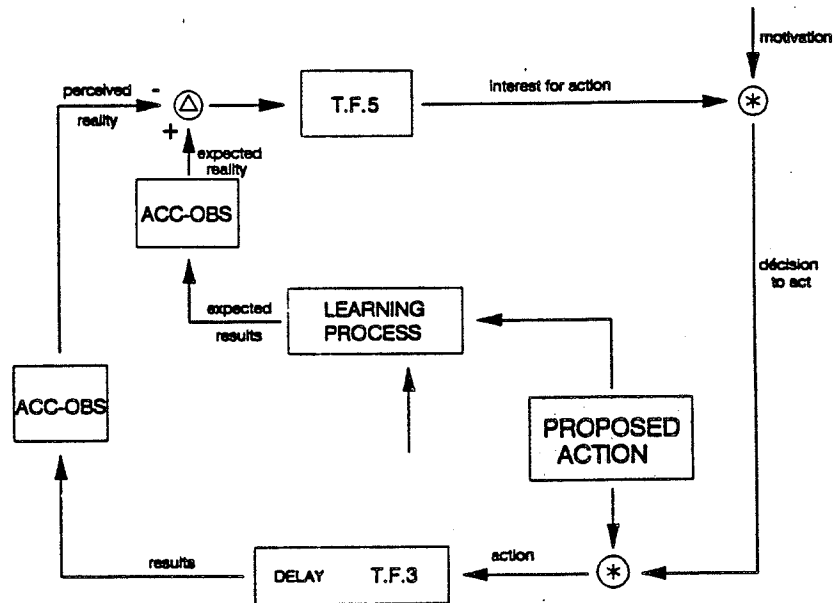
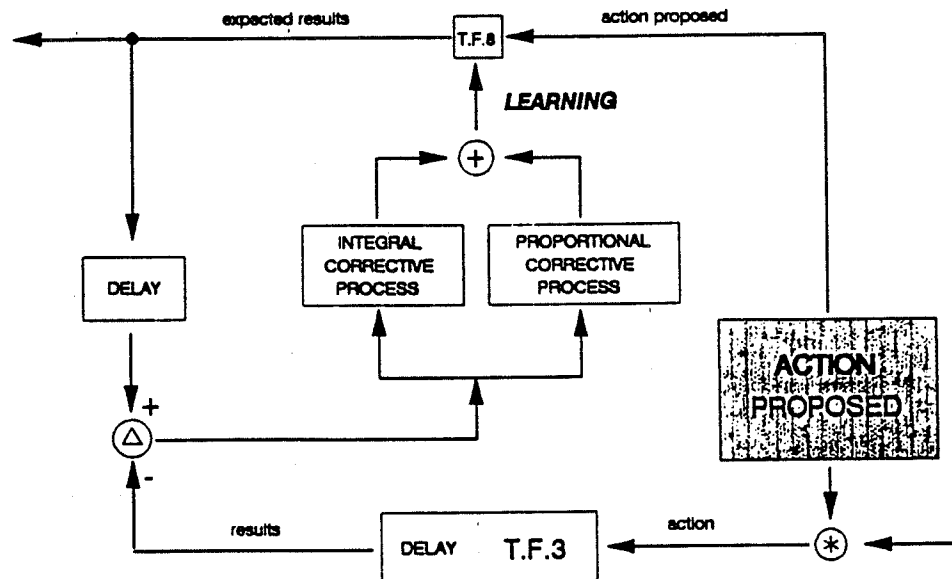II - 4 <u>LEARNING</u> (Fig 9)

        We have modeled this learning process as a simple Proportional + Integral feedback which progressively modifies the anticipated results to make them correspond with those results effectively obtained. Obviously, more complicated learning processes could be introduced, although it may be difficult to verify their adequacy in the case of human behavior.

Fig 9

II - 5 <u>INHIBITION</u> (Fig 10)

This last positive feedback loop is a slow-acting, hence a long-lasting loop. It describes the effect of <u>Frustration</u> progressively developed as the <u>Perceived Reality</u> does not conform to one's <u>Aspirations</u>. In this generic model, the transfer function TF6 is linear with a minimum threshold of reaction. Frustration itself is of interest here only as it slowly builds up into a feeling or attitude of demotivation, which Henri Laborit calls <u>Inhibition</u> (in the sense that it "inhibits" the desire for action). Again, this is a cumulative process whose growth is limited by obsolescence of past feelings.

