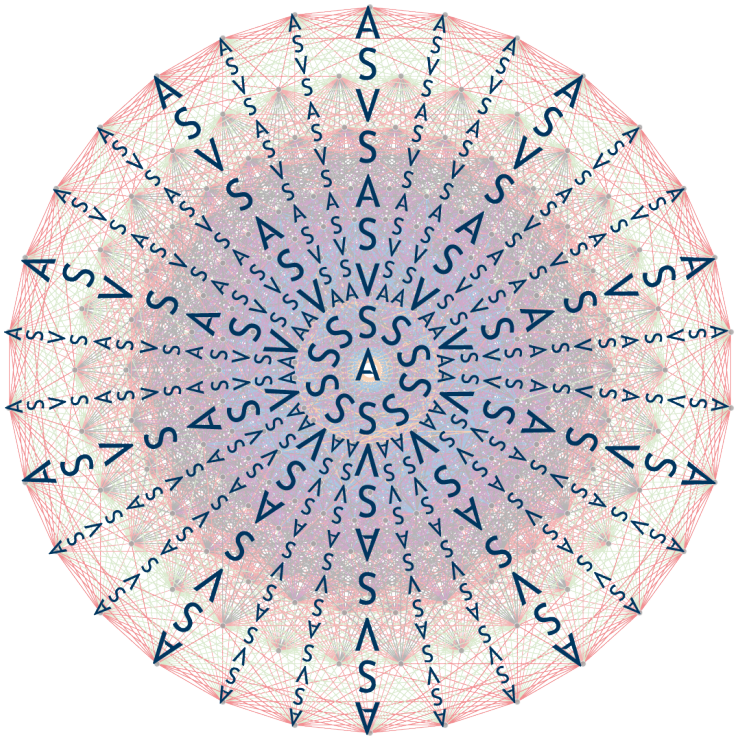

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CHAPTER IV

THE DYNAMIC OF *INFORMATION VARIETY* IN *DECISION MAKING* PROCESSES

Sergio Barile

1. INTRODUCTION

Decision making in top management is necessary, and continuously influences the given context. The *decision makers* process is usually based on uncompleted data, and it not based on science. Decision making studies, including recent works from psychology research, especially regarding the notion of subjectivity, use complicated and laborious procedures of calculation, where reliable and easily available data is necessary during such process. However, today it seems clear that organized working structures cannot make their decisions on sole calculation, for it is necessary to understand the nature of the elements, which become part of this process. So which factors bring to a right or wrong choice, and which knowledge–elements contribute to determine a safe solution? The *Viable Systems Approach* (***VSA***), with the parameters of *consonance* and *resonance*, measures the appropriateness of a decision in a problem-solving context. Such model bases its dynamics on the following concepts: *information variety* ($V_{\inf}$)*, interpretation schemes* (S_{int})*, and categorical values* (C_{val}) *(strong beliefs, values of values)*. The paper, after a short introduction regarding basic (***VSA***) concepts, focuses on the concept of *decision making* in complex contexts. The

proposed model analyses the level of knowledge perceived in a knowledge-acquiring situation, and allows to identify possible lines of *resonance*.

2. THE DYNAMIC OF *INFORMATION VARIETY* IN *DECISION MAKING* PROCESSES

Decisions can be defined as complex, not to be confused with simple or complicated ones, if the approach used does not follow a typical pattern of problem solving. If we consider the system concept, a complex decision is mainly characterized by a clear difficulty to maintain its stable conditions, but also by an insufficient definition of the problem which needs to be solved, and an incomplete identification of cause (Barile, 2008). During the knowledge-acquiring process, summed up in Figure 1 [a], the *decision making* is based essentially on *abduction* inferences, later verified inductively (Barile, 2008). The hypothesis developed in past works considers the possibility that dynamic mechanisms, linked to the process of knowledge-acquiring, can be represented by the curve in Figure 1 [b], and has a formulation expressed in the equation $y = \delta e^{-\beta x} x^{\alpha}$ which, with the variety of the parameters x, α, β, δ, enables the opportunity to configure possible alternatives in relation to the process of learning, and thus to the decision-making deriving from the (***VSA***) (Barile, 2008). Some recent studies have focused on the dynamics regarding social behavior by focalizing on personal *information variety* (heritage information resource) of a *decision maker*. The first step of research is to define the so called *information variety* through three dimensions that can be expressed with a logical measuring system (Fromm, 1968):

