Hypothesis of Psychophysical Dynamics of Consciousness:

Attentional mechanism underlying fundamental micro-states of perceptual consciousness.

SUMMARY

Foreword

This imaginary homogeneous time is, as we have endeavoured to show elsewhere, an idol of language, a fiction of which the origin is easy to discover. In reality there is no one rhythm of duration; it is possible to imagine many different rhythms which, slower or faster, measure the degree of tension or relaxation of different kinds of consciousness, and thereby fix their respective places in the scale of being. To conceive of durations of different tensions is perhaps both difficult and strange to our mind, because we have acquired the useful habit of substituting for the true duration, lived by consciousness, an homogeneous and independent Time; but, in the first place, it is easy, as we have shown, to detect the illusion which renders such a thought foreign to us, and, secondly, this idea has in its favour, at bottom, the tacit agreement of our consciousness.

Henry Bergson (Matter and Memory)

As soon as it is proved that two sensations can be equal without being identical, psychophysics will be established.

Henry Bergson (Time and Free Will:
An essay on the immediate data of consciousness)

The most fundamental form of simultaneous associations is the associative fusion or synthesis of sensations. Since simple sensations never present themselves in our consciousness, each real representation is a product of the fusion of sensations. We will distinguish two secondary forms of this fusion: intensive synthesis, in which sensations that are purely homogeneous are linked together; and extensive synthesis, which constantly arises from the coming together of heterogeneous sensations. The former is particularly effective in auditory representations; the latter in visual and tactile representations. All these fusions have one property in common: in the complex of sensations that come together, a single sensation, and generally the most energetic, has sovereignty over all the others, so that they play only the role of modifying elements, whose independent, spontaneous properties are completely lost in the product of fusion.

This loss of independence, which affects all the elements of a fusion product, with the exception of the dominant element, cannot be caused exclusively by the low energy of these elements. The same partial tone, which disappears in the coloration of the sound, still undergoes a noticeable weakening when it is only perceived per se, but without escaping us.

The real reason for the weakening of certain elements of a fusion product does not therefore lie in these kinds of teleological motives, but solely in the primitive properties of consciousness. Indeed, we find a sufficient reason for this in the property of apperception to be confined to a narrowly limited content of consciousness, and very often even to a single representation. Whenever a condition is added here on the part of external impressions, i.e. one of them is given with a constantly preponderant energy, this impression will therefore impose itself with irresistible power as the constituent and dominant element of the fusion product.

In the description we have given so far of apperception, it has been revealed as a function that shows itself on the occasion of representations, sometimes this function is passively determined by a predominant irritant, sometimes it makes an active choice between various impressions; and, in both cases, it seems to be in a position to reinforce the central sensory excitation.

Wilhelm Wundt (Elements of physiological psychology / Volume 2)

Preface

It is not primarily a question here of giving a neuroscientific explanation of the cerebral functioning at the basis of consciousness, but of a theoretical analysis adopting a different approach through symbolism. We start from the fact that the basic perceptual processes are independent of any other higher cognitive process that has to induce a qualitative aspect; all psychophysical dynamics is at this basic level. From this perspective, attention is considered as a fundamental dynamic process, from which perceptual consciousness can be understood as an emergent consequence. This has led to a psychophysical formalism generating mechanistic hypotheses to explain certain fundamental aspects of consciousness, such as awareness, perception, attention, the link between attention and consciousness, as well as the notion of psychological time, all leading to the concept of the fundamental state of consciousness. In other words, it is imperative to skim the surface of consciousness from its basic mechanistic aspects in order to better apprehend its higher aspects.

However, a few clarifications are necessary in order to make the concepts developed more explicit. First of all, this is a reflective theory, none of whose concepts derive from neuroscientific work on the subject. Consequently, it is not particularly necessary to have prior knowledge of neuroscience or any other cognitive science in order to approach it. It has to be looked at from a different angle, because its structure derives from a relatively simple mathematical reasoning about perceptual consciousness. But this is not specifically applied mathematics, such as the field of mathematics applied to the social sciences. Here, mathematics is indeed the main tool, but the basis of the work is modelled on a psycho-cognitive interpretation and a particular symbolism that reduces the complexity of the subject and thus justifies the formalism proposed. Secondly, when we study perceptual consciousness here, we are dealing with the most basic aspect linked to the interaction between the brain and the environment. This direct perceived environment encompasses both external data, such as natural stimuli, and sensory data within our organism, i.e. all the explicit and visceral sensory information that the brain integrates and that we can perceive consciously and unconsciously. The expression 'perceptual consciousness' is used here in a global sense, including the two major forms of perception, conscious and subliminal. And finally, the term 'psychophysics' should not lead us to relate the theory directly to what has previously been established in this discipline; the choice of this term here is the most appropriate for describing the relationship between the immediate physical environment and the individual's internal psychic environment.

This psychophysical theory provides some understanding of consciousness at its most fundamental level. And although it is a hypothesis, it nonetheless allows us to approach the field of consciousness from a different angle than is usually the case. Isn't it important to have a theory that goes beyond the strict framework of neuroscience in order to unify the various fields of study linked to consciousness, including philosophy, psychology, artificial intelligence and neuroscience itself? In other words, shouldn't the starting point be abstract concepts, where empirical data can serve as evidence? In this way, we can create a junction that will make it easier to understand this complex field.

It is by starting from a psychophysical postulate that we arrive at certain conclusions where neural correlates can constitute a justification, and we can suspect probable neurophysiological correlations on the concepts which are elaborated there. Moreover, not only does this theory affect the neurocognitive domain, it also offers prospects for understanding the subjectivity of temporal measurement. One of the points of the work is an explanation of the mechanism of this subjective distortion, illustrated as the notion of a psychophysical unit of temporal measurement.

Ultimately, the theory should be seen more as a tool for explaining consciousness than as an actual understanding of it. Thus, throughout the work, by limiting itself to formalism and psychophysical deductions, any direct interpretation has been avoided.

Glossary

Vector EI: a vector External-Internal represents the elementary input of perceptual consciousness, symbolising the direct impact of an environmental stimulus. It refers solely to a basic characteristic, having only a quantitative perceptual meaning with no qualitative connotation (semantic or contextual). And when this input enters the perceptual consciousness system, it becomes a vector EIm, i.e. an internally modulated input.

Psychophysical awareness: this is the mechanism of quantitative equivalence between the direct impact of a stimulus and what has entered our perceptual consciousness, in relation to this stimulus. It applies only to stimuli that are consciously integrated. It takes place pre-semantically, at the earliest sensory stage.

Psychophysical acquisition: this is the process of integrating a stimulus over a given period of time. During this phase, there is a quantitative increase in internally modulated inputs, from the direct impact of the stimulus. It is during acquisition that the psychophysical awareness of the input takes place. Its limit value represents an attentional allocation value (the degree of attention) allocated to each stimulus.

Vector of consciousness acquisition: a local acquisition vector of consciousness is the combination of the intensity of the stimulus and the degree of attention due to psychophysical acquisition. Basically, it is an internal amplification of the signal. The global vector of consciousness acquisition is therefore the sum of the local vectors attributed to the different inputs integrated simultaneously during global attention. It mathematically translates the conscious coherence of instantaneous global perception of the direct environment.

Priority integration: the stimuli integrated simultaneously all compete independently of the difference in sensory modalities, according to decreasing intensities; so that the attentional allocation values will be allocated respectively to the values of the intensities, from the strongest to the weakest, or to the one whose element is brought to voluntary attention, followed by the strongest, and so on. It concerns the package of multimodal inputs integrated synchronously over a very short period.

Priority integration period: this is the extremely short duration during which a priority integration sequence takes place. It can vary from one sequence to another depending on a number of factors, both psychological and physiological. It corresponds to the speed of integration of stimuli from the direct environment. Over any length of time, there is an uninterrupted succession of priority integration sequences of different periods, so it gives rise to the notion of a subjective temporal measure.

Power of consciousness acquisition: during a priority integration sequence, the integration of the packet of inputs generates a consciousness acquisition vector, and we can define a power as being the ratio of this vector to the period of the sequence, i.e. inversely proportional to the latter. And the global power, resulting from the packet of inputs, will be the sum of all the local powers induced by the local vectors. Furthermore, a psychophysical energy of consciousness acquisition will result from the accumulation of powers over time.

Fundamental state of consciousness: this is the state of perceptual consciousness experienced at each priority integration sequence. This state is imposed by the synchronous multimodal integration of stimulus packets from the direct environment. The priority integration sequence defines the conscious coherence of the individual's perception, but it does not represent a coherent whole that is significant for the individual, but a basic multimodal representation, inducing a state of perceptual consciousness. It is from this fundamental state that the higher layers of consciousness are constructed, such as the semantics and contextualisation of inputs, but also the psychological state of the moment, which will be added to it to generate a feeling.

Introduction

There are several aspects of consciousness, linked to the different contexts in which it occurs. Here, however, we are studying perceptual consciousness, which is necessary for an individual to realize any other form of consciousness. And for this first form of consciousness to be achieved, it must necessarily go through a particular process, which is awareness; so, we need to understand the intrinsic mechanisms linked to this first process. From this perspective, perceptual experience emerges from fundamental dynamic processes related to attention. However, an individual's consciousness is not just the result of integrating stimuli from the environment, because this integration is constantly biased by the fact that we are constantly thinking.

Since the work we are doing is a basic analysis of consciousness, it is more precisely a question of recognising the process of becoming aware of a stimulus as a phenomenon that can be described in an objective and measurable way. The aim is to demonstrate the existence of a psychophysical system of sensory integration that enables the brain to process information from the environment in a structured way. In doing so, we first established a postulate that led to a psychophysical model of consciousness, where no other cognitive process can be carried out; that is, there are no qualitative, semantic or contextual associations, linked to the instantaneous integration of this stimulus, that could directly influence the consciousness process during this very short period of time. So whether the stimulus has been integrated several times before or is being perceived for the first time, the result remains the same: the process of psychophysical awareness is independent of any other cognitive process that might directly influence it. It is after this mechanism that the stimulus can be processed in combination with the physiological nature of the sense that conveys it and its qualitative relationship.

The approach taken is to explore the domain of perceptual consciousness via a certain symbolic representation. We thus reduce any type of environmental stimulus to a common entity (input) so as not to differentiate between stimuli because of the nature of the senses that convey them to the brain. So, to the notion of the intensity of a stimulus, we allocate a common (undefined) unit representing the strength of the input. And the association of these input strengths with the values of the different attentional allocations, according to a certain algorithm, constitutes the entire psychophysical perceptual process available to each individual.

In the first Part, *General Concepts*, it is in the first chapter, *Symbolic Representation*, that we propose our approach using symbolism. This is followed by the chapter *Psychophysical Awareness*, in which the process of becoming aware of a stimulus in the integration of information in the brain is briefly defined. The chapter *Psychophysical Loop* explains the discrete mechanism of integration of environmental stimuli, a mechanism that can be likened to a dynamic acquisition of perceptual consciousness, leading to the emergence of an acquisition vector. This vector will be defined mathematically in the chapter entitled *Vector of consciousness acquisition*. Followed by the chapter *Calculation of the Degrees of Attention*, where the different numerical Attention Allocation Values are found, necessary for the mathematical establishment of the consciousness acquisition vector, showing that the Golden Ratio φ $\left(\frac{1+\sqrt{5}}{2}\right)$ is of major importance with regard to conscious perception and more specifically attention.

In the second Part, *Psychophysical mechanisms of global perceptual consciousness*, we explain how the global psychophysical process of simultaneously integrating a set of stimuli from the direct environment works. We begin with the chapter *Psychophysical process of multimodal perception*, in which we show how the perceptual system simultaneously encompasses several sensory modalities, with the degree of attention as the main parameter. This is followed by the chapter *Priority Integration*, in which the mechanism for ordering the integration of a set of stimuli according to their strengths is determined, thus indicating the pattern of distributed attention; and the concept of global vector is defined, before moving on to the chapter *Priority Integration Matrix*, in which the range of possibilities for focusing on any stimulus in a direct environment is expressed mathematically. Then, in the chapter *Psychophysical efforts of attention*, we show that it is important to take into account all the stimuli present when focusing attention on a particular signal. In the chapter *Attentional capacity*, we explain a psychophysical formula that expresses the amount of attention that can be paid to a stimulus. Finally, *Psychophysical analysis of automatisms* is a chapter in which an attempt is made to provide a rough explanation of certain psychophysical mechanisms of learning and assimilation.

In the third Part, *Psychophysical mechanisms of thought*, we show that thought, being a reprocessing of integrated signals, also proceeds from a psychophysical mechanism. Thus, in the chapter *Thought inputs*, we define how an element of thought should be taken into account. The chapter *Internal focus* explains the process of psychophysical awareness of a thought input and defines the psychophysical vector of access to conscious thought. In the chapter *Thought conductance*, a formula translates the amount of attention that can be focused internally, on thought, as a function of the influence of the perceived direct environment. Then, in the next chapter, *Internal focus effort*, we define the notion of conscious focusing effort on an element of thought, due to the hindrance that the surrounding stimuli can cause during attention on an element of thought. Finally, the chapter *Interpretation of the effort* Δp, is a mathematical analysis of this effort as a function of the parameters of the direct environment.

The fourth Part, *Psychophysical dysfunctions*, is a kind of proof showing that the individual's normal perceptual process must necessarily follow a functional logic defined by the mechanisms of priority integration. The first chapter, *Psychophysical mechanism of the impression of déjà-vu*, is a hypothesis of how this particular sensation works, based on the concepts developed, showing that it arises from a particular dysfunction of the perceptual system. This is followed by the chapter *Psychophysical acquisition dysfunction*, in which we show that inadequate perception can result from a certain integration parameter being abnormally allocated. Next, the chapter *What is an attentional resting-state dysfunction* briefly explains the logic of the non-pathological functioning of access to consciousness based on the process of priority integration, and which in the opposite case is a psychophysical dysfunction of the perceptual system; leading then to two cases explained in the following two chapters: *Case 1 - Absence of attentional resting-state* and Case 2 - *Abnormal attentional resting-state*; where dysfunctions are explained when the perceptual system follows a multimodal integration logic with abnormal internal parameters.

Finally, in the last Part, *Dynamics of perceptual consciousness*, the psychophysical dynamism of perceptual consciousness is discussed. The first chapter, *Period of the priority integration sequence*, describes the variable but iterative nature of priority integration, and explains the causes of this variation. The second chapter, *Notion of psychophysical unit of temporal measurement*, is a hypothesis explaining the subjective distortion of temporal estimation due to variation in the period of priority integration. The variability of this period also led to the definition of the concept of power, which is discussed in the chapter *Power of consciousness acquisition*; this concept in turn made it possible to introduce the concept of energy in the chapter *Concept of psychophysical energy of consciousness acquisition*. Finally, in the last chapter, *Fundamental state of consciousness*, we describe how consciousness can be generated at its basic level, and how the continuous perception of environmental stimuli functions as a function of the basic psychophysical processes involved.

Part 1: General concepts

Symbolic representation

The senses - vision, hearing, olfaction, touch, taste, proprioception, vestibular (and others), and also sensorimotor perception - are what transmit signals from the direct environment (the immediate external environment and the internal environment of the body) to our consciousness. The more an individual memorises the details of an environment, the more he or she will become familiar with it, because then there will be enough elements linking him or her to that place; the integration of signals makes it possible to have a fixation. And the introduction of a signal can be conscious, meaning that the signal is manifest for deep semantic and contextual access; pseudo-conscious, where the presence of the signal is detected but with superficial contextualisation; or subliminal, so that the signal is not identified despite its integration into perceptual consciousness. At the same time, thought can be considered as a kind of special modality in that it retransmits to consciousness what the senses have already integrated.

The overall mechanism of waking consciousness has the following basic schema:
Attributes → Objects → Functions → Representations. Attributes form objects, each object has a function and the combination of a set of functions gives a representation. The creative capacity of the being starts from the objects, i.e. it is possible to create objects in order to also create functions that we desire in relation to particular representations. But these representations, ranging from the simple to the complex, may or may not have meaning, and this must be understood in the sense of phenomenal associations for consciousness. The meaning of representations and the semantics of functions originate in higher cognitive processes subsequent to perceptual processes. For example, writing is made up of the visual objects that are letters, each of which has its own functional semantics, and whose association is intended to create meanings for written communication between individuals. The attributes already exist, we discover them, but we cannot create new ones; they are the elementary shapes, colors, sounds, etc., present in nature. And through this creativity we bend to the laws of nature, because in the process of designing our objects we are obliged to follow the laws of physics.

Signals differ in the attributes that make them up. These are shapes, colors, sounds, tastes, lights, smells, etc.; but also the different emotions (joy, anger, fear and many others), because although these internal sensations are of a particularly different nature to the first, they induce changes in bodily parameters, manifesting themselves to us in the form of internal irritants, perceptible more or less intensely, which we can expressively translate when they reach a certain threshold of detection. The strength of signals must have a common unit of measurement, whatever the sensory modality through which we perceive the stimuli, so that the different types of perception come together in a single entity which is the element of perceptual consciousness.