Fig 10

Finally, the complete model is represented in Fig 11. It is a generic representation of human behavior as the latter is described by various theories in psychology and sociology, and which find here a ground for common action and enhanced validity.

The DYNAMICS of MOTIVATION

Fig 11

ACC-OBS : accumulation with obsolescence

III - <u>SIMULATION</u> Results

In the present paper, this chapter will be the shortest one, although it will be the one most expanded in subsequent papers dealing essentially with practical applications of the model in working, personal and even psychotherapeutical environments. For the time being, we shall limit ourselves to "what if" types of scenarios applied to two kinds of personality: timid and dynamic (the reader will interpolate the results for the "in between" personality). These scenarios were used to test and validate the model, calibrate some of the generic parameters, and acquire some experience as to the general types of dynamics which one can find in reality.

III - 1 - The <u>Response to a new Proposal</u>

We shall analyze the response of the model to a new and permanent proposal by the environing management, a proposal which can vary from a 10 to a 40% improvement over the permanent and every day type of activities requested from the personnel. In a first set of runs, this new proposal is represented by a step function (+.05 and +.2 over a steady state routine action of .5), which in practice is symbolic of a policy of permanently novel ideas, suggestions, innovative proposals, a policy rarely if ever applied in reality.

This proposal is put forward to two types of individuals or groups : 1 - the "timid" type whose aspirations are only slightly above the perceived reality; 2 - the dynamic personality who always wishes for some 25% more than what is available or at least perceived as such.
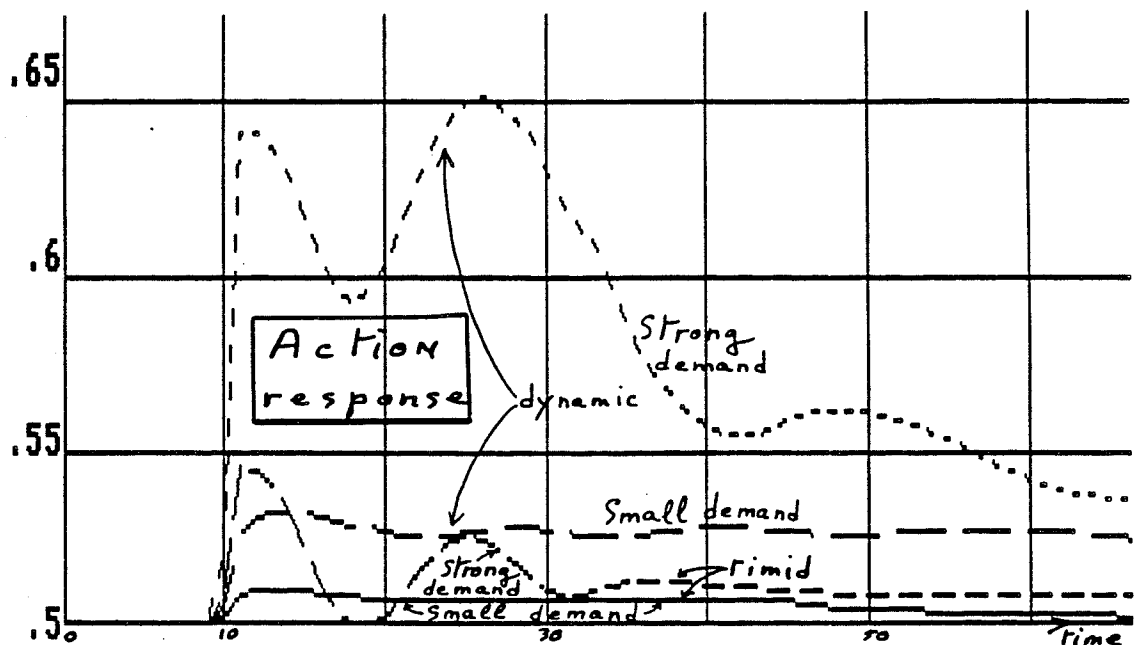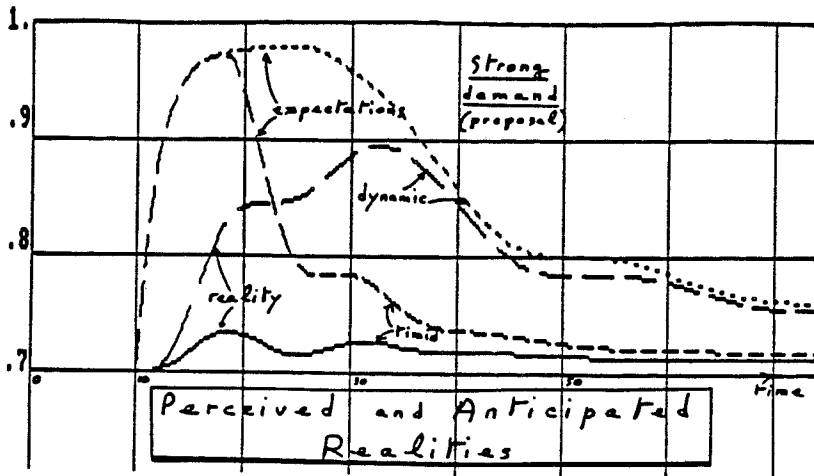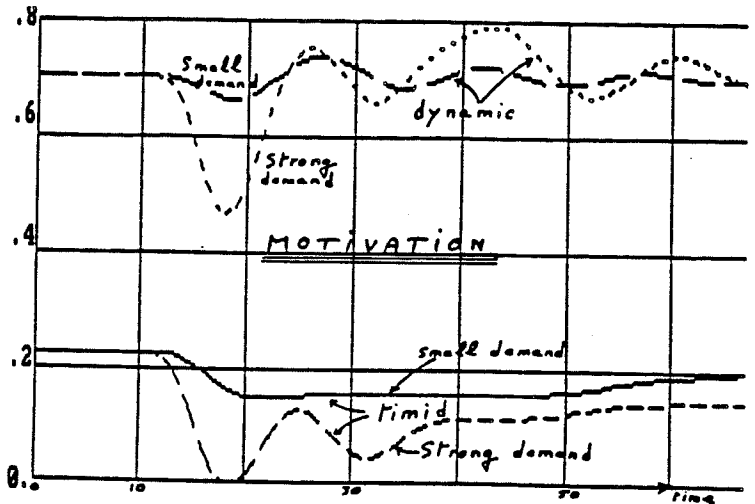
Fig. 12, 13 and 14 show :