$$V_{\inf}(k) = (U_{\inf}(k), S_{\inf}(k), C_{val}(k))$$

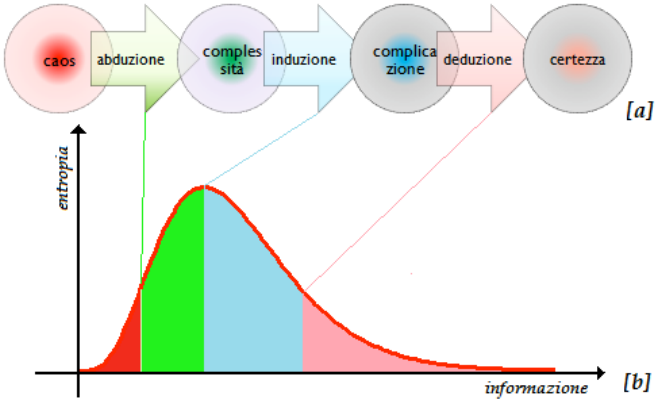
with:

- ✓ $V_{\inf}(k) =$ ***information variety*** (or heritage information resource) of a *viable system* k;
- ✓ $U_{\inf}(k) =$ ***information units*** belonging to the *information variety* of a *viable system* k;

- ✓ $S_{\text{int}}(k)$ = ***interpretation schemes*** (synthesis) belonging to the *information variety* of a *viable system* k ;
- ✓ $C_{val}(k)$ = ***categorical values*** belonging to the *information variety* of a *viable system* k ;
- ✓ $U_{\text{inf}}(k)$, $S_{\text{int}}(k)$, and $C_{val}(k)$ of the variety $V_{\text{inf}}(k)$

are the elements which determine a particular heritage information resource, and are not to be considered exclusively in dimensional terms; in other words, they do not calculate the proportions of the *information variety* such as orthogonal projections of height, depth and width, typical measurements which provide a spatial representation of materials, but as expressions of specific properties found in every single form of the above quoted variety, and thus able to condition the evolutionary dynamic during the knowledge-acquiring process (Barile, 2006; Audi, 1998; Shannon, 1949)[1].

Figure 1 – The dynamics of the ideal cycle of knowledge acquisition processes for a *viable system*.



Source: Barile, 2009; www.asvsa.com.

[1]The dimensions taken into consideration show substantial analogy with possible forms of knowledge which are traditionally analyzed with epistemological theories: direct knowledge ('I recognize a chair'), competence ('I know how to do something'), proportional knowledge ('everything has a beginning and an end'). The present paper presents no hypothesis regarding the measurements of these dimensions; amongst the possible alternatives we may consider the informative unit measurement proposed by Shannon.

In other terms, the following three factors need to be considered:

1. the 'structural' composition of the knowledge concept;
2. the form of the knowledge concept;
3. strong beliefs (resistance) which oppose to change.

The following step is to define the way the characteristics regarding the *information variety* influence the movement of the curve, and the relationship involving *categorical values*, structural arrangements and informative units during the knowledge-acquiring process. To be able to answer such a dilemma, the observation will be based on a mathematical *interpretation scheme*; a common differential equation of the second degree, normally used in physics to calculate optical, mechanical and electromagnetic phenomena, such as the holonomic theory, oscillatory circuits, black-body radiation and so on.

Let's ponder upon the meaning of the concepts of *categorical values* and *interpretation schemes*:

1. *Categorical values*, as already partly said above, supply with a 'dogmatic', inescapable, congenital approach, which is common to everyone, and to every viable system; here criteria of judgment originating from any kind of perception acts as a landmark. The process of learning, which is undertaken by *viable systems* (Golinelli, 2002), has to undergo the inertial force generated when referring to *categorical values*. The different levels of attention and interest in relation to discussions of given subjects, are remarkably conditioned by this methodological approach. Every form of interaction deriving either from active or passive variety derives from a perception which is correlated upon subjective *categorical values* (*resonance* if accepted, dissonance if refused)[2]. A re-reading of the debate regarding the Ptolemaic system versus the Copernican system, results as being a good example to explain the above. Of course no-one believes that all the adepts to the Ptolemaic system were lacking of intellect, whilst those belonging to the Copernican were men of great knowledge. It would be blasphemy to consider Ptolemy himself as ignorant, even though his geocentric theory resulted as erroneous, his studies and applications place him among the fore-runners of science considering