- Let us consider the sense organs as EI (External-Internal) conduits of access to consciousness, because they allow the integration of stimuli.
- All signals from the environment (attributes) are inputs for perceptual consciousness that we can consider as effective vectors $\overrightarrow{EI}$. The latter are then the direct impacts of environmental stimuli on the perceptual system. And the response to each input translates a behavior of the being. Knowing also that a simple automatic thought relative to an input can be considered as a response.

After the integration of the effective vectors, they must be considered of a different kind from those conveyed by the senses: they are modulated vectors, in the immediate sensory memory of the previously integrated input, i.e. linked only to the presence of the stimulus at the instant of perception, but this is not a significant memorization, so they must not yet be linked to the semantics of the stimulus linked to a previous integration. Let us then designate them as vectors $\overrightarrow{EI}$m (i.e. modulated vectors $\overrightarrow{EI}$) which integrate perceptual consciousness. And thought, acting effectively on access to consciousness, is an internal reintegration of inputs. It can then be considered as a reactivation of these vectors $\overrightarrow{EI}$m.

The strength of an element of consciousness represents its intensity in combination with the physiological quality of the corresponding sensory organ. It is indeed a force, because it is the value of the effective vector $\overrightarrow{EI}$ that acts on our consciousness. Since a considered signal is actually a physical attribute, any object in the environment can be made up of one or more basic attributes, i.e. a defined perceived object is in fact a global perception of these attributes: for example, a television set is globally made up of visual attributes and auditory attributes, or a figure can be made up of colors and shapes. The attribute is therefore really the input to be considered, the basic element of perceptual consciousness. Each attribute has its own external physical unit: we have luminosity, tonality, weight, volume of sound, pressure, salinity, and so on. But the strength of the input must be taken into account internally, once the sense organ has integrated it and transformed it into an electrical impulse that is common to the transfer of information from all the sensory modalities (In neurophysiology, the intensity of a stimulus is determined by the frequency of the action potentials generated by it. The nervous message is initially electrical in nature, then at a synapse, transmission takes the form of a chemical message which creates a new electrical message along the receiving neuron). In measuring sensation there are two aspects to take into account, an external aspect linked to the external physical intensity of the stimulus itself and the physiological constitution of the sense organs, and an internal aspect that concerns the individual's degree of attention. The combination of these two aspects is then what can translate an individual's subjective sensation.

The exact determination of the force is a very delicate matter, as it depends on how the attributes are to be physically assessed due to several physiological parameters that have to be taken into account. But while forces can be tricky to determine, the actual impacts of environmental signals in the brain are more accessible to measurement, either by brain imaging or by observing and analysing the corresponding reactions.

Psychophysical awareness

When we arrive in a new environment, the direct data from it is greater than the data stored in memory until, after we have been there for a while, we become accustomed to the environment, at which point the data stored in memory becomes equal to, and then greater than, the direct data.

Reducing this principle to a simple stimulus, we propose the following hypothesis: when the brain integrates a stimulus, its direct impact (linked to its physical presence) is potentially greater than its immediate sensory memory (consequent in the cerebral cortex), until there is quantitative equality between this direct impact and what is in immediate sensory memory: it is from this moment of equality that we can speak of ***psychophysical awareness*** of the stimulus in consciousness.

So, there is an increasing quantitative acquisition in the very short space of time from the start of perception until the mechanism of psychophysical awareness arrives. But this equivalence must subsequently be qualitative, in the sense that it is data linked to the nature of the stimulus.

Psychophysical ***acquisition*** is thus the mechanism of integration of a stimulus, established in a given, extremely short, lapse of time. This growing psychophysical acquisition will generate a psychophysical awareness of the input; but this process of psychophysical awareness will be overtaken as long as the acquisition continues, until it stops. And it is well after this that other higher cognitive processes related to understanding, interpreting or reacting to stimuli take place, but the internal organisation of these mechanisms is initially dependent on psychophysical acquisition, before depending on experience and the physiological constitution of the processing brain; a stimulus integrated consciously and voluntarily will have qualitatively more impact than if it is integrated subliminally, and under the same environmental conditions, a high-intensity stimulus will be quantitatively more consequential than a low-intensity one.

Psychophysical loop *(mechanism of perceptual consciousness acquisition)*

We start from the principle that the mechanism for integrating a simple stimulus is a discontinuous process; in other words, perception is a discrete process, so that when we integrate a stimulus it is in fact the result of a succession of several small pieces of data or information bits, each of which can be considered as a vector, the whole forming the element perceived over an extremely short period of time. When a stimulus is integrated, the first effective vector resulting from it (the direct physical impact representing the force of the stimulus) enters the perceptual system, then becomes a modulated vector (quantitatively degraded in force), which will re-enter the system during a second passage (to be modulated again and therefore in turn degraded a second time); i.e. during this second passage, there is reintegration of the set consisting of a new effective vector of the same value as the first and the modulated (degraded) vector resulting from the first effective vector. And this set will degrade in that the effective vector will become a new modulated vector, while the current modulated vector will degrade a second time; this last set of degraded vectors will again reintegrate the system at the next passage, accompanied by a new effective vector; and so on for as long as the psychophysical acquisition process is underway. There is an iterative mechanism for reintegrating each vector modulated and put into immediate sensory memory, which will then go through identical reprocessing by the perceptual system. So, with each passage there is integration of an effective vector (or direct impact) and a set of modulated vectors, with reduced intensities, arising successively from each other in an iterative fashion. This process should be understood as the simultaneous processing (in a given passage) of the direct impact of the stimulus and the reprocessing of this direct impact generated in previous passages.

A crude analogy could be made with the way a camera works: a film is in fact a set of shots taken very quickly and succeeding one another at regular intervals, giving an impression of continuity. But the camera keeps each shot in its memory with the same 'intensity', whereas the continuous perceptual system divides the intensity of each 'shot' integrated into each new passage, depending on the individual's degree of attention. But in addition, in the psychophysical process of perception, when the second 'snapshot' is taken, at the same time the previous 'snapshot' is reintegrated with a lower intensity and, during the next passage, when the third 'snapshot' is taken, the second is reintegrated with a lower intensity and the first with an even lower intensity.

This can be illustrated with the symbolic representation chosen earlier, as follows: in the first passage the effective vector $\overrightarrow{EI}$ integrates the perceptual system as a direct impact, then it is modulated into a vector $\overrightarrow{EIm}$ of lesser intensity, but the latter will reintegrate the system in the next passage; however, this reintegration is accompanied by a new vector $\overrightarrow{EI}$ which, in turn, will also be treated in the same way as the first effective vector, while the vector $\overrightarrow{EIm}$, which will also be degraded, will then become a vector $\overrightarrow{EIm}\downarrow$ (let us note degraded in intensity; vector $\overrightarrow{EIm}$ is a vector $\overrightarrow{EI}$ degraded in intensity). In the second passage, therefore, there is the pair of vector $\overrightarrow{EI}$ + vector $\overrightarrow{EIm}$, and the set will degrade to reintegrate the system in the third passage as vector $\overrightarrow{EIm}$ + vector $\overrightarrow{EIm}\downarrow$ (let us note for the set, vectors $\overrightarrow{EIm}_{+1}$), but moreover accompanied by a new vector $\overrightarrow{EI}$. And this whole set (vector $\overrightarrow{EI}$ + vector $\overrightarrow{EIm}$ + vector $\overrightarrow{EIm}\downarrow$) is going to be degraded and reintegrate the system in the next passage in vector $\overrightarrow{EIm}$ + vector $\overrightarrow{EIm}\downarrow$ + vector $\overrightarrow{EIm}\downarrow\downarrow$ (let us note vector $\overrightarrow{EIm}_{+2}$). Thus, in time we will have a set of vectors $\overrightarrow{EIm}_{+d}$ where the last one is a d-fold degraded vector $\overrightarrow{EIm}$, preceded by the other d vectors more and more degraded, one after the other, starting from the first modulated vector $\overrightarrow{EIm}$. This can be written down in the mathematical form:

$$\overrightarrow{EIm}_{+d} = \sum_{k=0}^{d} \overrightarrow{EIm}\downarrow^{k}$$

/ k being the number of degradations of the modulated vector $\overrightarrow{EIm}$.

● Let us note: $\overrightarrow{EIm}_{+1} = \overrightarrow{EIm} + \overrightarrow{EIm}\downarrow$; $\overrightarrow{EIm}_{+2} = \overrightarrow{EIm} + \overrightarrow{EIm}_{+1}\downarrow = \overrightarrow{EIm} + \overrightarrow{EIm}\downarrow + \overrightarrow{EIm}\downarrow^{2}$ and so on. Let be the <u>passage equations</u> at each integration of the direct impact vector $\overrightarrow{EI}$ and reintegration of the vectors $\overrightarrow{EIm}_{+d}$:

Passages	***Intégration***	$\longrightarrow$	***Modulation***
(1)	$\overrightarrow{EI}$	$\longrightarrow$	$\overrightarrow{EIm}$
(2)	$\underline{\overrightarrow{EIm}} + \overrightarrow{EI}$	$\longrightarrow$	$\overrightarrow{EIm}\downarrow + \overrightarrow{EIm}$
(3)	$\underline{\overrightarrow{EIm}\downarrow + \overrightarrow{EIm}} + \overrightarrow{EI}$	$\longrightarrow$	$\overrightarrow{EIm}_{+1}\downarrow + \overrightarrow{EIm}$
(4)	$\underline{\overrightarrow{EIm}_{+1}\downarrow + \overrightarrow{EIm}} + \overrightarrow{EI}$	$\longrightarrow$	$\overrightarrow{EIm}_{+2}\downarrow + \overrightarrow{EIm}$
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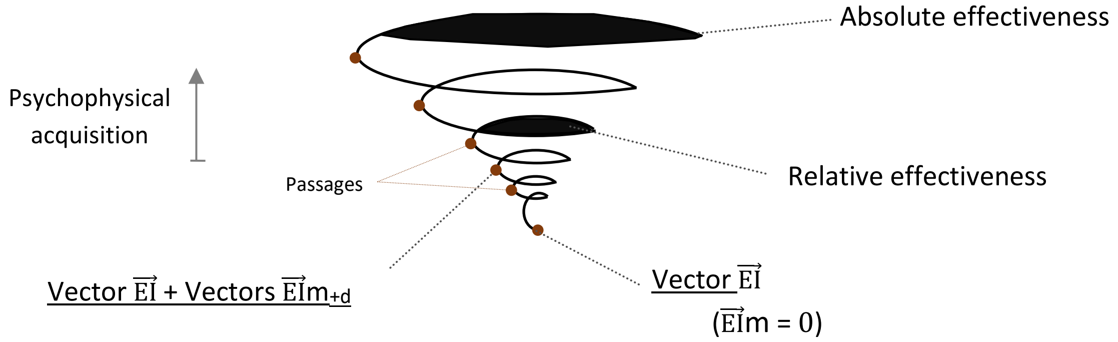
(p)	$\underline{\overrightarrow{EIm}_{+d}\downarrow + \overrightarrow{EIm}} + \overrightarrow{EI}$	$\longrightarrow$	$\overrightarrow{EIm}_{+(d+1)}\downarrow + \overrightarrow{EIm}$

Reintegration

This could be defined as a psychophysical loop of perceptual consciousness, due to the iterative reprocessing of each effective vector integrating our perceptual consciousness system at each passage.



During the growth of the acquisition, the sum of the modulated vectors $\overrightarrow{EI}m_{+d}$ will first equalise the effective vector $\overrightarrow{EI}$ (direct physical impact of the stimulus), we can then speak of ***relative effectiveness***, because all the vectors $\overrightarrow{EI}m$ act on the perceptual system in an effective way: we have a ***psychophysical awareness*** of the stimulus. Then, we approach an insurmountable limit corresponding to a threshold, at which point we can speak of ***absolute effectiveness***: there is no further growth in acquisition.

Vector of consciousness acquisition

Mathematical analysis:

Let the direct physical impact of the stimulus represented by the 'snapshot' C_i always have the same intensity whatever ***i*** is the value of the order of passage, and ***k*** a variable which may reflect the individual's degree of attention. So on the first passage we have the snapshot C_1; on the second passage we have $C_2 + C_1/k$; on the third one, we have $C_3 + C_2/k + C_1/k^2$ and so on until psychophysical acquisition of the stimulus stops, at which point there is no longer any direct physical impact.

As long as the psychophysical acquisition mechanism has not yet been completed (within a determined and extremely short time interval), we always have the same intensity value of C_i and the same numerical value of ***k***, i.e. the same degradation factor over the whole set of effective vectors and modulated vectors resulting from the same stimulus being acquired.

When the perceptual system integrates the vectors $\overrightarrow{EI}$ of a stimulus, these are integrated as modulated vectors and the increasing process of increasing will result in a great vector equal to the sum of all these modulated vectors ($\overrightarrow{EI}m_{+d}$); which is thus the combination of the stimulus's impact and the degree of attention paid to it.

This great vector could be translated as the resultant of the direct impulse impacts of the stimulus, modulated and reintegrated, made at each passage, and depending on an ***integration variable k***, during the extremely short duration of the stimulus integration.

Considering the mathematical analysis, the great vector is then equivalent to the following sum: $C/k + C/k^2 + C/k^3 + \ldots + C/k^n$

Let **V** be this great vector; it is a function of the vectors $\overrightarrow{EI}m_{+d}$ of the stimulus and the degree of attention, having as parameter the ***psychophysical integration variable k***.

From the passage equations let's calculate the value of the vector **V** at each passage (n), which will be a function of the set of modulated vectors:

- **(n = 1):** $\overrightarrow{\mathbf{EI}} \rightarrow \overrightarrow{\mathbf{EI}}\mathbf{m}$

  $V = f(\overrightarrow{EI}m)$

  Now $\overrightarrow{EI}m = \frac{1}{k}\overrightarrow{EI}$

  $V = (1/k).\overrightarrow{EI}$

- **(n = 2):** $\overrightarrow{\mathbf{EI}}\mathbf{m} + \overrightarrow{\mathbf{EI}} \rightarrow \overrightarrow{\mathbf{EI}}\mathbf{m}\downarrow + \overrightarrow{\mathbf{EI}}\mathbf{m}$

  $V = f\,(\overrightarrow{EI}m_{+1})$

  And with $\overrightarrow{EI}m_{+1} = \overrightarrow{EI}m + \overrightarrow{EI}m\downarrow = \frac{1}{k}\overrightarrow{EI} + \frac{1}{k}(\frac{1}{k}\overrightarrow{EI})$

  $V = (1/k + 1/k^2).\overrightarrow{EI}$

- **(n = 3):** $\overrightarrow{\mathbf{EI}}\mathbf{m}\downarrow + \overrightarrow{\mathbf{EI}}\mathbf{m} + \overrightarrow{\mathbf{EI}} \rightarrow \overrightarrow{\mathbf{EI}}\mathbf{m}_{+1}\downarrow + \overrightarrow{\mathbf{EI}}\mathbf{m}$

  $V = f\,(\overrightarrow{EI}m_{+2})$

And with $\overrightarrow{EI}m_{+2} = \overrightarrow{EI}m + \overrightarrow{EI}m_{+1}\downarrow = \frac{1}{k}\overrightarrow{EI} + \frac{1}{k}\left(\frac{1}{k}\overrightarrow{EI} + \frac{1}{k}(\frac{1}{k}\overrightarrow{EI})\right)$

$V = (1/k + 1/k^2 + 1/k^3).\overrightarrow{EI}$

By recurrence, **V** evolves into the sum of geometric sequence of reason $\boldsymbol{\frac{1}{k}}$

$$\mathbf{V} = \frac{1}{k}\left(\frac{1-\frac{1}{k^n}}{1-\frac{1}{k}}\right)\overrightarrow{\mathbf{EI}}$$

We then have the formula for the Vector of consciousness acquisition:

$$\mathbf{V} = \frac{k^n - 1}{k^n(k-1)}\overrightarrow{\mathbf{EI}}$$

We can also write: **V = A(n,k).F**

- **F** is the force of the input corresponding to its direct impact, the vector $\overrightarrow{EI}$ representative of the intensity of the stimulus.
- **A(n,k)** is the expression of the increasing evolution of psychophysical acquisition, parameterised by the psychophysical integration variable **k**.