Fig 12

Fig 13

Perceived and Anticipated Realities

Fig 14

MOTIVATION

   1 -   how relatively little can be obtained with undemanding personalities. This is partly to be explained by the permanently low level of motivation developed by the "timid" person or group (Fig 14).
   2 - problems of instability when people are faced with a sudden change, and which appear as oscillations in our type of condensed representation of reality. Such oscillations may demotivate, even discourage both management and personnel, thus creating a feedback onto the unique exogenous input of the model, the "New Action Proposal", a feedback which is not set up in the present analysis but which may be a frequent cause of failure of projected improvements in social relations. Such discouragement may be particularly apparent when one is faced with periods of inaction (Fig 12 and 14) resulting from bold actions proposed to not very dynamic people.
   3 - the learning process for both timid and dynamic personalities. Fig 13 shows an equal burst of initial expectations, much more rapidly compensated through the learning process in the "timid person" case, essentially when reality comes to disagree too much with expectations. In the case of dynamic people's response, reality tends to catch up with hopes, thus retarding the learning process. In both cases, however, this learning process takes over, eventually decreasing the <u>interest for action</u>.

III - 2 The search for a better "new action proposal"

The question may be put forward as follows : what ways
are better than others in order to reach a certain aim, knowing
that we are not looking for the "optimal" path, but that we
merely wish to avoid certain difficulties such as over-reactions,
breakdowns and demotivation (instabilities), loss of interest,
etc...