[2]See close examination of *resonance* and *consonance*.

the poor knowledge of the discipline during that period. So why was he wrong? The answer is to be found in the fact that the heliocentric theory had become for Ptolemy, and his peers, a pet theory; a shared *value category*, sedimentary and sustained by strong influences from all perspectives: the Christian dogma with its reference to the Bible, source of unquestionable truth. At this point, a first conclusion: intelligence, considered as an active effort which is capable of ordering a large amount of information stuffed-up in one's mind at any given *decision making* time is to be considered highly influenced by the effects of *categorical values*[3] (Kuhn, 1970; Fromm, 1968); the choice which is taken amongst various possible solutions, accustoming oneself to a given resolution theory. We must bear in mind that in (***VSA***) terms, the level of acquaintance is represented by the level of *consonance*, and that every *information variety* must necessarily refer to its variety (*consonance*), keeping in mind the influence of the *categorical values*. Hence, *consonance*, conceived as a variety of the *information variety* $V_{\inf}$ according to the information perceived i, is strongly conditioned by *categorical values*, which guide us to adopt certain *interpretation schemes*, and in doing so, influence the process of selection of hypotheses. Thus, one can sustain that the action of *categorical values* in relation to incoming information, strongly influences the dynamics regarding *consonance*. There is an action, a force which intervenes during the moment of the information perception which conditions the learning process. Keeping in mind that the concept of *consonance* can be expressed with the formula $Cons = \frac{\partial V_{\inf}}{\partial i}$, we can sustain that *categorical values*, which from this point onwards we will refer to as C_{val} while influencing the variety of *consonance* depending on incoming information ∂i. In formula, the action A_1 carried out during *decision making* processes submitted to further perceived information ∂i, originating from the interaction of *values categories* C_{val} caused by a

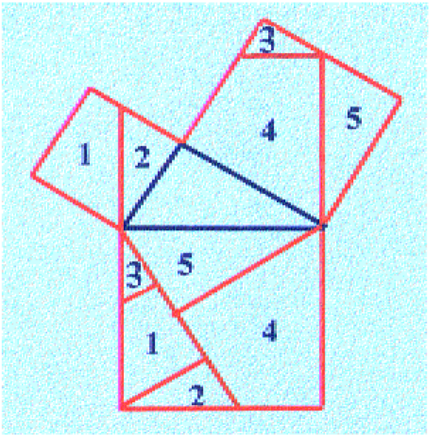
[3]This cannot be a considered as a renovating viewpoint, the question has already widely been tackled by Kuhn. Erich Fromm states: "Social sciences have opted for the trend of dealing with human problems without thinking of their emotional counterparts".

variety of *consonance* equal to $Cons = \frac{\partial V_{\inf}}{\partial i}$ is expressed by the following formula: $A_1 = C_{val} \cdot \frac{\partial Cons}{\partial i}$.

2. The concept regarding the *interpretation scheme* has an important role in the dynamics which condition a knowledge-acquiring/learning process. As mentioned above, it can be considered as a container in which perceived information is organized. A frame which exalts or diminishes the result of its perception, depending on the given cause and the relationship between the context and the problematic it intertwines with. For this reason, it seems clear to us that the understanding of facts appears strongly influenced by the 'container' in which they are placed. For example, if we wish to give information concerning the theory of the Pythagorean system with the synthetic algebraic formula: $c^2 = a^2 + b^2$ where a, b and c are, respectively, the two cathetus and the hypothenuse of a rectangular triangle, is completely different from giving an in-depth explanation of the geometrical representation in Figure 2. We deduce that the form given to information can either help or interfere with the process of learning and knowledge growth. What is mainly determined is that the 'form' introduced by the *information variety* conveyed, enabling a generic identification with context, be compatible with the form used by the *information variety* received. So it is useful to remember that most forms of communication are implicit rather than explicit, as in the case of Pythagoras and his theory. Let's take into account two events which have recently caught the public eye: the murder case known as 'Amanda and Meredith' and the 'Sandri' case. In both, the victims are innocent, young adults, killed by violent murderous acts. In the first case, the victim is killed during the degeneration of a party, whilst in the second a young football supporter, completely unaware of the situation, is killed near a gas-station by the gun shot of a policeman, following the conflict of two rival gangs of supporters, right before the football match kick-off. The interest and attention of the public eye tends towards justice, in the 'average value' of each case. While the first case is, sadly, perceived in a usual 'form', to which we seem obliged to deal with, in the second the perceived 'form' generates greater indisposition and anxiety. Herein, it is not relevant to examine closely these two 'forms', but rather it is

sufficient for us to underline the fact that 'form' can become 'substance'. It is now possible to conclude that the movement of a given *information variety* is influenced by the level of adequacy that the 'form' of incoming information reaches. The 'form' configuration turns into a factor which can modify the speed of the variety of dynamics regarding *information variety*. It is reasonable to keep in mind that when information is perceived, the action of this perception turns into a clash which is proportional to the variety of variety which opposes against it.