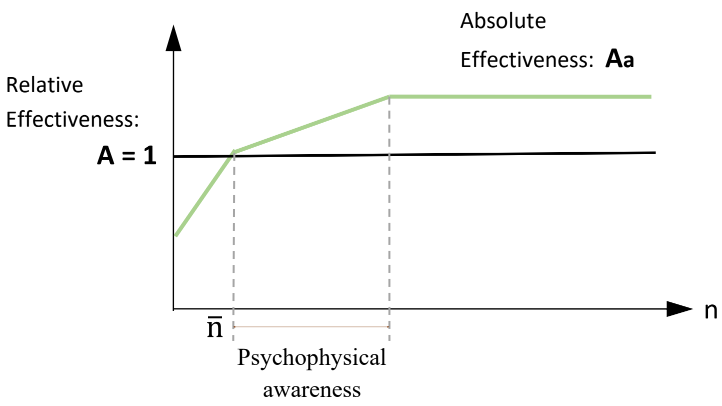
Calculation of the Degrees of Attention

Psychophysical awareness corresponds to the fact that, during a passage, the sum of the modulated vectors of a stimulus is equal to the effective vector of the stimulus: $\overrightarrow{EI}m_{+d} = \overrightarrow{EI}$.

So psychophysical awareness corresponds to the value of increasing acquisition being equivalent to A(n,k) = 1 during a particular passage n.

$$A(n,k) = \frac{k^n - 1}{k^n(k-1)}$$

The evolution of the acquisition value is a function of n as follows:



- Before relative effectiveness there is a period of preconscious integration.
- There is psychophysical awareness of the stimulus, during a particular passage $\bar{n}$ (note the bar over the n), when the acquisition is A(n,k) = 1. Then, at absolute effectiveness, there is no longer any consequent growth in acquisition, but it approaches a limit value (Aa).
- After absolute effectiveness there are other higher cognitive processes, subsequent to the perceptual process. A process of cognitive associations linked to the nature of the stimulus then begins; for example, it is from this moment onwards that recognition of a known stimulus is more obvious than that of a lesser-known stimulus.

With A(n,k) = 1

We have $\frac{k^n - 1}{k^n(k-1)} = 1$

This psychophysical awareness equation can be simplified to:

$k^{n+1} - 2k^n + 1 = 0$

For a value of the integration variable k, the equation will determine a particular passage where psychophysical awareness will occur. So for each particular passage of psychophysical awareness $\bar{n}$ (note the bar over the n) corresponds one and only one value of k. It is from this value of k that we can calculate the value of absolute acquisition A_a corresponding to the asymptotic limit of A(n,k) at the end of the increasing process of psychophysical acquisition.

For k = 1 we have $\overrightarrow{EIm} = \overrightarrow{EI}$ from the first passage, which is impossible because the first modulated vector cannot be equal to the effective vector; hence there can be no psychophysical acquisition. And k cannot be < 1, because a modulated vector $\overrightarrow{EIm}$ is always weaker than an effective vector $\overrightarrow{EI}$.

For k ≥ 2, we have the expression on the left-hand side of the equation which becomes non-zero (hence non-verified) whatever the value of $\bar{n}$.

So, the value of k is such that 1 < k < 2.

From the equation $k^{n+1} - 2k^n + 1 = 0$, for each particular passage of psychophysical awareness $\bar{n}$ (note the bar over the n), let's look for the value of the corresponding psychophysical integration variable **k**. And for each variable **k** let's calculate the value of the corresponding absolute acquisition $\mathbf{A_a}$ being the asymptotic limit:

$\mathbf{A_a} = \lim_{n\to\infty}\left(A(n,k)\right) = \frac{1}{k-1}$ (considered from a certain number n_a of passages).

In the following table of values, we have related all the possible numerical values of the psychophysical variable k, from each psychophysical awareness equation, as a function of each precise value of a particular passage $\bar{n}$. And from k, we find the value of the absolute acquisition A_a. This being a limit, n_a corresponds to the passage where the psychophysical acquisition will approach it, assuming this is the last passage; also, at the particular passage $\bar{n}$ = 40 we can consider a value of k ≈ 2, inducing an acquisition very close to 1.

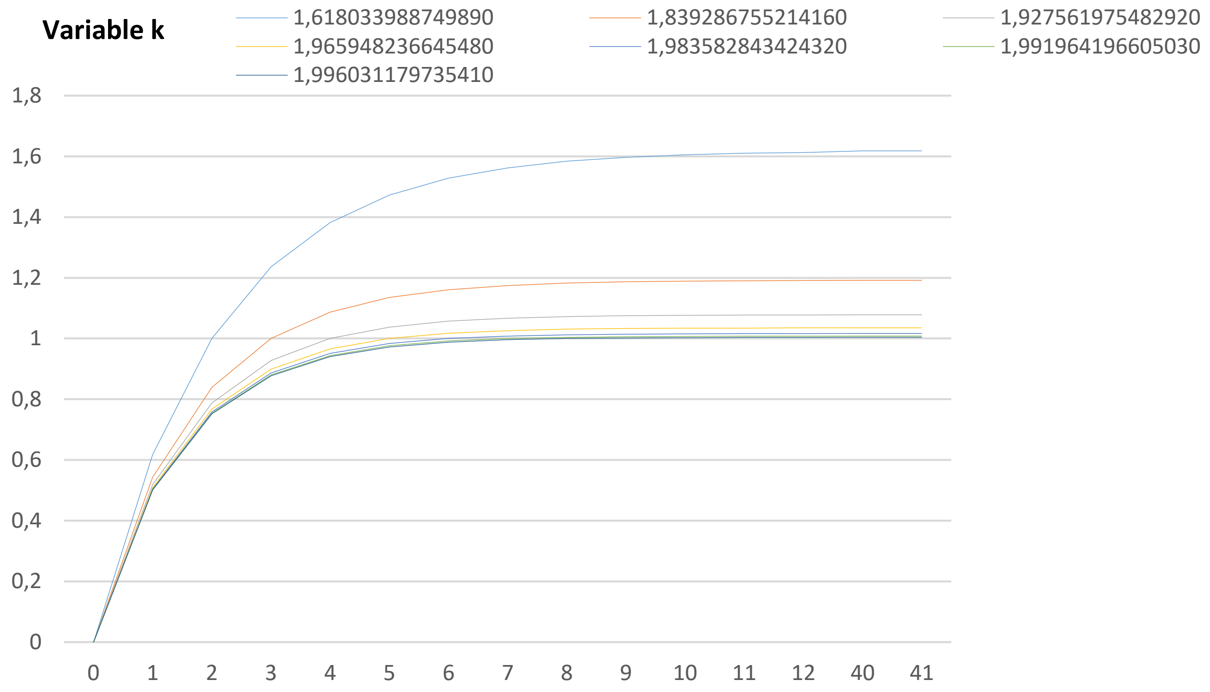
Thus, the absolute acquisition values (A_a) represent quantitatively the different degrees of attention or, more technically, the **Attentional Allocation Values (AAV)**.

TABLE OF VALUES

$\bar{n}$	Variable k	n_a	$A_a = \frac{1}{k-1}$
2	1,61803398874962	41	1,61803398874962
3	1,83928675520000	41	1,19148788397322
4	1,92756197500000	41	1,07809507822914
5	1,96594823650000	41	1,03525216177565
6	1,98358284300000	41	1,01669117870125
7	1,99196419650000	41	1,00810090074657
8	1,99603117950000	41	1,00398463480028
9	1,99802947000000	41	1,00197442065513
10	1,99901863250000	41	1,00098233152824
11	1,99951040250000	41	1,00048983732313
12	1,99975550050000	41	1,00024455929463
13	1,99987783250000	41	1,00012218242672
14	1,99993893800000	41	1,00006106572880
15	1,99996947500000	41	1,00003052593180
16	1,99998473900000	41	1,00001526123290
17	1,99999237050000	41	1,00000762955821
18	1,99999618500000	41	1,00000381501455
19	1,99999809250000	41	1,00000190750364
20	1,99999904650000	41	1,00000095350091
21	1,99999952350000	41	1,00000047650023
22	1,99999976150000	41	1,00000023850006
23	1,99999988050000	41	1,00000011950001
24	1,99999994050000	41	1,00000005950000
25	1,99999997010000	41	1,00000002990000
26	1,99999998509850	41	1,00000001490150
27	1,99999999255000	41	1,00000000745000
28	1,99999999627450	41	1,00000000372550
29	1,99999999813750	41	1,00000000186250
30	1,99999999906850	41	1,00000000093150
31	1,99999999953450	41	1,00000000046550
32	1,99999999976750	41	1,00000000023250
33	1,99999999988350	41	1,00000000011650
34	1,99999999994150	41	1,00000000005850
35	1,99999999997090	41	1,00000000002910
36	1,99999999998545	41	1,00000000001455
37	1,99999999999272	41	1,00000000000728
38	1,99999999999636	41	1,00000000000364
39	1,99999999999818	41	1,00000000000182
40	≈ 2	41	≈ 1

- *The numerical values of k and A_a are irrational numbers (the zeros at the end of some of them are only added for writing convenience). These values are approximate and may differ slightly depending on the calculation methods used.*

▪ Below are the graphical representations of the evolution of the first 7 psychophysical Acquisitions.



Abscissa: number of passages / Ordinate: acquisition value.

For a small value of the variable k, the acquisition A(n,k) will grow faster before reaching its asymptotic limit. In fact, for acquisitions due to the first (smallest) values of the integration variable, the relative effectiveness (A(n,k) = 1) is reached first. The perception of a stimulus is then more obvious with a low value of the integration variable than with a high value. A small value of k means a greater absolute acquisition value A_a and therefore a higher **AAV**.

The psychophysical acquisition vector from a stimulus being V = A(n,k).F, we can then consider the absolute acquisition value A_a as being the term for the AAV. Let us then note the different values of the acquisitions of the form A_i as representing the **Attentional Allocation Values**, with:

A_1 = 1,61803398874962..

A_2 = 1,19148788397322..

$A_{39} \approx 1$

● *The Golden Ratio φ and Attention*

The psychophysical awareness equation for the particular passage $\bar{n} = 2$ is
$k^3 - 2k^2 + 1 = 0$

And the positive solution of this is the ratio $\frac{1+\sqrt{5}}{2}$ corresponding to the first value of the psychophysical variable of integration $k_1 = 1.618033988754962$ (corresponding to the golden ratio φ).

Thus, we cannot have a psychophysical integration variable such that $k < \varphi$. The particularity of this ratio for access to consciousness is that it is the first value of the psychophysical integration variable; it is the fastest possible psychophysical awareness.

The psychophysical awareness passage for $\bar{n} = 2$ corresponds to the second passage of the vector $\overrightarrow{EI}$ (see the passage equations) and we can only speak of psychophysical awareness from this moment:

- At the first integration passage there is a single modulated vector $\overrightarrow{EIm}$: but here psychophysical awareness is not possible, because if $\overrightarrow{EIm} = \overrightarrow{EI}$ this gives a integration variable $k = 1$; now this unit value means that there has been no division but integration without degradation, which is not possible.
- On the second passage, acquisition becomes $A(2,k) = 1/k + 1/k^2$. For psychophysical awareness with $A(2,k) = 1$, the solution is $k = \varphi$. And at absolute effectiveness we notice that the limit at infinity of $A(2,\varphi)$ is equal to $\frac{1}{\varphi-1} = \varphi$.

Thus, for access to consciousness, φ is the largest possible value for psychophysical acquisition; it then represents the highest **AAV**, that of the individual's attention. When perception occurs with the integration variable of value φ, psychophysical awareness occurs after two integration passages, but the greater the value of k, the later psychophysical awareness occurs and therefore the less consequential it becomes in terms of **AAV**. The Golden Ratio **φ** is an ***attentional constant***.

Part 2: Psychophysical mechanisms of global perceptual consciousness

Psychophysical process of multimodal perception

The individual appears to perceive several stimuli from the external environment and internally (in his own body) simultaneously. The process of global perception is a multimodal integration mechanism; it involves the way in which environmental stimuli are integrated according to a structuring due to the different psychophysical integration variables.

Since the acquisition $\mathbf{A_i}$ represents the degree of attention of the stimulus: if we were to use only one single integration variable k for all the stimuli perceived at the same time, this would mean that all the Acquisitions (or AAV) would be identical, i.e. the information would be processed in the same way whether or not we pay attention to the stimulus, or whether it is very intense or not. However, the information retained differs according to the degree of attention of the individual; it is obviously more significant when we are attentive than when we are inattentive. And the only parameter likely to vary between several signals at a time of simultaneous is the AAV, and therefore the allocation of acquisition A_i to the different stimuli. The individual therefore uses several psychophysical integration variables at the same time. This explains the fact that there is a kind of multimodal global perception, which represents a set of particular degrees of attention (conscious and subliminal) of the stimuli in the direct environment. However, each acquisition A_i is unidirectional, meaning that it can only be allocated to one stimulus input at a time. And the first acquisition A_1 generated by the first integration variable k_1 is well ahead of the others. This first acquisition is associated with the individual's attention.

<u>We propose the following hypothesis</u>: There are two necessary and sufficient conditions for a stimulus to manifestly reach consciousness: firstly, the stimulus must be strong enough to be potentially describable, and secondly, the AAV allocated to the stimulus must be consistent. In this case, acquisitions from A_1 to A_{39} concern global conscious perception, where A_1 (φ) is the highest AAV, necessary for attention to a stimulus. Then the acquisitions from A_2 to A_{39} are those of pseudo-conscious perceptions, because the signals to which they are allocated have strengths large enough to be potentially perceived consciously, but the individual does not pay attention to one of them, so the stimuli can only be roughly describable. And assuming that there are more than 39 stimuli simultaneously integrating the perceptual system, it is conceivable that there could be several stimuli, the least salient ones, all allocated a last integration variable $k_{40} = 2$, so all having the acquisition $A_{40} = 1$ (increasing acquisition of limit = 1); the particularity that the unit value is a limit of acquisition

A(n,2), results in the fact that there will never be relative effectiveness achieved, i.e. no equality between what is put into immediate sensory memory and the direct impact of the stimulus, and therefore no process of psychophysical awareness; in this case it could be considered as subliminal integration. The acquisition A(n,k) is indeed unidirectional, so each of the last stimuli does receive a distinct acquisition value. However, since none of these values can exceed this limit (= 1), A_{40} is assigned as the common degree of attention allocated to them. Thus, due to this acquisition A_{40}, the signals will not be integrated in a way that is obvious enough to provoke a conscious voluntary reaction, such as expressing a concrete or even crude memory of the perception of these signals; however, the inputs allocated to this acquisition, being integrated nonetheless, may have a certain cognitive effect.

To sum up, during global perception, the individual uses several degrees of attention at the same time, and his entire perceptual system will process several stimuli at the same time. However, the AAV are quite distinct in relation to the psychophysical integration variables corresponding to them. The stimulus on which attention is focused will be allocated the first acquisition A_1; other stimuli will be allocated secondary acquisitions (A_2 to A_{39}) in order to be perceived in a pseudo-conscious manner: these first 39 acquisitions therefore concern global access consciousness. And the others stimuli will be perceived subliminally, all with the same acquisition A_{40}; it is also conceivable that the number of subliminal stimuli allocated this last acquisition A_{40} is much greater than the number of stimuli of the whole conscious and pseudo-conscious perceptual system.

[This is only a calculation hypothesis. We could just as easily assume that there are more secondary acquisitions, with values increasingly close to 1, and therefore more than 39 stimuli integrated in a globally conscious manner. However, we could always consider a final acquisition (=1) which would concern subliminal integration.**]**

Priority integration *(psychophysical process of distributed attention)*

The individual does not only need to use the highest AAV (A_1) to correctly manage all the signals in his environment and interact with it accordingly (automatic movements do not necessarily need voluntary attention to be carried out, once they have been properly assimilated). However, as the individual cannot direct his attention to several stimuli at once, he cannot be absolutely aware of everything at all times, but only of the stimulus to which his attention (controlled or not) is directed. The potential targets (stimuli in play) compete with each other, so that the most intense one dominates, followed by the next, less intense one, and so on. There is a dynamic encoding of the allocation of acquisitions to stimuli in the environment, and the principle of this encoding is due to the intensity of the stimuli. As each acquisition is unidirectional, there is an obligatory sequence of acquisitions allocated in decreasing order with the intensity of the stimuli. Global perception then follows a certain order: the stimulus with the highest degree of attention will be processed with the largest acquisition value, and so on down to the last stimulus with the lowest degree of attention, which will be processed with the smallest acquisition value.

Let there be *n* signals from e_1 to e_n with respective forces:

$F_1 > F_2 > F_3 > F_4 > F_5 > F_6 > F_7 > \ldots > F_n$

When attention is not focused on a particular signal, the largest acquisition A_1 will be allocated to the signal e_1 with the greatest force F_1; then A_2 will be allocated to e_2 and so on, so that the acquisitions will be allocated to signals with decreasing force values. The following chain is then obtained as an automatic allocation:

- A_1/e_1; A_2/e_2; A_3/e_3; A_4/e_4; A_5/e_5; A_6/e_6; A_7/e_7; … A_n/e_n

This is ***absolute priority integration***, defined as a process of selecting the most salient stimuli. Absolute priority integration involves making no voluntary effort to pay attention to a particular stimulus, and being passively challenged by the most salient stimuli around us, which we can define as a ***attentional resting-state***. This is a totally passive state of attention in which the individual makes no voluntary effort to pay attention, a state of absolute attentional passivity. It refers to a state of mental relaxation or calm when attention is not actively directed towards a specific task or stimulus.