We shall limit ourselves to comparing the response by
timid and dynamic personalities to two similar "new proposals" by
management, one put down suddenly (step function), the other
gradually (ramp), the final aim being in both cases a 40%
improvement in the quality and/or quantity of activities
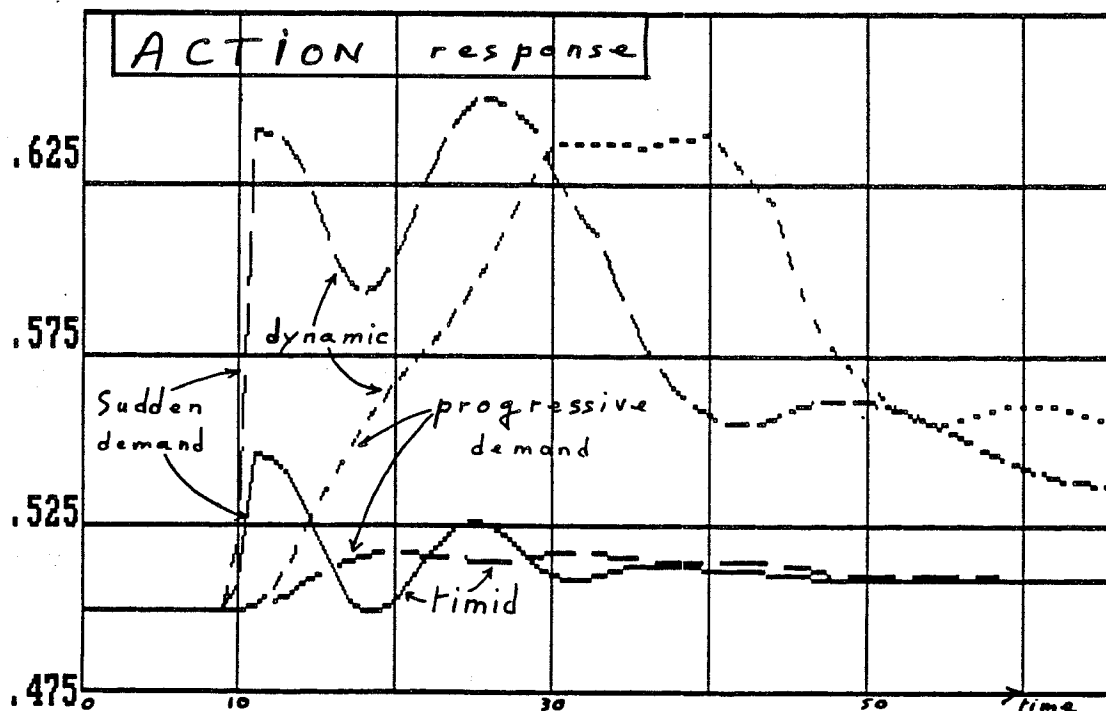(Fig 15).

Fig 15

Not surprisingly, a progressive action appears at first
as less "risky" than a sudden one : no overshoots, no temporary
loss of interest leading to a period of lesser activity. This is
particularly true when dealing with timid personalities whose
periods of possible inactivity may demotivate and even block the
whole process.

On the other hand, simulations do show that slowly
improving action proposals may frustrate the dynamic personality
more than a brusk and sudden one.

IV - <u>CONCLUSION</u> - What to do with such a model?

Having built the model, tested it, proven its general validity, we are now in the process of applying it in various cases :

Industrial Environment:

- possible bonus policies
- the influence of environment on group response
- the influence of training policies
- the development of aspirations
- etc...

From the few simulation results shown above, one can see an additional possible use of the model, namely as a help to fit <u>action proposals</u> and <u>population</u> (finding which characteristics are most required, given the type of action proposed, desired or imposed). Timid as well as Dynamic personalities have various characteristics which can be useful in different ways at different moments, and which are all represented in our model. A systematic sensitivity analysis would help understand which characteristic is most useful, most to be searched for and eventually developed, and at what moment.

Psychotherapy

A dynamic simulation of nevrotic type reactions, with a possible use as a help to cure. (In this type of application, the Inhibition loop will become very important).

Whatever its use, this model should be considered first of all as a help to understanding the multiple possible evolutions of human motivation and behavior, a domain which daily concerns every one of us and whose complexity is probably due more to the intrinsic intricacy of its structure (loops) than to the "fuzzyness" of unavailable data.

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