Figure 2 – Graphical representation of the Pythagorean theorem.



Source: Barile, 2009; www.asvsa.com.

So this action either resists or facilitates the comprehension process. The *interpretation scheme* during this action is a fundamental factor, which we will indicate with the formula $S_{\inf}$, and depends on the interpretation and assimilation phase adopted by the *decision maker*. To further synthesize, the *interpretation scheme* influences the movement of the *information variety* in relation to incoming information. In formula, A_2 is the action produced by the *interpretation scheme* $S_{\text{int}} : A_2 = S_{\text{int}} \frac{V_{\inf}}{i}$.

There is another effect to take into consideration, the main action that the perceived information has on the *information variety*. An impulsive action/collision between the quantity of incoming

information, and the quantity which the subject already disposes of. This action in formula can be expressed as: $A_3 = kV_{\text{inf}}$.

To sum up, we can affirm that the variety of *information variety*, a consequence of the perception of new forms of information, corresponds to the synthesis of various actions/forces which influence the moment of knowledge reorganization.

The joint action of the forces $A_1 + A_2 + A_3$ brings us to formula:

$$C_{val} \cdot \frac{\partial Cons}{\partial i} + S_{\text{int}} \cdot \frac{\partial V_{\text{inf}}}{\partial i} + k \cdot V_{\text{inf}}$$

The consequence of every kind of perception is the requirement for the perceiving subject to reach a balance, a stable reorganization of the entire information/knowledge; a situation in which the effect of the collision with perceived information, is made adequate by the action executed by *interpretation schemes*, and balanced by the action of the *categorical values*. In formula:

$$C_{val} \cdot \frac{\partial Cons}{\partial i} + S_{\text{int}} \cdot \frac{\partial V_{\text{inf}}}{\partial i} + k \cdot V_{\text{inf}} = 0$$

Baring in mind that $R_{is} = \frac{\partial Cons}{\partial i}$ and that $Cons = \frac{\partial V_{\text{inf}}}{\partial i}$ and so $R_{is} = \frac{\partial' V_{\text{inf}}}{\partial i}$, from which:

$$C_{val} R_{is} + S_{\text{int}} Cons + kV_{\text{inf}} = 0$$

corresponding to:

$$C_{val} \frac{\partial'' V_{\text{inf}}}{\partial i} + S_{\text{int}} \frac{\partial' V_{\text{inf}}}{\partial i} + kV_{\text{inf}}$$

it is necessary to resolve the following equation:

$$\alpha \ddot{y}(x) + \beta \dot{y}(x) + \delta(x) = 0$$

The solution is as follows[4]:

[4]Wolfram Mathematics 6.0 method.

$$y = e^{x\frac{(-\beta-\sqrt{\beta^2-4\alpha\delta})}{2\alpha}} C_1 + e^{x\frac{(-\beta+\sqrt{\beta^2-4\alpha\delta})}{2\alpha}} C_2 . \quad (1)$$

The code regarding Figure 3 enables us to dynamically assign value to the varieties α, β, δ, φ, and obtain the graphical representation of the corresponding function y.

Figure 3 – Wolfram Mathematica 6.0 software code.