And when there is controlled attention, directed at another signal e_i in particular, the first acquisition A_1 is allocated to this element e_i (whatever the value of its force, provided it is sufficiently salient), followed by an automatic allocation of acquisitions from A_2 to A_{40} to the *n-1* other remaining signals, respectively in descending order of force values. For example, if the individual pays particular attention to signal e_3, his **priority integration** will be as follows:

- $\underline{A_1 / e_3}$; A_2 / e_1; A_3 / e_2; A_4 / e_4; A_5 / e_5; A_6 / e_6; A_7 / e_7; … A_n / e_n

Here the acquisitions are staggered, so that A_2 is allocated to signal e_1 and A_3 is allocated to e_2, then A_4 is allocated to e_4 and so on, because attention to e_3 has induced the highest AAV (A_1) to be allocated to it.

We can see that if the individual voluntarily focuses his attention on the most intense element, the process of priority integration is identical to that of involuntary attention in a attentional resting-state; in other words, there is the same psychophysical chain of global perception in both cases, even though there is no attentional passivity in the first (we will see that there is a difference in processing speed between the two cases, later on in the concept of Power /Part 5).

Priority integration is a multimodal integration mechanism, linked only to the direct process of global perception, before other high-level cognitive processes intervene. It is an autonomous unconscious mechanism for integrating inputs. In the awake state, the individual is constantly on the alert, solicited by the many constant changes in stimuli, where the slightest variation calls for attentive attention: a small movement, a different sound, the sensation of a mosquito bite, a small draught, another person talking suddenly, a car going by; but priority integration is a process of automatic allocation of AAV to stimuli, implying that a change in the direct environment leads to a change in the allocation of these AAV, and therefore another different priority integration sequence for a different global perceptual representation.

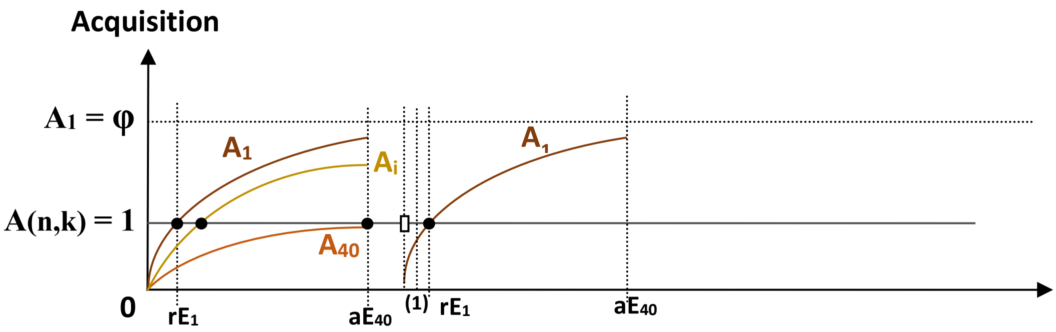
-- The process of priority integration is an extremely short temporal sequence, such that the individual is not aware of it, giving the impression of simultaneous perceptions of an instant. It involves a very rapid succession of psychophysical awarenesses (relative effectivenesses rE) on a number of simultaneously integrated multimodal inputs, the first of which is the one on which the highest AAV is allocated. These relative effectivenesses are followed, at the last passage of the sequence, by the absolute effectivenesses (aE) of these inputs:

Priority Integration **(PI)** = 0 → rE1 → … → rEi → … → rE39 → (aE1 - aE40)

The relative effectivenesses of the inputs involved are made successively one after the other, and while the last are being made, the first psychophysical acquisitions continue to grow, but at aE40 (absolute effectiveness of the weakest inputs at the last passage), also corresponding to all the absolute effectivenesses, all the acquisitions stop to make way for the next PI sequence. There is a continuous succession of PI sequences.

There may be a variable number n of inputs from one PI sequence to another, but this has no influence on the duration of the sequence. The 39 most salient inputs will have their rE first, in decreasing order of force, before reaching their aE at the same time on the last passage; while the other (*n - 39*) subliminally integrated inputs will also reach their aE on this last passage without having reached relative effectivenesses. The number n of inputs depends only on the simultaneous presence of environmental stimuli.

In a PI sequence, there is a growth in psychophysical acquisition of each input, but this growth is more consistent for the first stimuli allocated the first acquisitions, because the higher the AAV allocated to the stimulus, the faster the growth in psychophysical acquisition and the faster the psychophysical awareness.



During a PI sequence, the greatest acquisitions reach their relative effectivenesses more quickly (A(n,k) = 1), with therefore a shorter preconscious phase, and this means that their subsequent cognitive processes will be more considerable than those of the weakest acquisitions; for example, a stimulus allocated the first acquisition (A_1) will have a correspondingly longer processing time (between psychophysical awareness rE1 and the end of the sequence at the last passage aE40) than all the other stimuli, which means that the processing effect on a stimulus to which attention is being paid will be most effective during the PI sequence. This could explain the more effective and obvious effect of attention on a stimulus, even one of low intensity compared with the others, especially if it is given sustained attention over a period of time comprising several PI sequences.

- ***Psychophysical vector of global perception***

The vector (V) is the product of the degree of attention (the absolute acquisition A) and the intensity of the stimulus (the force F). But it's not just a question of a mathematical product: a degree of attention higher than another includes not only a psychophysical awareness that precedes that of a lower degree of attention, but also a longer conscious processing time for the input concerned, before the end of the PI sequence.

An acquisition vector, relative to a stimulus of force F and allocated an acquisition A, is a **local psychophysical vector** that we can denote $\mathbf{V_{i|j} = A_j.F_i}$ where ***i*** is the index of force $\mathbf{F_i}$ following the order of decreasing priority integration of stimuli and ***j*** is the index of acquisition $\mathbf{A_j}$ allocated.

With regard to the global perception of a set of stimuli as described by the process of priority integration, we must consider a **global psychophysical vector** of perception as being the sum of all the local vectors of the different stimuli present in the PI sequence. We can denote it $\mathbf{[V_i]}$ where the index ***i*** is that of the force $\mathbf{F_i}$ of the element $\mathbf{e_i}$ on which attention is focused, i.e. allocated in the first acquisition $\mathbf{A_1}$ and the square brackets represent the consideration of the global vector.

Also, in the attentional resting-state, the psychophysical vector of global perception of absolute priority integration will therefore be the sum of all the local vectors $V_{i|i}$ of the inputs of an absolute priority integration sequence, which can be noted:

$[V_1] = V_{1|1} + V_{2|2} + V_{3|3} + V_{4|4} + V_{5|5} + V_{6|6} + V_{7|7} + \ldots + V_{n|n}$

Or: $[V_1] = \varphi.F_1 + A_2.F_2 + A_3.F_3 + A_4.F_4 + A_5.F_5 + A_6.F_6 + A_7.F_7 + ... + A_n.F_n$

This vector is also the global psychophysical vector when the being is focused on the signal e_1 of greater force F_1; let us note $[V_\varphi]$ in order to distinguish it in writing from the vector acquired when focusing on the dominant signal:

$[V_\varphi] = \sum_{i=1}^{n}(A_i.F_i)$; global vector in the attentional resting-state.

We can also write: $[V_\varphi] = V_{1|1} + \sum_{i=2}^{39}(V_{i|i}) + A_{40}\sum_{i=40}^{n}(F_i)$

Here the first expression $V_{1|1}$ concerns attention on the dominant element (F_1) with an acquisition A_1; the second one concerns the other acquisitions (A_2 to A_{39}) necessary for pseudo-conscious perception; and the last expression concerns all the subliminally integrated signals with the same acquisition value $A_{40} = 1$.

And when attention is voluntarily focused on any signal e_i of force F_i we then have, according to the rule of priority integration, a psychophysical vector of global perception of the form:

$$[V_i] = \varphi.F_i + \sum_{j=1}^{i-1}(A_{j+1}.F_j) + \sum_{j=i+1}^{39}(A_j.F_j) + A_{40}\sum_{j=40}^{n}(F_j)$$

The index ***i*** being that of the force $\mathbf{F_i}$ of the input on which attention is focused. This global expression is naturally considered as a function of all acquisitions.

And from this formula, the hypothesis of the global system of perceptual consciousness (conscious and subliminal integrations) will be described as follows:

$\varphi.F_i$ is the local vector of attention on any signal e_i.

$\sum_{j=1}^{i-1}(A_{j+1}.F_j) + \sum_{j=i+1}^{39}(A_j.F_j)$ concerns the integration of the set of signals that will be perceived pseudo-consciously.

$A_{40}\sum_{j=40}^{n}(F_j)$ concerns the subliminal integration of the remaining signals.

Priority integration matrix

Taking into account a set of simultaneously integrated stimuli, the expression of global psychophysical vector will depend on the element to which attention is focused. We will then consider a system of priority integrations with all the possible global vectors of a PI sequence, knowing that attention is obviously not focused on subliminally integrated inputs:

$[V1] = \varphi.F_1 + \sum_{j=2}^{39}(A_j.F_j) + A_{40}\sum_{j=40}^{n}(F_j)$

$[V2] = \varphi.F_2 + A_2.F_1 + \sum_{j=3}^{39}(A_j.F_j) + A_{40}\sum_{j=40}^{n}(F_j)$

$[V3] = \varphi.F_3 + \sum_{j=1}^{2}(A_{j+1}.F_j) + \sum_{j=4}^{39}(A_j.F_j) + A_{40}\sum_{j=40}^{n}(F_j)$

$[V4] = \varphi.F_4 + \sum_{j=1}^{3}(A_{j+1}.F_j) + \sum_{j=5}^{39}(A_j.F_j) + A_{40}\sum_{j=40}^{n}(F_j)$

$[V38] = \varphi.F_{38} + \sum_{j=1}^{37}(A_{j+1}.F_j) + A_{39}.F_{39} + A_{40}\sum_{j=40}^{n}(F_j)$

$[V39] = \varphi.F_{39} + \sum_{j=1}^{38}(A_{j+1}.F_j) + A_{40}\sum_{j=40}^{n}(F_j)$

The psychophysical link between the lines of the system is that the priority integration having vector [V1] is either passive or active (focus on signal e_1 of force F_1), whereas the other vectors are those of only voluntary attentions. We have to consider this system as "elastic", with the point of return [V1]: in other words, a being whose attentional reference point is the entire system, in which it is constantly immersed when surrounded by the greatest forces, will have a choice of voluntary attention to one of the salient signals, but will always tend to focus its attention on the signal of greatest intensity. The system therefore represents all the individual's possible choices of attention to a set of simultaneously integrated stimuli.

We can consider a priority integration square matrix of order 39, because voluntary attention can only take place with conscious integration acquisitions (A_1 - A_{39}), The PI matrix is:

$$
\begin{pmatrix}
\mathbf{V_{1|1}} & V_{2|2} & V_{3|3} & V_{4|4} & V_{5|5} & V_{6|6} & \dots & V_{39|39} \\
V_{1|2} & \mathbf{V_{2|1}} & V_{3|3} & V_{4|4} & V_{5|5} & V_{6|6} & \dots & V_{39|39} \\
V_{1|2} & V_{2|3} & \mathbf{V_{3|1}} & V_{4|4} & V_{5|5} & V_{6|6} & \dots & V_{39|39} \\
V_{1|2} & V_{2|3} & V_{3|4} & \mathbf{V_{4|1}} & V_{5|5} & V_{6|6} & \dots & V_{39|39} \\
V_{1|2} & V_{2|3} & V_{3|4} & V_{4|5} & \mathbf{V_{5|1}} & V_{6|6} & \dots & V_{39|39} \\
V_{1|2} & V_{2|3} & V_{3|4} & V_{4|5} & V_{5|6} & \mathbf{V_{6|1}} & \dots & V_{39|39} \\
- & - & - & - & - & - & - & - \\
V_{1|2} & V_{2|3} & V_{3|4} & V_{4|5} & V_{5|6} & V_{6|7} & \dots & \mathbf{V_{39|1}}
\end{pmatrix}
$$

The vectors $\mathbf{V_{i|1}}$ correspond to the local vectors of attention on the element e_i with: $V_{i|1} = \varphi.F_i$

Every individual is continually challenged by the environment in irregular ways; this irregularity is due to changes in forces caused by the constant dynamism of the external and internal environment. This direct environment is not constant, the different stimuli that challenge the individual are multiple and variable; there are never the same signals of identical forces in continuous integration over a period of time that the individual can appreciate. So, the Matrix of Priority Integrations is just as changeable, and we are no longer talking about a single matrix over an appreciable period of time, but a series of different PI matrices; we obtain a matrix band of priority integrations and there is a whole dynamism of perceptual consciousness linked to this matrix band.

Psychophysical efforts of attention

Let then be the system of priority integrations:

$$\begin{cases} [V1] = \boldsymbol{\varphi.F1} + A2.F2 + A3.F3 + A4.F4 + \dots + A39.F39 + \dots + A40.Fn \\ [V2] = A2.F1 + \boldsymbol{\varphi.F2} + A3.F3 + A4.F4 + \dots + A39.F39 + \dots + A40.Fn \\ [V3] = A2.F1 + A3.F2 + \boldsymbol{\varphi.F3} + A4.F4 + \dots + A39.F39 + \dots + A40.Fn \\ [V4] = A2.F1 + A3.F2 + A4.F3 + \boldsymbol{\varphi.F4} + \dots + A39.F39 + \dots + A40.Fn \\ ------------------------ \\ [V39] = A2.F1 + A3.F2 + A4.F3 + A5.F4 + \dots + \boldsymbol{\varphi.F39} + \dots + A40.Fn \end{cases}$$

The global psychophysical vector [V1] corresponds to that in which the attention (voluntary or not) is allocated to the element e_1 with the most consistent force F_1; in all cases, attention to this stimulus is not hindered by any other more intense stimulus, it requires no particular discriminative effort of attention. What would happen to this effort if attention were focused on the other signals $e_{i>1}$ in the direct environment?

When the individual turns his attention to another signal, the global vector corresponds to [Vi]. But this vector is obviously lower than the global vector [V1] induced by the first signal. This tendency can then be expressed by the vector differential: Δ_i = [V1] - [Vi].

The weaker the force F_i in relation to F_1, the smaller the vector [V_i] in relation to the vector [V1], and therefore the greater the differential Δ_i. And this differential will also depend on all the forces interposed between F_1 and F_i. Paying attention to a weak signal e_i will require a more substantial effort of attention. So Δ_i can represent a **psychophysical effort of attention** on the signal e_i on which attention is focused.

Hence the system of psychophysical attentional efforts:

$$\begin{cases} \boldsymbol{\Delta 1 = 0} \\ \boldsymbol{\Delta 2 = (\varphi - A2)F1 + (A2 - \varphi)F2} \\ \boldsymbol{\Delta 3 = (\varphi - A2)F1 + (A2 - A3)F2 + (A3 - \varphi)F3} \\ \boldsymbol{\Delta 4 = (\varphi - A2)F1 + (A2 - A3)F2 + (A3 - A4)F3 + (A4 - \varphi)F4} \\ ------------------------ \\ ------------------------ \\ \boldsymbol{\Delta 39 = (\varphi - A2)F1 + (A2 - A3)F2 + (A3 - A4)F3 + (A4 - A5)F4 + \dots + (A39 - \varphi)F39} \end{cases}$$

$A_1 = \varphi$

Let $\alpha_i = A_i - A_{i+1}$

Then, after calculation we have $\Delta_i = \sum_{k=1}^{i-1} \alpha_k F_k - \sum_{k=1}^{i-1} \alpha_k F_i$

And $\Delta_i = \sum_{k=1}^{i-1} \alpha_k (F_k - F_i)$

The general formula then amounts to: $\Delta_i = \sum_{k=1}^{i-1} (A_k - A_{k+1}).(F_k - F_i)$

Note that the attentional effort on any stimulus depends on all stimuli with an intensity greater than this.

→ It should be clearly distinguished that a psychophysical effort of attention should not be equated with fatigue, due to sustained attention made on a stimulus for a certain duration. We can voluntarily keep our attention continuously on a stimulus by concentrating, thus leading to weariness when this lasts, but the psychophysical effort of attention being a differential of psychophysical vectors, it changes at any moment by following the dynamic of constant variation in the intensities of the stimuli that reach us.