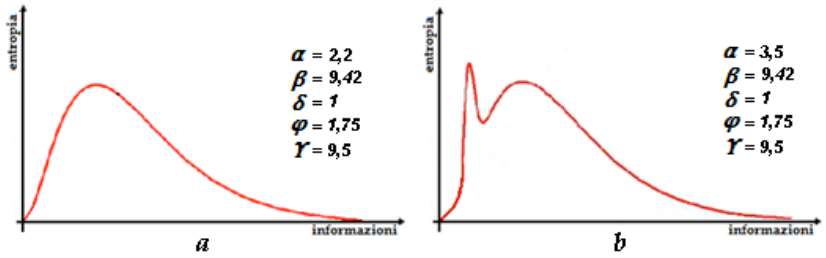
```
Manipulate[Column[{Panel[Column[{
Style[StringJoin["α =", ToString[α]], Medium],
Style[StringJoin["β =", ToString[β]], Medium],
Style[StringJoin["δ =", ToString[δ]], Medium],
Style[StringJoin["ϕ =", ToString[ϕ]], Medium],
Style[StringJoin["ϒ =", ToString[ϒ]], Medium]}]],
Plot[e^((-β-Sqrt[β^2-4 α δ])/(2 α) x) C1 + e^((-β+Sqrt[β^2-4 α δ])/(2 α) x) C2, {x, 0, zoomX},
PlotRange → {{0, zoomX}, {0, zoomY}},
PlotStyle → {{Thickness[0.005], Red}}, ImageSize → 500]}, Alignment → Right],
{{α, 1}, 1, 15, 0.005}, {{β, 1}, 1, 15, 0.005},
{{δ, 1}, 1, 15, 0.001}, {{ϕ, 1}, 1, 150, 0.05},
{{ϒ, 1}, 1, 15, 0.25},
Delimiter, {{zoomY, 3, "Asse Y"}, 1, 100, 2, ControlType → VerticalSlider},
{{zoomX, 60, "Asse X"}, 1, 100, 2, ControlType → VerticalSlider},
ControlPlacement → {Top, Top, Top, Bottom, Bottom, Left, Right}]
```

Source: Barile, 2009.

The expression obtained represents an important result for our study. The most important conclusion which we are now able to make is to have verified that knowledge/information-acquiring (perception) performed by an *information variety* leads to a balancing-process, which can be mathematically represented in equation (1), substantially by a factor of the kind e^{-x}, which we have defined as intellectual potential. This demonstrates that the curve, resulting from an initial step towards knowledge-acquiring (*abduction*) and backed up by additional points of view/considerations and an hypothesis to be verified, finds significant confirmation in what has been elaborated. In

addition, the graphics of Figure 4 a and b, and of Figure 5 a and b, determined by the code in Figure 3, show that the balanced curve has, as factors α, β, δ, φ vary and the constant action of C_1 and C_2, a curve performance which is analogous to the one produced in the previous paragraphs[5].

Figure 4 – The rebalancing process of an *information variety* related to the variation of α.



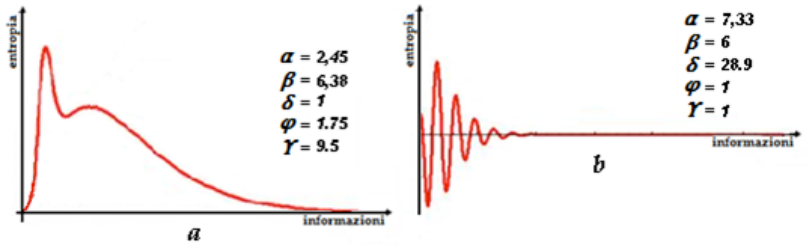
Source: Barile, 2009; www.asvsa.com.

Equation (1) enables us to link the different characteristics of *information variety*, *categorical values*, *interpretation schemes* and *information units* with the algebraic representation expressing the process of knowledge-acquiring, showing the process achieving a new kind of *information variety* and its isomorphic characteristics summed up in the formula $e^{-x} \cdot x^{\sigma}$.

An equation which represents *information variety* in a viable system makes it possible to lead the concepts of *consonance* and *resonance* to that same equation, and determine the balancing equation of the forces (A_1, A_2, A_3), used in the process of knowledge-acquiring.

[5]As the subject is relevant for the present paper the demonstration is not further developed, but is easily deducible from notions which can be found in any book of mathematical analysis.

Figure 5 – The rebalancing process of an *information variety* related to the variation of α, β, φ.



Source: Barile, 2009; www.asvsa.com.

This is valid when using the model to evaluate the dynamics of learning and *decision making*, when two structures of *information variety* are compared.

It is possible to evaluate the moment in which a given *information variety* $V_{\inf 1}$ intercepts and communicates with an *information variety* $V_{\inf 2}$ with specific *categorical values*, *interpretation schemes* and *information units*, as follows.

Let us assume that the starting point of the relation is $V_{\inf 1} = e^{-i} \cdot i^{\sigma}$.

Keeping in mind that the factor of ***consonance*** detectable in an *information variety* is given by:

$$Cons = \frac{\partial V_{\inf}}{\partial i},$$

and so

$$Cons = \frac{\partial}{\partial i}(e^{-i} \cdot i^{\sigma}),$$

from which:

$$Cons = -e^{-i} \cdot i^{\sigma} + e^{-i} \cdot i^{-1+\sigma} \cdot \sigma,$$

and remembering that

$$Ris = \frac{\partial Cons}{\partial i} = \frac{\partial' V_{\inf}}{\partial i} = \frac{\partial''}{\partial i}(e^{-i} \cdot i^{\sigma}),$$

and so,

$$Ris = \frac{\partial}{\partial i}(-e^{-i} \cdot i^{\sigma} + e^{-i} \cdot i^{-1+\sigma} \cdot \sigma)$$

we have:

$$Ris = e^{-i} \cdot i^{\sigma} - 2e^{-i} \cdot i^{-1+\sigma} \cdot \sigma + e^{-i} \cdot i^{-2+\sigma} \cdot (-1+\sigma) \cdot \sigma .$$

In conclusion, the composition of these forces is summed up in the following equation:

$$y = C_{val} \cdot \frac{\partial Cons}{\partial i} + S_{\text{int}} \cdot \frac{\partial V_{\text{inf}}}{\partial i} + k \cdot V_{\text{inf}} .$$

Substituting the expressions determined above we have:

$$\begin{aligned} y = {} & C_{val} \cdot (e^{-i} \cdot i^{\sigma} - 2e^{-i} \cdot i^{-1+\sigma} \cdot \sigma + e^{-i} \cdot i^{-2+\sigma} \cdot (-1+\sigma) \cdot \sigma) + \\ & + S_{\text{int}}(-e^{-i} \cdot i^{\sigma} + e^{-i} \cdot i^{-1+\sigma} \cdot \sigma) + U_{\text{inf}}(e^{-i} \cdot i^{\sigma}). \end{aligned} \tag{2}$$

The equation (2) can be elaborated by formulating a code similar to the one shown in Figure 3.

We will now try to underline, using a specific approach, the corresponding characteristics between *categorical values*, *interpretation schemes* and *information units*, between $V_{\text{inf}1}$ and $V_{\text{inf}2}$.

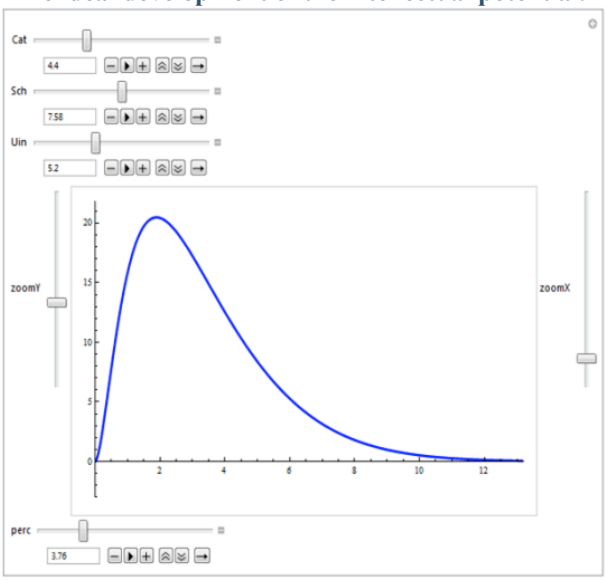
What follows are indications regarding the role that the different factors have in characterizing a curve describing the route leading towards knowledge.

Figure 6 represents an 'ideal' development (certainly, very rare) of the curve, highlighting for each factor (*categorical values*, *interpretation schemes* and *information units*, plus the information perceived by the receiving variety information), a corresponding value.

Below are the corresponding abbreviations:

- *Categorical values* ↔ *Cat;*
- *Interpretation schemes* ↔ *Sch;*
- *Information units*↔ *Uin;*
- *Perceived information* ↔ *Perc*

Figure 6 – The ideal development of the intellectual potential.



Source: Barile, 2009; www.asvsa.com.

Figure 7 and figure 8 introduce the resulting effect when modifying one of the several constant factors.

Figure 7 gives the value of the *categorical value* variety which from $C_{val} = 4.4$ goes to $C_{val} = 13.84$. Such increase indicates that between the two *information varieties* there is a significant difference from what is referred to in Figure 6.