• ***Comprehensive inhibition***

It happens that among a multitude of different and intense noises, we manage to isolate one sound (for example our neighbor's conversation) and that we are unable to report the other sounds in any meaningful way, there is a comprehensive inhibition effect here. However, the psychophysical characteristics of this effect are not exclusively unimodal. This effect could be generalised to all the sensory modalities involved, because it is directed by attention, which is unidirectional. If you focus your attention on another sensory modality, you will no longer be able to understand the sounds you hear. So, if we focus our attention on a visual signal, the sounds and all the other stimuli perceived can be summarily ignored; in addition to the global vector characteristics, there is a whole dynamic of attentional efforts at play. What's more, the effect of inhibition will be more obvious on the same modality because of the a posteriori processing by the same set of higher cognitive processes.

Illustration:

• Given a direct environment in which the most consistent forces come from auditory signals: let then be an auditory object O_1 of force F_1 and a composite object O_2 of forces $F_2(a)$ auditory and $F_2(v)$ visual, attention on O_2 can be visual or auditory depending on the individual's choice. As the individual is stimulated by both objects at the same time, $F_1 > F_2(a) > F_2(v)$.

If the individual focuses on the auditory base of O_2, then the global perceptual vector becomes $[V_{2a}] = \varphi.F_2(a) + A_2.F_1 + A_3.F_2(v)$.

If the individual focuses on the visual basis of O_2, then the global perceptual vector becomes $[V_{2v}] = \varphi.F_2(v) + A_2.F_1 + A_3.F_2(a)$.

The priority integration system is:

$$\begin{cases} [V\varphi] = \varphi.F1 + A2.F2(a) + A3.F2(v) \\ [V_{2a}] = A2.F1 + \varphi.F2(a) + A3.F2(v) \\ [V_{2v}] = A2.F1 + A3.F2(a) + \varphi.F2(v) \end{cases}$$

- By focusing attention on the auditory basis of object O_2, there will be a psychophysical effort of attention $\Delta_{2a} = [V\varphi] - [V_{2a}] = (\varphi - A_2).(F_1 - F_{2a})$.

And if the force F_1 varies by increasing, the literal form of the system does not change, but from a certain threshold of this force, the effort Δ_{2a} could be too great for the focus on the auditory base of the object O_2 to be consistent enough.

With a change in the situation of the environment, assuming for example that F_1 and $F_2(v)$ do not change values, but that only $F_2(a)$ varies by decreasing so that:
$F_1 > F_2(v) > F_2(a)$.

The new system will then be of the following form:

$$\begin{cases} [V\varphi] = \varphi.F1 + A2.F2(v) + A3.F2(a) \\ [V_{2v}] = A2.F1 + \varphi.F2(v) + A3.F2(a) \\ [V_{2a}] = A2.F1 + A3.F2(v) + \varphi.F2(a) \end{cases}$$

- If the individual focuses his attention on the auditory basis of object O_2, his global vector returns to third place and he will therefore have a psychophysical effort of attention $\Delta_{2a} = [V\varphi] - [V_{2a}] = (\varphi - A_2).F_1 + (A_2 - A_3).F_2(v) + (A_3 - \varphi).F_2(a)$.
This effort linked to $F_2(a)$, is here much higher than the previous one due to the third position of the vector in the priority integration system, implying then the taking into account of the visual element of force $F_2(v)$.

Attentional capacity

The local psychophysical vector $V_{i|1}$ translates attention to an element e_i without taking into account any other stimulus integrated simultaneously; and the psychophysical vector of global perception [Vi] translates attention to this signal while taking into account all the stimuli integrated consciously and subliminally during a PI sequence. We can then translate the ratio $V_{i|1}$ to [Vi] as a quantity of attention to the signal e_i in a direct environment perceived by the individual; this quantity depends not only on the intensity of the main stimulus but also on the intensities of all the stimuli perceived by the individual at the same moment (PI sequence) of attention focused on this main element. The expression of this quantity, which is then an attentional capacity, is:

$$C_i = \frac{V_{i|1}}{[V_i]}$$

$V_{i|1}$ cannot be zero (because $F_i > 0$), nor can it be equal to, let alone greater than [Vi], which is the vector summation of all the perceptions on the priority integration sequence. So, we have: $0 < C_i < 1$.

If C_i is close to 0, there is a low amount of attention on signal e_i; and conversely if C_i is close to 1, there is a high amount of attention on signal e_i.

***Illustrations** (artificial data):*

1● Consider an environment whose first 7 elements have the following forces respectively:

$F_1 = 7$; $F_2 = 6$; $F_3 = 5$; $F_4 = 4$; $F_5 = 3$; $F_6 = 2$; $F_7 = 1$.

The priority integration matrix highlighting the local psychophysical vectors on the elements gives:

Attention on :	*PI matrix :*							*Order :*
e_1	11,33	7,75	5,39	4,14	3,05	2,02	1,004	1234567 (absolute PI)
e_2	8,34	9,71	5,39	4,14	3,05	2,02	1,004	2134567
e_3	8,34	6,47	8,09	4,14	3,05	2,02	1,004	1324567
e_4	8,34	6,47	5,17	6,47	3,05	2,02	1,004	1243567
e_5	8,34	6,47	5,17	4,07	4,85	2,02	1,004	1235467
e_6	8,34	6,47	5,17	4,07	3,02	3,24	1,004	1234657
e_7	8,34	6,47	5,17	4,07	3,02	2,01	1,618	1234567 (no absolute PI)

The order is that of the values of the vectors respectively in decreasing order. Attention on element e_7 gives an order resembling an absolute priority integration (in a attentional resting-state) whereas this is not the case, because here there is a non-zero psychophysical effort of attention. When attention is focused on signal e_2, there is a local vector (in green) greater than the local vector generated by the first signal e_1 ($\varphi.F_2 > A_2.F_1$), which is not the case for the other signals in the matrix; there is therefore quantitatively no strong hindrance to focusing on this signal, unlike the other signals.

Psychophysical Global Vectors	***Psychophysical Efforts of Attention***	***Attentional Capacity***
$[V_1] = 34{,}077$	$\Delta_1 = 0{,}000$	$C_1 = 0{,}332$
$[V_2] = 33{,}650$	$\Delta_2 = 0{,}427$	$C_2 = 0{,}289$
$[V_3] = 33{,}110$	$\Delta_3 = 0{,}966$	$C_3 = 0{,}244$
$[V_4] = 32{,}528$	$\Delta_4 = 1{,}549$	$C_4 = 0{,}199$
$[V_5] = 31{,}926$	$\Delta_5 = 2{,}151$	$C_5 = 0{,}152$
$[V_6] = 31{,}316$	$\Delta_6 = 2{,}761$	$C_6 = 0{,}103$
$[V_7] = 30{,}702$	$\Delta_7 = 3{,}375$	$C_7 = 0{,}053$

- We can see that the effort of attention on element e_7 is 8 times greater than the effort of attention on element e_2 whereas attention on e_7 gives an order similar to the absolute PI, but the real situation in absolute PI is attention on element e_1 with zero effort.
- If we had a situation where $F_1 = 7$ and $F_2 = 1$, we would have $\Delta_2 = 2{,}559$, and this effort of attention would have been less than the effort Δ_7 (= 3.375) on the last element e_7 of force $F_7 = 1$ in our present situation; in both cases we have the same difference in force intensity, but in the case where $F_2 = 1$, there is no force present between F_1 and F_2, whereas here there are 5 forces between F_1 and F_7, hence the differences in attentional effort between the two cases.
- The attentional capacities show an amount of attention on the most salient stimulus (e_1) that is 6 times greater than the amount of attention on the last stimulus (e_7).

2● Consider a situation with a noisier environment than the previous situation where the first 7 forces have the following values:

$F_1 = 64$; $F_2 = 63$; $F_3 = 61$; $F_4 = 57$; $F_5 = 49$; $F_6 = 33$; $F_7 = 1$.

Attention on :	***PI matrix :***							***Order :***
e_1	103,55	75,06	65,76	59,00	49,82	33,27	1,004	1234567 (absolute PI)
e_2	76,25	101,94	65,76	59,00	49,82	33,27	1,004	2134567
e_3	76,25	67,92	98,70	59,00	49,82	33,27	1,004	3124567
e_4	76,25	67,92	63,15	92,23	49,82	33,27	1,004	4123567
e_5	76,25	67,92	63,15	57,95	79,28	33,27	1,004	5123467
e_6	76,25	67,92	63,15	57,95	49,40	53,39	1,004	1234657
e_7	76,25	67,92	63,15	57,95	49,40	33,13	1,618	1234567 (no absolute PI)

Here, despite the presence of several large forces, there are 4 signals (e_2 to e_5) generating local vectors (> $A_2.F_1$) greater than that of the first signal. If we compare this situation with the one above, we can see that the environment is much noisier, and not only are the forces greater, but the majority of them are close to F_1. A noisier environment does not necessarily mean greater attentional disturbance.

Psychophysical Global Vectors	***Psychophysical Efforts of Attention***	***Attentional Capacity***
$[V_1] = 387{,}480$	$\Delta_1 = 0{,}000$	$C_1 = 0{,}267$
$[V_2] = 387{,}054$	$\Delta_2 = 0{,}427$	$C_2 = 0{,}263$
$[V_3] = 385{,}974$	$\Delta_3 = 1{,}506$	$C_3 = 0{,}256$
$[V_4] = 383{,}643$	$\Delta_4 = 3{,}837$	$C_4 = 0{,}240$
$[V_5] = 378{,}832$	$\Delta_5 = 8{,}648$	$C_5 = 0{,}209$
$[V_6] = 369{,}073$	$\Delta_6 = 18{,}407$	$C_6 = 0{,}145$
$[V_7] = 349{,}423$	$\Delta_7 = 38{,}056$	$C_7 = 0{,}005$

- Efforts in this second situation are greater than those in the first, obviously due to the greater differences in forces.
- Comparing the 2 situations, we can see that attention to element e_4 in the second situation will require an effort Δ_4 (3.837) slightly greater than the effort Δ_7 (3.375) of attention to element e_7 in the first situation, whereas attention to element e_4 in this second situation generates a consequent local vector (greater than that of the most salient element) unlike element e_7 in the first situation.

Moreover, attention to element e_5 in the second situation, will generate an effort Δ_5 (8.648) more than twice as great as that of element e_7 in the first situation.

- In both situations, the local vectors of attention on element e_7 are identical, but overall, there are large differences in the efforts and attentional capacities on the same element, due to quantitatively quite distinct environments.
- The capacities C_4 (0.240) of the second situation and C_3 (0.244) of the first situation are almost equal, while their respective forces $F_4 = 57$ and $F_3 = 5$ are very far apart. The amount of focused attention depends more on the set of stimuli perceived than on the intensity of the stimulus in question (although the latter is important in the first instance).

Psychophysical analysis of automatisms

Information from the direct environment is processed for all stimuli integrated simultaneously. The brain processes both information that we can remember and information that we are not aware of. This is why we can carry out several tasks at the same time, some of which we are aware of and some of which we are not. For example, we can talk on the phone while walking, without concentrating on the process of walking; but it is impossible to read a newspaper with absolute attention while walking along a street full of obstacles, where we have to pay close attention to the route to follow.

When an individual is confronted with a new situation, he or she necessarily uses attention to get to know his or her immediate environment. And if certain signals have already been known, learning will be all the faster, as the signals may be identical or semantically associated with what has already been assimilated. But once the new environment has been assimilated, so that it becomes habitual, the individual no longer needs to voluntarily pay attention to the signals, which have become habitual, because there will be less and less assimilation work and the higher cognitive processes linked to these signals will be fairly consistent. The individual no longer needs to pay continuous voluntary attention to react to the assimilated signals; many of the constant signals in this environment can be processed pseudo-consciously and even unconsciously, if assimilation is consistent enough, so that activities can be carried out in parallel. There is then a transfer of processing from the conscious to the non-conscious. Attention can then be allocated to other new and more or less intense signals. For example, it is much easier to talk on the phone in a street you know well than in a new street you don't know at all.

In this way, we can understand the psychophysical mechanism of learning. Let's take the example of an individual who is learning to pedal: his concentration on the stimuli (even though he is only aware of the whole) from the whole process of riding the bike will inevitably use up his attention. As he learns, he will have assimilated enough of the stimuli from the bike-riding process, and will therefore need to use the first acquisition of priority integration less and less. Once they have mastered their technique, they will be able to deal with the driving process pseudo-consciously, while directing their voluntary attention to signals other than those generated by cycling, and they will then pedal normally.

Let's take the example of an individual learning to write: by simplification (without taking other stimuli into account), let's choose three forces as the elements of the writing process: F_v linked to the stimulus of seeing the writing trace, F_p linked to the pressure of the pen on the paper and F_t linked to the touch of the pen. Let's assume a calm environment where $F_v > F_p > F_t$. We then consider a priority integration whose global allocation will be: $\varphi.F_v\ /A_2.F_p\ /A_3.F_t$. For F_v the psychophysical effort of attention is zero ($\Delta_1 = 0$). Here assimilation is easier because of the relatively large forces (in a relatively calm environment) of the writing process. If the three forces were too weak in relation to other signals from the direct environment perceived by the learner, it would obviously have been more difficult for him to learn to write. So at the beginning, the learner's attention must be focused on the writing process; the most obvious signal here is vision, but attention can switch to the other two signals at very brief moments. And as the assimilation process progresses, he will need to use his sustained attention less and less, until it becomes automatic and the higher cognitive processes are large enough to be processed with little acquisition in a noisier environment. Of course, the process of learning to write involves many more subtleties than this, and the ability to assimilate varies from one individual to another.

Automatism is the ability to effectively manage an entire process of perception with the use of secondary acquisitions, i.e. pseudo-consciously.

Part 3: Psychophysical mechanisms of thought

Thought inputs

This is not a model of the individual's (complex) thought, linked to several high-level cognitive processes, but simply a question of access to thought input. As this is a form of internal reintegration of stimuli, it is a kind of special modality, but it does not allow the introduction of new external signals. So, in a way, it derogates from the laws of physical reality: we can use thought to create representations or functions that are impossible to realise in reality, and this is what imagination is all about. Nevertheless, even by thought, we cannot change the basic attributes; we cannot imagine what we have not yet perceived (seen, heard or felt) as attributes.

Access to thought is the result of a mechanism similar to that of perceiving a stimulus, there is also a process of 'psychophysical' awareness of an element of thought. However, the two mechanisms operate independently. The priority integration mechanism is made up of externally generated inputs, i.e. stimuli from the direct environment (the immediate external environment and the internal environment of the body), but the generation of internal thought inputs is much more complex. There are different ways of generating these inputs. They can be automatically generated by stimuli (external and internal), the latter activating cortical areas which then reactivate modulated vectors; this is a form of automatic thought. They can also be generated by voluntary efforts to recall, which reactivate the corresponding cerebral areas and generate the appropriate modulated vectors; this is a form of recall thought. And there is a third form, that of imagination and reflection, which is the form of abstract and creative thought, and which differs from the other two in that it is not only made up of them, but also does not function as directly. In addition to the will, abstract and creative thought comes from a non-conscious set of cerebral impulses, profoundly conditioned by experience, the psychological state of the moment, internal biological functioning (blood circulation, vegetative system, oxygenation, etc.), and homeostasis, which will generate constant changes in internal somatic inputs, i.e. unconscious inputs (or not) in priority integration sequences; in addition to the interplay of cortical associations. This is a kind of very subtle strategy of choice on the part of the individual, where indeterminism and determinism are interwoven by a stochastic set of modulated vector incidences, which will thus form aggregates of vectors structured into the object of thought created.

Thus, the element of thought is no longer exactly like a modulated vector, because it returns as an input, into the psychophysical system of integration, like an external effective vector. The modulated but restructured vectors are therefore the thought inputs to be considered, because when there is psychophysical awareness of thought, whatever its form, it is on these inputs that the process of acquiring the thought element will take place in order to achieve psychophysical awareness of this thought element.

Dreams: the consciousness of dreams may be based on the same mechanisms as thought. And in this sense, dreaming is in some ways similar to thinking, but the same 'psychophysical' process underlying them is more evident during sleep, due to the absence (or near absence) of external stimuli. What's more, during wakefulness, attention is more easily focused on the external environment.

Internal focus

Priority integration is the psychophysical process considered for sensory modalities. But what is its impact on thought and vice versa? There is no priority integration for thought. Since it is made up of vectors internal to the individual and not of actual vectors coming directly from the sensory organs, thought does not compete with stimuli from the direct environment. Although there is no competition, attention to thought will take precedence over the stimuli in the parallel PI sequence, but this last will influence the amount of possible attention paid to the thought input (depending on the strengths of the sensory inputs in the sequence).