The excessive differential of the *categorical values* disorders a standard route and determines that the initial resolution-hypothesis cannot be materially achieved; interrupting the physiological cycle, and thus it requires a new abduction phase.

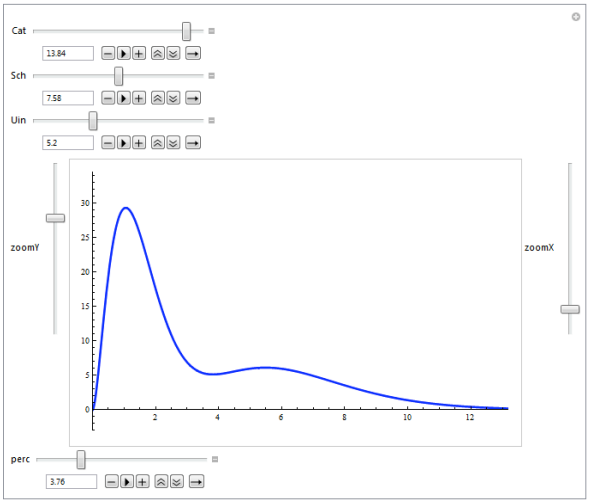
The effort needed (to dominate entropy) in the second phase is surely inferior to the effort made in the first. In brief, strong 'beliefs' have initially conditioned what comes across as obvious.

The episode regarding Galileo is eloquent; he invited his accusers to look into the telescope so they could observe for themselves and ascertain the heliocentric movement of planet Jupiter. They believed this to be pointless, for they considered the geocentric theory indisputably true and evident.

Figure 8 shows similar characteristics but depends on different factors.

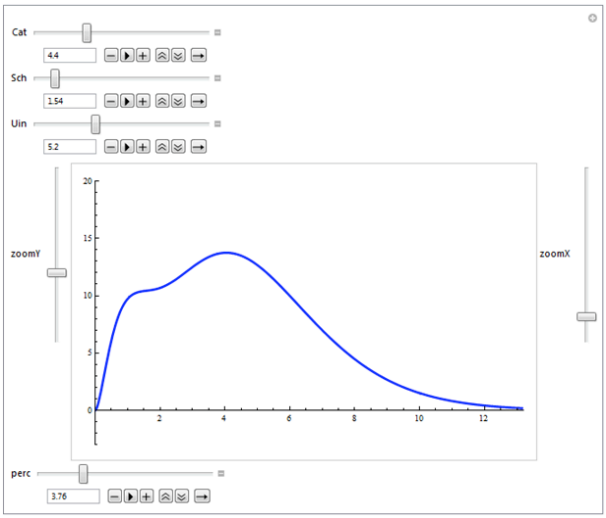
In comparison to Figure 6, the curve of Figure 8 has a modified consistency regarding the differential between the *interpretation schemes*. It shows a minor inflection point expressed by the value $S_{\text{int}} = 1.54$, from the preceding $S_{\text{int}} = 7.58$. The reduction brings to a redefinition of the resolution-route, but does not require a reformulation of the abduction hypothesis. It seems to ascertain the necessity to act during the induction phase, which gives us the idea that the lack of *interpretation schemes* has initially compromised the capacity of the *decision maker* to regularly verify the occurrence of hypothesis (see block-structure in Figure 6 and 7 in paragraph 3). Great parts of decisions made in problematic, complex conditions belong probably to that typology. Here the *decision maker* is like an artist that feels and interprets an internal urge which encourages his specific actions, even though he cannot to give meaning to his perception. Actions that follow one's urge which have to be adjusted arranged and adapted to the available expression modalities. It is not a coincidence, confirming the above mentioned, that is, *decision makers* with positive reputations, managing to resolve cases considered "*impossible*, can easily see their reputation change to negative if they fail to tackle simple tasks. Paganini never performed an encore, not because he didn't want to, but rather because he couldn't.

Figure 7 – The intellectual potential path disturbed by too many *categorical values*.



Source: Barile, 2009; www.asvsa.com.

Figure 8 – The intellectual potential path disturbed by too many *interpretation schemes*.



Source: Barile, 2009; www.asvsa.com.

In conclusion, Figure 9 and Figure 10 respectively represent a distortion caused by a decrease and by an increase of the *information units*.

In the first case (Figure 9) we see a typical phenomenon; a *decision maker* (or a learner), with the tendency to excessively simplify a given issue to be resolved.

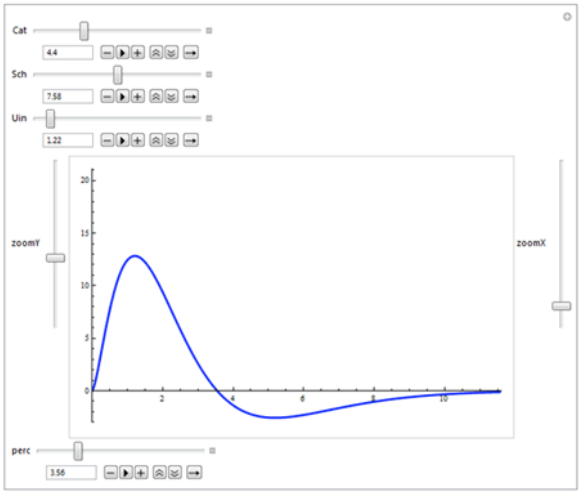
As the *decision maker* cannot count on the necessary information (from $U_{\inf} = 5.22$ to pass to $U_{\inf} = 1.22$), he tends to excessively trivialize a problem, convincing himself that the task is simple, losing control of the *decision making* process, this way making the outcome appear incomplete and conditioned by context.

Public administration is frequently conditioned by politics, a field in which many professionals have very poor managerial skills and do not have the necessary methodological, technical and instrumental know-how.

In similar cases a significant increase of perceived information (indicated by 'perc' in the figure) brings us to an 'explosion of information', where 'noise', considered as a distracting factor gets in the way of the learning process and produces a pathological condition of instability (a continuous oscillation between possible abductions:

"I'm going to do this, no better do that, no I think this is better" and so forth).

Figure 9 – The intellectual potential path disturbed by the lack of *information units*.



Source: Barile, 2009; www.asvsa.com.

Figure 10 represents a typical case which demonstrates that aggregating more and more information brings to poor results.

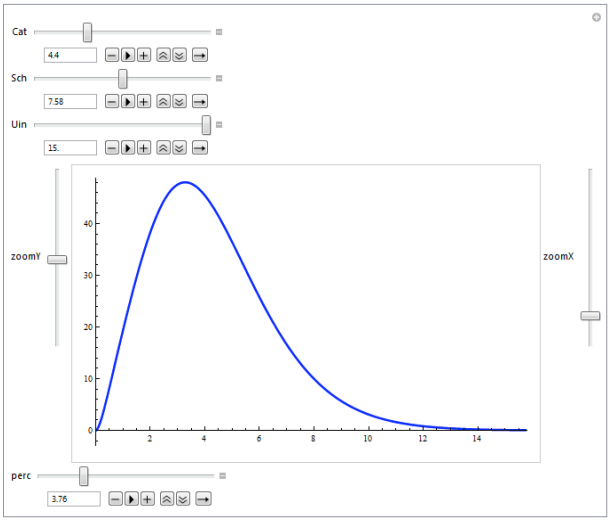
The passage from $U_{\inf} = 5.2$ to $U_{\inf} = 15$ means that the curve will rise significantly from its reference point when reaching sintropy occurrence.

The process is proportional in characteristics, whilst the phases are extended according to the information flow.

It is as if too much information provokes hesitation and delays the action of the *decision maker*.

The abduction moment is postponed, more time is spent in proposing and formulating hypothesis; we end up dawdling about with the deduction model.

Figure 10 – The intellectual potential path disturbed by too mamy *information units*.



Source: Barile, 2009; www.asvsa.com.

The best skill that a *decision maker* should master is the ability to evaluate the right time to switch off the flow of incoming (too much) information, which will result as unfruitful and contaminating, stalling the knowledge-acquiring process. The following passage written by Taylor brilliantly describes this concept: *"Even though the pieces of a puzzle never fit in perfectly, gradual modifications can bring to important changes. If thought is a complex process, in which images, concepts and structures struggle to adapt to each other, they form a system in which the transformations which occur in certain moments and places, have repercussions on the entire track. When these repercussions form one merged-wave the system loses stability. Whilst more and more experience is acquired, ideas have more and more difficulty to elaborate, at this point the thought process distances itself from the point of balance and gets closer to point break. In this precise moment danger and opportunity intertwine. Close to chaos and overdone by confusion, thought can flow towards insanity and suffer unforeseeable counter-effects. The critical point of agitation is the point in which ideas reach maximum turbulence. If change is verified, new configurations emerge spontaneously"*.

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