▪ Conscious thought is voluntary because the individual focuses his attention on an internal input. Consider a thought element e_p of force F_p: when there is internal focus on this element, consider a thought acquisition A_p with the integration variable $k_1 = \varphi$ of voluntary attention as the parameter. The force F_p of the thought element is representative of a vector internally: $\overrightarrow{EIp}$. The calculation of the acquisition A_p follows the same reasoning as that of the perception of a stimulus, in the sense that for there to be a psychophysical awareness mechanism on a thought element, there must also be equality between the direct impact of this thought element of force F_p and the sum of the modulated vectors, generated by reintegration on the instant of focus of the thought element. But unlike an environmental stimulus whose external physical impact is an effective vector $\overrightarrow{EI}$, the thought element is already internal, so the first vector is to be taken into account in calculating the thought acquisition A_p; in other words, this acquisition takes into account both the first vector linked to the force F_p and all the other modulated vectors.

Thus, we are looking for a vector of thought acquisition V_p which, in addition to the vectors degraded in the psychophysical loop, will always take into account one more vector $\overrightarrow{EIp}$:

- (1) : $\overrightarrow{EIp} \quad \longrightarrow \quad \overrightarrow{EIp}{\downarrow}$ *(modulation)*
  With $\overrightarrow{EIp}{\downarrow} = \frac{1}{k}\overrightarrow{EIp}$ we have $V_P = \overrightarrow{EIp} + (1/k).\overrightarrow{EIp}$
- (2) : $\overrightarrow{EIp} + \overrightarrow{EIp}{\downarrow} \quad \longrightarrow \quad \overrightarrow{EIp}{\downarrow} + \overrightarrow{EIp}{\downarrow\downarrow}$
  So $V_p = \overrightarrow{EIp} + (1/k + 1/k^2).\overrightarrow{EIp}$
- (3) : $\overrightarrow{EIp} + \overrightarrow{EIp}{\downarrow} + \overrightarrow{EIp}{\downarrow\downarrow} \quad \longrightarrow \quad$ *modulation*

There is an evolution into the sum of a geometric sequence of reason $\frac{1}{k}$ + unity (corresponding to the direct internal focusing impact of the thought input):

$$V_p = \left(1 + \frac{1}{k}\frac{1-\frac{1}{k^p}}{1-\frac{1}{k}}\right)\overrightarrow{EIp}$$

The Vector of thought acquisition is therefore: $V_p = (1 + \frac{k^p-1}{k^p(k-1)}).\overrightarrow{EIp}$

Now the variable of integration k is equal to the attentional constant φ, because in internal focus on a thought input, there can only be voluntary attention. And the limit (at infinity) of the expression $\frac{\varphi^p-1}{\varphi^p(\varphi-1)}$ is equal to φ.

$V_p = (1 + \varphi).\overrightarrow{EIp}$

We then consider a thought attentional allocation value $A_p = (1 + \varphi)$.

$V_p = A_p.F_p$

> Although the acquisition A_p considered takes into account the vector $\overrightarrow{EIp}$ related to the direct impact of the thought input, the increasing dynamic of a psychophysical acquisition only includes the vectors in modulation. And so psychophysical awareness will indeed occur in the second passage (2), where there will be equality between the value of the direct internal impact and the sum of the modulated vectors linked to this impact of the thought element:
> We have $\overrightarrow{EIp} = (1/\varphi + 1/\varphi^2).\overrightarrow{EIp}$ where $1/\varphi + 1/\varphi^2 = 1$

• When focusing internally, with a set of signals e_i from the direct environment, we cannot consider a 'global vector of thought acquisition'; the thought input cannot be integrated into the priority integration sequence, like other effective stimuli from the environment that automatically follow the priority integration rule. However, we will consider in the global a vector sum ΣV_p relative to the thought input:

$$\Sigma V_p = (1 + \varphi).F_p + A_2.F_1 + A_3.F_2 + \dots + A_{39}.F_{38} + A_{40}.F_{39} + A_{40}.F_{40} + \dots + A_{40}.F_n$$

Although the thought element cannot be integrated into the PI sequence, the allocation of the acquisition A_p due to the attention on the thought element, will create an allocation shift of all the acquisitions. The force F_{39} will therefore be shifted towards subliminal integration, so that it will be allocated acquisition A_{40}.

$$\Sigma V_p = (1 + \varphi).F_p + \sum_{i=1}^{38}(A_{i+1}.F_i) + A_{40}\sum_{i=39}^{n}(F_i)$$

ΣV_p in this mathematical form, must be considered as a function of F_p.

Thought conductance

In a given physical environment, the ratio of the local vector of internal focus to the global vector sum ΣV_p relative to the thought input can represent a quantity of focusing on a thought input, i.e. an attentional quantity on the thought element, in parallel with the stimuli making up a priority integration sequence, which can be a hindrance to this focusing on thought. This ratio therefore corresponds to an attentional capacity for internal focus, which we can refer to as the psychophysical conductance of thought C_p:

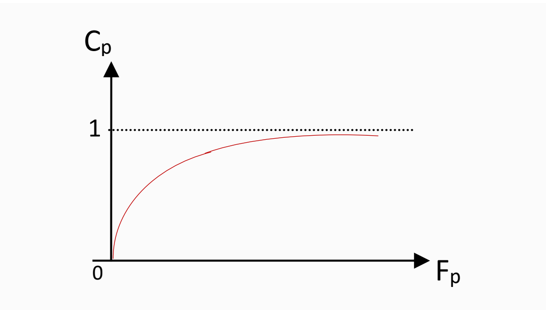
$$C_p = \frac{Vp}{\Sigma Vp}$$

$$C_p = \frac{(1+\varphi).Fp}{\Sigma Vp}$$

We will therefore consider the thought conductance C_p as a function of F_p.

We have $\Sigma V_p = (1 + \varphi).F_p + \sum_1^n A_{i+1}.F_i$; here the second expression (in Σ) does not depend on the force F_p (the thought element does not influence the priority integration sequence).

We can then consider the following function: $C_p = \dfrac{(1+\varphi).Fp}{(1+\varphi).Fp + \sum_1^n Ai+1.Fi}$



The closer the psychophysical conductance of thought C_p is to 1, i.e. the greater the force of thought F_p relative to stimuli from the direct environment, the easier there will be effective access to conscious thought.

The value of the expression $\sum_1^n A_{i+1}.F_i$ is decisive for the function of C_p: the smaller this sum, the faster the function approaches its limit 1; conversely, if the sum is large, the function will approach this limit more slowly. This seems quite obvious in the sense that there is greater ease of internal focus in a calm environment.

Internal focus effort

The attentional resting-state is defined when there is absolute priority integration without voluntary attention, i.e. when there is attentional passivity and the first AAV is allocated, without any effort to focus, to the greatest force F_1 of the strongest stimulus present; consequently, focusing on an element of thought must generate an effort of attention.

The integration system relating to thought is then defined as follows:

$$\begin{cases} [V\varphi] = \boldsymbol{\varphi}\,.\,\mathbf{F1} + A2.F2 + A3.F3 + \dots\dots\dots + A39.F39 + \dots\dots\dots + A40.Fn \\ \Sigma Vp = (1+\varphi).Fp + A2.F1 + A3.F2 + A4.F3 + \dots + A40.F39 + \dots + A40.Fn \end{cases}$$

The internal focus effort therefore amounts to:

$$\Delta_P = [V\varphi] - \Sigma V_p$$

$$\Delta_p = \sum_{i=1}^{39} (A_i - A_{i+1}).F_i - (1+\varphi).F_p$$

- In the case where we have a force of the thought input greater than the greatest force ($F_p > F_1$), there is no absolute priority integration on the thought element e_p; a normal individual without any brain dysfunction only voluntarily focuses towards thought signals, regardless of the greater or lesser intensities of the environmental stimuli. And while the effort of attention on a stimulus will only depend on the superior forces as well as those of the element, the effort of internal focus will depend on all the efficient forces of the PI sequence.

Let's consider the internal focus effort function $\Delta_p = \boldsymbol{f}(F_p)$: this function is not continuous at $F_p = 0$, because that would mean focusing on a zero thought (which is of course - unthinkable!). We must then consider the limit of the function Δ_p at zero: $\lim_{Fp \to 0} (f(Fp)) = \Delta_{pmax}$ which means a maximum effort of internal focus that is impossible to achieve:

$$\Delta_{pmax} = \sum_{i=1}^{39} (A_i - A_{i+1}).F_i$$

Let this be the psychophysical function of the internal focus effort:

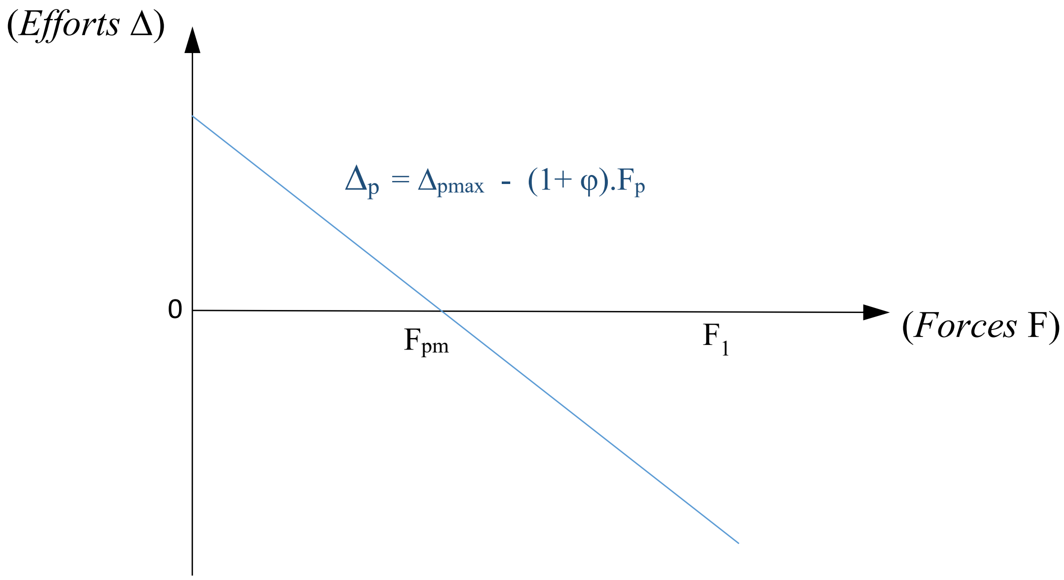
$$\Delta_p = \Delta_{pmax} - (1+\varphi).F_p$$

This function translates a possible psychophysical behaviour of internal focus in a precise situation of the immediate sensory environment.

For zero effort ($\Delta_p = 0$) we then consider the average thought force:

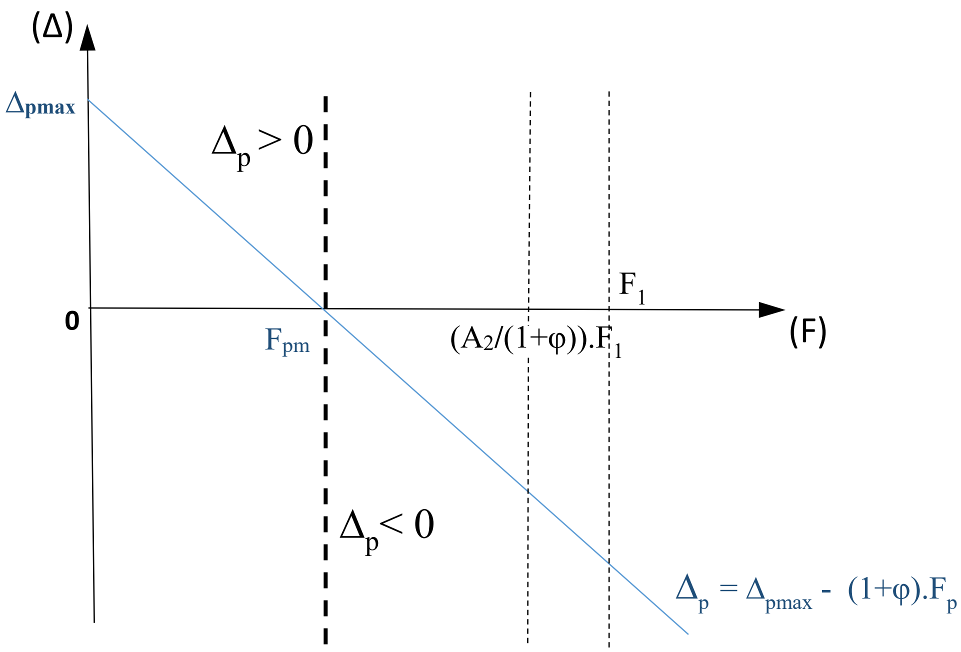
$$F_{pm} = \frac{\Delta pmax}{1+\varphi}$$

And in this case the vector sum relative to the average thought force is equivalent to the global psychophysical vector in an attentional resting-state: $\Sigma V_p = [V\varphi]$ although the intensity of the average thought force is less than the greatest force F_1.



Interpretation of the effort Δp

It is only in the case of internal focus that we can have a negative effort of attention. Whatever the intensity of the stimuli around us, we can voluntarily focus our attention on our thoughts, and this is more or less easy depending on the intensity of the thought input, combined with the intensity of the stimuli in the environment perceived during a priority integration sequence. When the strength of the thought input is high and that of the stimuli is low, the result can be a vector sum ΣV_p relative to the thought input, greater than the vector of the attentional resting-state [V_φ] linked to the greater force of the dominant element, thus generating a negative effort of attention.



- Zone where $\Delta_p > 0$:

  Here the force F_p is less than the average thought force F_{pm}.

  - The local vector of access to thought V_p is less than the local vector $V_{1|2}$ of the greatest force: $(1 + \varphi).F_P < A_2.F_1$ or $F_p < (A_2/(1 + \varphi)).F_1$. Not only is the force of thought too weak (compared to the greatest force of the priority integration sequence), but so is the local vector of thought. At this level it is impossible for the individual to concentrate easily on a thought element.

- Zone where $\Delta_p < 0$:
  Here the force F_p of the thought element is greater than the average thought force F_{pm}.
  - If locally $V_p < V_{1|2}$ then we have $F_p < (A_2 /(1 + \varphi)).F_1$. Although there is an ease due to negative effort, it is not so easy because the local thought vector is low relative to the environment, especially if several stimuli have consequent intensities. And it's not as in the case of priority integration, where the intensity of a stimulus that is too weak makes it incomprehensible; here, for the same low intensity, thought can be accessible, but internal focus remains quite difficult.
  - If locally $V_p > V_{1|2}$ then we have $F_p > (A_2 /(1 + \varphi)).F_1$:
    - for $F_p < F_1$: even if the force of thought is weaker than that of the stronger signal, it is still sufficiently strong for internal focus to be easy.
    - for $F_p > F_1$: it goes without saying that there is no impediment to concentration that could be generated by the environment.

Part 4: Psychophysical dysfunctions

Psychophysical mechanism of the impression of déjà-vu

In the process of psychophysical acquisition, for there to be psychophysical awareness of an input, the acquisition A(n,k) would have to be equal to 1, during a specific passage (relative effectiveness = instant when what is put into immediate sensory memory is equal to the physical impact of the stimulus). But what would happen if there was a sudden interruption in the growth of acquisition just before relative effectiveness was reached, immediately followed by a restart in the next passage? In other words, in a priority integration sequence, a stimulus is integrated and then abruptly stopped before there is any psychophysical awareness of the stimulus, and then immediately reintegrated into the same sequence.

- Let us analyse the evolution of Acquisitions when this happens in passage (2).

→ In the first passage, there is only one effective vector $\overrightarrow{\mathrm{EI}}$ and we cannot yet speak of psychophysical awareness.

→ In the second passage there is a ***break*** (abnormal interruption of the acquisition), so no integration of a new vector $\overrightarrow{\mathrm{EI}}$, but only the reintegration of the previous vector $\overrightarrow{\mathrm{EI}}$ (in the first passage) which has been modulated into vector $\overrightarrow{\mathrm{EI}}\mathrm{m}$ (= $\frac{1}{k}\overrightarrow{\mathrm{EI}}$).

→ In the third passage there is a ***restart***, so integration of a new vector $\overrightarrow{\mathrm{EI}}$ and reintegration of the previous vector $\overrightarrow{\mathrm{EI}}\mathrm{m}$, but degraded to $\overrightarrow{\mathrm{EI}}\mathrm{m}\downarrow$ (= $\frac{1}{k}\overrightarrow{\mathrm{EI}}\mathrm{m}$).

Hence the passage equations:

(1) : $\overrightarrow{\mathrm{EI}} \rightarrow \overrightarrow{\mathrm{EI}}\mathrm{m}$

(2) (*Break*) : $\overrightarrow{\mathrm{EI}}\mathrm{m} \rightarrow \overrightarrow{\mathrm{EI}}\mathrm{m}\downarrow$

We cannot yet have psychophysical awareness, because if $\overrightarrow{\mathrm{EI}} = \overrightarrow{\mathrm{EI}}\mathrm{m}\downarrow$ then we have:

$1 = 1/k^2$ for $k = 1$, but $k \geq \varphi$.

(3) (*Restart*) : $\overrightarrow{\mathrm{EI}} + \overrightarrow{\mathrm{EI}}\mathrm{m}\downarrow \rightarrow \overrightarrow{\mathrm{EI}}\mathrm{m} + \overrightarrow{\mathrm{EI}}\mathrm{m}\downarrow^2$

For psychophysical awareness we pose:

$\overrightarrow{\mathrm{EI}} = \overrightarrow{\mathrm{EI}}\mathrm{m} + \overrightarrow{\mathrm{EI}}\mathrm{m}\downarrow^2$ which gives $1 = 1/k + 1/k^3$.

And for the first integration variable $k_1 = \varphi$, we will have $1/\varphi + 1/\varphi^3 < 1$; there is no possible equality, so no relative effectiveness at this level either.

(4) : $\overrightarrow{EI} + \overrightarrow{EI}m + \overrightarrow{EI}m{\downarrow}^2 \rightarrow \overrightarrow{EI}m + \overrightarrow{EI}m{\downarrow} + \overrightarrow{EI}m{\downarrow}^3$

For psychophysical awareness we pose:
$\overrightarrow{EI} = \overrightarrow{EI}m + \overrightarrow{EI}m{\downarrow} + \overrightarrow{EI}m{\downarrow}^3$ which gives $1 = 1/k + 1/k^2 + 1/k^4$.
And for $k = \varphi$, we will have an acquisition $A = 1/\varphi + 1/\varphi^2 + 1/\varphi^4 = 1 + 1/\varphi^4$; so here the acquisition becomes > 1.

- We must therefore consider that psychophysical awareness is virtually achieved between passages (3) and (4), because there is no equality at a precise passage which would correspond to relative effectiveness:

(3) : immediate sensory memory < physical impact

(4) : immediate sensory memory > physical impact

From passage (4) we have an acquisition value greater than 1. The vectors modulated during this passage are then quite substantial, which means that at this level we can have the impression of having already become aware of the element concerned without having passed through the condition of quantitative vector equality of relative effectiveness.
Given that in a priority integration sequence, all the acquisitions are used at the same time for the perception of several simultaneous stimuli, we will do the same with the other psychophysical integration variables.
With the second integration variable $k_2 = 1.8392867552$:
(1) → (2) (*Break*) → (3) (*Restart*)

(4) : $A = 1/k_2 + 1/k_2^2 + 1/k_2^4 < 1$

- Immediate sensory memory < physical impact

(5) : $A = 1/k_2 + 1/k_2^2 + 1/k_2^3 + 1/k_2^5 > 1$

- Immediate sensory memory > physical impact

We can see the same effect as in the case of the first integration variable k_1 (φ), where we also have virtual relative effectiveness, but later here between passages (4) and (5). Doing the same reasoning for the variable k_3 we find a virtual relative effectiveness between passages (5) and (6). And so on, for any variable k_i we find a virtual relative effectiveness between passages (i+2) and (i+3).

Note that the passage equations and the mathematical forms of the acquisitions are all identical; only the numerical acquisition values differ from one variable k to another, giving later acquisition values greater than 1 as a function of the integration variable.

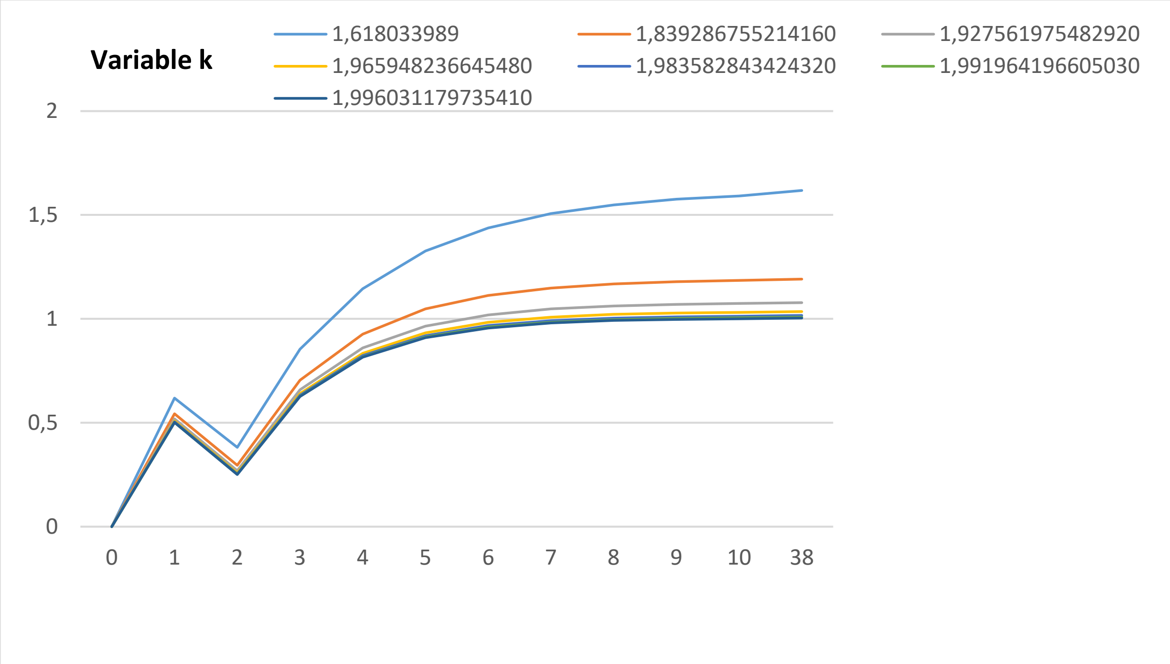
• Ultimately, an input is first integrated in preconscious mode, then if there is a *break* immediately followed by a *restart* of integration of the input, this will create the impression that it has already been perceived. In other words, we 'perceive' the information before we even realise it. The *break* is therefore a kind of "short circuit" that creates the impression of having already perceived it. It's a question of poor synchronisation between our ‘perception of the moment’ (physical impact) and our immediate sensory memory.

As far as global perception is concerned, all the integration variables are taken into account. The impression of déjà-vu is then the set of ‘déjà-perceived’ effects specific to each integration variable, specific to each stimulus integrated into a priority integration sequence.

In psychophysical terms, the impression of déjà-vu is a sequence of ‘déjà-perceived’ effects (of progressively lower amplitude), the first of which is an effect on attention. This is an impression throughout the perceptual system of having already had a psychophysical awareness of the direct environment; and it concerns all the sensory modalities involved in the PI sequence. The individual may have the impression of having already experienced the events of the moment.

We can illustrate this in the graph below, representing the *break* in the second passage, thus affecting the increasing evolution of the different psychophysical acquisitions during a priority integration sequence.

Only the first 7 acquisitions are shown here, although it should be noted that this mechanism will affect all 39 values of consciousness acquisition in the priority integration sequence, A_{40} being an acquisition that does not provoke psychophysical awareness.



Abscissa: number of passages / Ordinate: acquisition value.

Each curve represents a 'déjà-perceived' effect linked to a specific input. The first effect (in blue), due to the first integration variable ($k_1 = \varphi$), will obviously be much more significant than the other effects that follow.

Passage (1):
Until then, the growth of the acquisition is identical to a normal evolution with a value $A = 1/k$.

Passage (2):
There is a *break* which will lead to a decrease in the acquisition value which will be $A = 1/k^2$ instead of $1/k + 1/k^2$ in normal evolution.

Passage (3):
A *restart* will lead to a growth in the acquisition value. However, we have:
$A = 1/k + 1/k^3 < 1$; so no psychophysical awareness yet whatever the value of the integration variable k.

Passage (4):
The first acquisition due to the variable $k_1 = \varphi$ is $A = 1/\varphi + 1/\varphi^2 + 1/\varphi^4 > 1$; relative effectiveness is exceeded as far as attention is concerned, and the curve of the acquisition of this first 'déjà-perceived' effect resumes a normal evolution up to absolute effectiveness. But as far as the other integration variables are concerned, the acquisition values are always less than 1: $A = 1/k_i + 1/k_i^2 + 1/k_i^4 < 1$.

Passages (5 and +):
For each variable of integration $k_{i>1}$ we have successively an acquisition A > 1 from passage (i+3).

- Let us analyse the evolution of Acquisitions when there is a *break* in the third passage (3).

(1) : $\overrightarrow{E\bar{I}} \rightarrow \overrightarrow{E\bar{I}m}$

(2) : $\overrightarrow{E\bar{I}} + \overrightarrow{E\bar{I}m} \rightarrow \overrightarrow{E\bar{I}m} + \overrightarrow{E\bar{I}m}\downarrow$

From the set of modulated vectors $\overrightarrow{E\bar{I}m}_{+1}$ we have an acquisition $A = 1/k + 1/k^2$.
And for the first integration variable $k = \varphi$, we have $A = 1/\varphi + 1/\varphi^2 = 1$. We therefore have a significant real relative effectiveness at the level of this passage, because there is equality between the physical impact linked to the presence of the stimulus and what has been put into immediate sensory memory: during this passage, there is a psychophysical awareness of the stimulus to which attention is allocated.

(3) (*Break*) : $\overrightarrow{E\bar{I}m} + \overrightarrow{E\bar{I}m}\downarrow \rightarrow \overrightarrow{E\bar{I}m}\downarrow + \overrightarrow{E\bar{I}m}\downarrow^2$

The value of the acquisition has fallen: $A = 1/k^2 + 1/k^3$.
And for $k = \varphi$ we will have $A = 1/\varphi^2 + 1/\varphi^3 < 1$; there is no longer any relative effectiveness, despite the psychophysical awareness of the stimulus during the previous passage.

(4) (*Restart*) : $\overrightarrow{E\bar{I}} + \overrightarrow{E\bar{I}m}\downarrow + \overrightarrow{E\bar{I}m}\downarrow^2 \rightarrow \overrightarrow{E\bar{I}m} + \overrightarrow{E\bar{I}m}\downarrow^2 + \overrightarrow{E\bar{I}m}\downarrow^3$

The value of the acquisition has increased: $A = 1/k + 1/k^3 + 1/k^4$.
And for $k = \varphi$ we have $A = 1/\varphi + 1/\varphi^3 + 1/\varphi^4 = 1$.

We have the equality of immediate sensory memory = physical impact. There is therefore a second real relative effectiveness at this level.

In this second case, where the *break* is made in passage (3), we have one psychophysical awareness for attention in the previous passage (2) and another in the following passage (4). Here we have two psychophysical awarenesses in the same priority integration sequence, which can lead to a powerful impression of 'déjà-perceived', and the impression of anticipating what is going to happen at the moment.

- *Break* to passage (3) with the integration variable k_2:

The passage equations will be identical to those for the first variable k_1.

(1) → (2) → (3) (*Break*) → (4) (*Restart*)

(4) : $A = 1/k_2 + 1/k_2^3 + 1/k_2^4 < 1$

(5) : $A = 1/k_2 + 1/k_2^2 + 1/k_2^4 + 1/k_2^5 < 1$

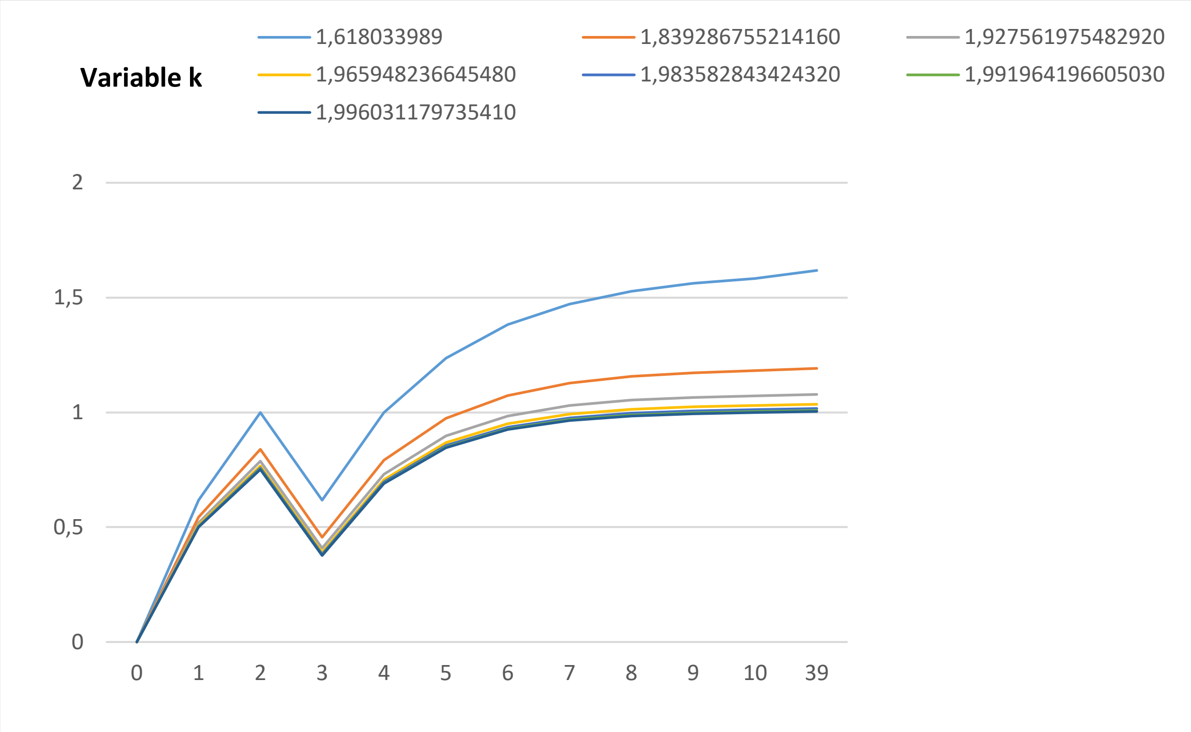
(6) : $A = 1/k_2 + 1/k_2^2 + 1/k_2^3 + 1/k_2^5 + 1/k_2^6 > 1$

Here we have a virtual relative effectiveness between passages (5) and (6); we then see a similarity with the previous situation of the *break* in passage (2). In other words, there is a virtual relative effectiveness resulting in passage (6) in an impression of having already perceived the stimulus.

And by proceeding in the same way with the other integration variables $k_{i>2}$ we have the same effect between passages (i+3) and (i+4).

- In this second situation, we therefore have an impression from the pseudo-conscious perceptual system (A_2 to A_{39}) of having already perceived the signals, as in the previous situation. But in conscious perception, concerning attention, there is a double psychophysical awareness, the first of which can be considered as an impulse independent of the perceived input. As the individual is more aware of the stimulus on which attention is focused, he may have the illusory feeling of being able to predict what is going to happen at any moment during the effect, in addition to the impression of having already experienced the general situation.

We illustrate this in the graph below, representing the *break* in the third passage, again affecting, as in the previous situation, the temporal evolution of the different psychophysical acquisitions during a priority integration sequence.



Abscissa: number of passages / Ordinate: acquisition value.

Passage (1):

The evolution is normal. The acquisition is A = 1/k.

Passage (2):

Progress remains normal and so acquisition has increased with $A = 1/k + 1/k^2$.

We can see that for attention, acquisition is A = 1; corresponding to a psychophysical awareness.

Passage (3):

There is a *break* which will cause a drop in the acquisition value, because there has been no integration of the effective vector due to the physical impact, and the modulated vectors degrade: $A = 1/k^2 + 1/k^3$.

Passage (4):

The *restart* has allowed the introduction of a new effective vector, resulting in acquisition growth with $A = 1/k + 1/k^3 + 1/k^4$.

Passages (5 and +):

For each variable there is successively an acquisition A > 1, but from the corresponding passage (i+4).

- ***Remarks:***

-• It is mathematically possible to envisage *breaks* beyond passage (3), in which case we will just have different global impressions of déjà-vu mechanisms from one *break* level to the next, but the intrinsic mechanisms described above remain the same. Also we are not going to do the calculation for all levels of *break*, because the two processes presented can globally describe the mechanisms of this dysfunction. Although it is possible to have all these kinds of dysfunctions due to the *breaks* at different levels of passage, the impressions on the individual remain globally the same due to the identical local psychophysical processes.

-• The impression of déjà-vu being a dysfunction of global perception, it involves all the simultaneous sensory modalities in a priority integration sequence. But this dysfunction must then be considered over a relatively long period, i.e. comprising several successive priority integration sequences in dysfunction, with the same level of *break*; hence a succession of *breaks* over a series of PI sequences.

Psychophysical acquisition dysfunction

A psychophysical acquisition dysfunction corresponds to an invalid integration of stimuli by the perceptual system. Let's assume an integration dysfunction due to the value of the psychophysical integration variable k. This is normally between the values φ and 2 (φ ≤ k ≤ 2). Outside this range, the integration of the stimuli may generate inappropriate psychophysical behaviour.
If k = 1, this corresponds to the fact that there is no degradation of the vectors of the integrated stimulus; thus, the effective vector $\overrightarrow{EI}$ and the modulated vector $\overrightarrow{EIm}$ will be equal; moreover, the sum of all the modulated vectors (corresponding to the growth in the value of the acquisition) would be too consequent and would have no asymptotic limit. However, let's assume an integration variable k_0 as close as possible to unity: the vector $\overrightarrow{EIm}$ will thus have a value very close to the vector $\overrightarrow{EI}$; the modulation would be asymptotically equal to its direct physical impact at the first passage. The modulated vectors, reintegrating the perceptual system through the psychophysical loop, would only degrade very slowly in an iterative fashion, generating too much acquisition vector for the signals integrated with this variable k_0.
The psychophysical acquisition formula being $A(n,k) = \frac{k^n-1}{k^n(k-1)}$

- In passage (1), for n = 1: $A(1,k) = \frac{k-1}{k(k-1)} = \frac{1}{k}$; acquisition here would be very close to 1 for $k = k_0$.
- In passage (2), for n = 2: $A(2,k) = \frac{k^2-1}{k^2(k-1)} = \frac{k+1}{k^2}$; here the acquisition would be very close to 2 for $k = k_0$, so a very rapid doubling of vector (remember that this passage is the one where the acquisition linked to attention (the first variable $k_1 = φ$) is in relative effectiveness).

We note we could consider a virtual relative effectiveness between passages (1) and (2); but there is no *break* in the integration of the effective vectors $\overrightarrow{EI}$ (as in the situation of the impression of déjà-vu). There is very quickly a great value of psychophysical acquisition leading to a great local vector of acquisition of consciousness. This is a dysfunction of psychophysical acquisition, in which signals from the environment are abnormally stored, too intensely, in a priority integration sequence.

From passage (2) onwards, the normal mechanism of priority integration generates the normal acquisitions from A_1 to A_{40}. The PI sequence is then made up of 41 acquisition values, where for the first A_0 we have virtual relative effectiveness in the preconscious zone of attention, i.e. before the start of the conscious zone of the normal priority integration process.

And in absolute effectiveness we posit: $A_0 = \lim_{n \to \infty}(A(n, k)) = \frac{1}{k0 - 1}$

The closer the value of the integration variable k_0 is to 1, the larger the acquisition value A_0 will be (tending towards infinity). And in addition to a large acquisition which increases very quickly, generating a large local vector of acquisition of consciousness, the period between its virtual relative effectiveness and its absolute effectiveness results in a much longer subsequent cognitive processing than with the other stimuli in the PI sequence, including that of attention. However, having virtual relative effectiveness, there is no psychophysical awareness to imply adequate cognitive efficiency that can lead to a higher-than-normal form of perceptual consciousness.

What is an attentional resting-state dysfunction?

The individual's global perception is continually focused on stimuli from the direct environment. There really is no zero state of attention, because it is impossible not to be attentive to the constant changes in the situation due to the continuous variations in stimuli (in addition to thought). And so the individual must focus his attention at all times, either on a stimulus or on his thoughts. But in absolute terms we have considered that when there is no voluntary effort (however very slight) to pay attention at a given moment, we are talking about a attentional resting-state, the principle of which is absolute priority integration.

Since several inputs reach us simultaneously, by virtue of priority integration, the individual cannot have the same degree of attention of all these incoming stimuli at the same time, otherwise the information from the inputs perceived by the individual at that moment would all be processed in the same way and given priority; all these stimuli could have the same impact on perceptual consciousness, leading to disorientation of the individual because there is no priority for ascending (first level) processing of the information reaching the brain (the priorities for descending processing due to the cognitive context only taking effect after the priority integration sequence). As a result, a logic of priority integration must ensure a balance in the conscious and subliminal processing of stimuli for the individual.

For the sake of attentional tranquility, every normal individual must have a psychophysical basis of attentional rest, corresponding to the process of absolute priority integration, and which is a kind of state of perceptual consciousness equilibrium. Otherwise, there is a psychophysical dysfunction in perceptual integration.

There are two main types of this perceptual integration dysfunction:

- An absence of attentional resting-state.
- An abnormal attentional resting-state.

Case 1 - Absence of attentional resting-state

An absence of attentional rest corresponds to a lack of adequate attentional frame due to the rule of priority integration, the process of which is the allocation of psychophysical acquisitions, respectively in decreasing order of intensity, starting with acquisition A_1 (φ). If the acquisitions were quantitatively identical ($A_i = A_{i+1}$), i.e. with the same degree of attention on the stimuli, there would be no priority of basic information processing directed by attention. The environment would not call out forcefully, due to a lack of consistent competitiveness between sensory inputs, and the individual would then have to try to direct one's attention at all times without being able to be fixed in an attentional resting-state. In other words, the perceptual system is unable to direct and fix attention in an appropriate and orderly way, allowing it to exclude quantitatively irrelevant information, and to be able to concretely process, at a higher level, that which is most salient for its interaction with the environment. Since the attentional resting-state is in a sense a state of equilibrium, its absence will lead to a loss of efficient orientation of access to consciousness.

- ***Psychophysical aspects***

The fact that the acquisitions are identical means that, whatever the strengths of the stimuli present, these will be integrated with the same psychophysical integration variable k.

▪● Let us assume the case where all acquisitions are equal to A_1 (φ), meaning that whatever the intensities of the different stimuli that reach us, there is simultaneously, in the same priority integration sequence, the same high AAV allocated to each of them: there would then be on this sequence, psychophysical awareness mechanisms similar at every point, on the different inputs present. All stimuli are interpreted as a priority, regardless of their force, which need only be sufficient for basic processing.

For each signal, the same global perceptual psychophysical vector value is:

$$[V_i] = \varphi.\sum_{i=1}^{n} Fi$$

The PI matrix here therefore only has inputs with identical acquisitions. There is no absolute priority integration led by the largest force F_1; hence no more psychophysical efforts of attention to consider, $\Delta_i = 0$.

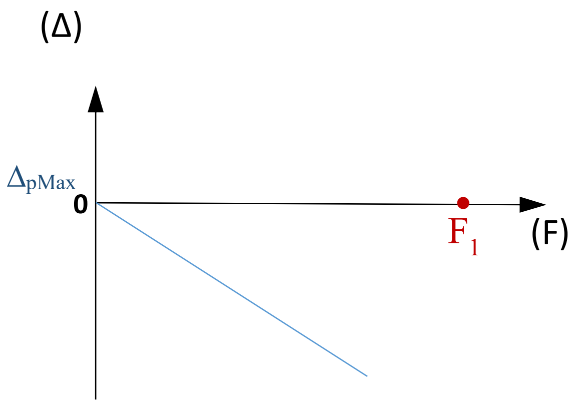
- In this case, let's analyse the psychophysical functioning of thought by internal focalisation.

The Thought system is written:

$$\begin{cases} [V] = \varphi.F1 + \varphi.F2 + \varphi.F3 + \varphi.F4 + \varphi.F5 + \dots + \varphi.Fn \\ \Sigma Vp = (1+\varphi).Fp + \varphi.F1 + \varphi.F2 + \varphi.F3 + \varphi.F4 + \varphi.F5 + \dots + \varphi.Fn \end{cases}$$

Just assuming that the global vector [V] is the only one that is effective, an assumed internal focus effort would be: $\Delta_P = [V] - \Sigma Vp$

$\Delta_P = -(1+\varphi).F_p$



We have a maximum internal focus effort $\Delta_{pMax} = 0$. The effort Δ_p is negative, causing thought to be abnormally too easy.

▪● Suppose the case where the first acquisition A_1 (φ) related to attention is allocated to a single stimulus, but all other acquisitions are identical and equal to the same value $A_0 < \varphi$; so that there is a global psychophysical dysfunction, but excluding attention. In this case, the stimulus on which attention is focused will have the local vector $V_{i|1} = \varphi.F_i$; while all the other local vectors will be identical and each equal to $V_k = A_0.F_k$.

Hence a global vector of perception: $[V_i] = \varphi.F_i + A_0.\sum^{n-1} F_k$

Although we cannot strictly speak of a global attentional resting-state, attention can be fixed on the largest force F_1 of global vector:

$[V_1] = \varphi.F_1 + A_0.\sum^{n-1} F_k$

And rewriting:

$[V_1] = \varphi.F_1 + A_0.F_i + A_0.\sum^{n-2} F_k$

$[V_i] = \varphi.F_i + A_0.F_1 + A_0.\sum^{n-2} F_k$

We obtain an effort of attention: $\Delta_i = [V_1] - [V_i]$

$\Delta_i = (\varphi - A_0).F_1 + (A_0 - \varphi).F_i$

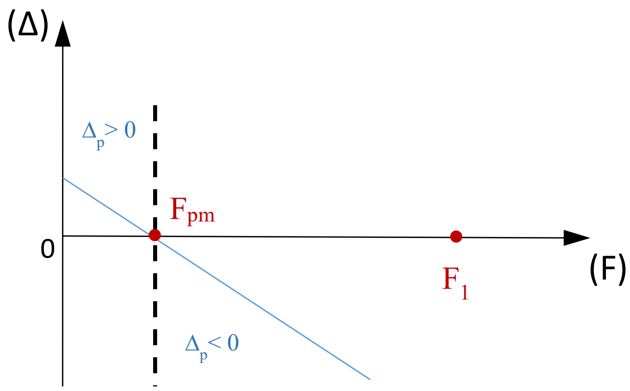
This effort is just the same as an effort of attention without psychophysical dysfunction, with the difference here that, whatever the element on which attention is focused, the mathematical form remains the same, i.e. it does not depend on any other force than that of the stimulus in question and the largest one F_1; and the weaker the force F_i the greater the effort.

- System of Thought:

$$\begin{cases} [V1] = \varphi.F1 + A0.\sum^{n-1} Fk \\ \Sigma Vp = (1+\varphi).Fp + A0.F1 + A0.\sum^{n-1} Fk \end{cases}$$

An internal focus effort is then represented by:

$\Delta_P = (\varphi - A_0).F_1 - (1+\varphi).F_p$



We have $\Delta_{pMax} = (\varphi - A_0).F_1$

$F_{pm} = \frac{\varphi - A0}{(1+\varphi)} F_1$

Here, although thought seems abnormally easy, the possible focus on the dominant force F_1 can noticeably modulate the thought system.

Case 2 - Abnormal attentional resting-state

In the PI sequence, all the inputs involved are physical irritants (external and internal) which impose themselves on the individual's global perceptual system. Thought, on the other hand, does not impose itself on a normal individual. So what happens if it is forcibly challenged without any real possibility of control over it? In this case, the thought input could be confused with a physical input. The vector sum ΣV_p relative to the thought input can then be integrated into the priority integration matrix, and in this case, we can consider a global thought vector $[V_p]$. Thus, if thought is challenged by force, attention will involuntarily focus on the thought element; in other words, the attentional resting-state is here on the thought, there is an absolute priority integration in which F_p is the main force, implying a psychophysical vector of absolute global perception corresponding to the global vector of thought $[V_p]$. However, the latter does not follow the same competitive logic of priority integration between physical stimuli in the direct environment, which can lead to instability in global perception and especially in voluntary attention. The individual may find it difficult to focus his attention correctly on the stimuli in the environment and thus be able to evolve normally within it; there is a lack of attentional flexibility, he loses his real physical attentional reference point (made up of effective vectors $\overrightarrow{EI}$) for an imaginary reference point (made up of internal vectors). This is an attentional disorientation in which thought may predominantly guide behaviour.

However, in an absolute priority integration over thought, apart from acquisition A_p which is allocated to a thought input, all the other acquisitions (A_2 to A_{40}) will normally be directed to stimuli from the direct environment. It should be noted that a forced integration of thought is not similar to a forced integration of a stimulus from the environment; the integration of a stimulus is specific to a greater dominant intensity over those of other stimuli, during a PI sequence, whereas here the thought element will integrate regardless of its intensity, as long as it is sufficiently intense to reach overt consciousness.

- ***Psychophysical aspects***

By inserting the vector $[V_p]$ into the PI matrix, we obtain for this state of dysfunction, a psychophysical system of integrations identical (in form) to the normal priority integration system, with the difference that the main parameter is a force of thought input (F_p), and that the vectors of global perception of the system will be functions of this force F_p.

Hence the following system of integrations:

$$\begin{cases} [Vp] = (\mathbf{1}+\boldsymbol{\varphi}).\boldsymbol{Fp} + A2.F1 + A3.F2 + A4.F3 + \dots + A39.F39 + \dots + A40.Fn \\ [V1]p = (1+A2).Fp + \boldsymbol{\varphi}.\boldsymbol{F1} + A3.F2 + A4.F3 + \dots + A39.F39 + \dots + A40.Fn \\ [V2]p = (1+A2).Fp + A3.F1 + \boldsymbol{\varphi}.\boldsymbol{F2} + A4.F3 + \dots + A39.F39 + \dots + A40.Fn \\ [V3]p = (1+A2).Fp + A3.F1 + A4.F2 + \boldsymbol{\varphi}.\boldsymbol{F3} + \dots + A39.F39 + \dots + A40.Fn \\ ------------------------------------ \\ [V39]p = (1+A2).Fp + A3.F1 + A4.F2 + A5.F3 + \dots + \boldsymbol{\varphi}.\boldsymbol{F39} + \dots + A40.Fn \end{cases}$$

- In each expression of $[V_i]_p$ we are indeed considering a local vector of thought equal to $(1+A_2).F_P$ because there is the direct impact of F_p (which is internal) in addition to an allocation expressed by the second acquisition A_2.

The attentional effort is:
$\Delta_{i/p} = [V_p] - [V_i]_p = (\varphi - A_2).F_p + \Delta_{\mathbf{i/pmin}}$

Here we have a minimum effort $\Delta_{\mathbf{i/pmin}}$ because it is not an effort of attention on the thought element, but on an element of the environment.
This effort corresponds quantitatively to an immediate measure of the degree of dysfunction of the individual when he voluntarily wants to focus his attention on a stimulus. And we can have positive as well as negative efforts of attention, but a negative effort will not be as obvious, because depending on a large value of the force of the element on which the attention is going to be focused:

- $\Delta_{i/p} > 0$: attention on the physical signal of the environment is very difficult, because the thought being internal to the individual, the individual cannot easily turn away from it by ignoring it as with environmental stimuli. Sustained attention to a stimulus cannot last without thought interfering.

- $\Delta_{i/p} < 0$: attention to the signal may be somewhat easy despite forced thought. Sustained attention can last for a while without the interference of thought being too noticeable.

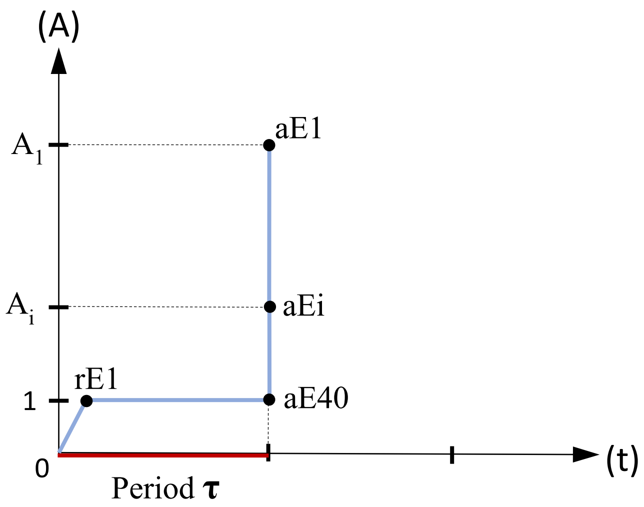
Part 5: Dynamics of perceptual consciousness

Period of the priority integration sequence

Recall that the psychophysical mechanism of priority integration is:

[PI] = 0 → rE1 → ... → rE39 → aE40

Let us note a period **τ** as the duration of a priority integration sequence.
Sketch of the curve of the set of acquisitions at relative effectivenesses (rE) and absolute effectivenesses (aE):



- 0 to rE1: this is the preconscious phase of attention, when there is as yet no psychophysical awareness mechanism, but all the inputs in play are taken into account simultaneously from the start at 0.
- rE1 to aE40: all the relative effectivenesses succeed one another, the acquisitions becoming equal to 1 in turn; from one passage to the next there are psychophysical awarenesses mechanisms for the inputs in play.
- aE1 - aE40: all absolute effectivenesses are reached simultaneously at the last passage, marking the end of the PI period.
- The secondary cognitive processes subsequent to a given priority integration sequence take place after the current period, in parallel with the following sequences.

• *Variation mechanisms of the PI period*

The period **τ** can vary from one sequence to another. This variation may be influenced by the direct environment (external physical and internal somatic factors) or by psychological factors specific to the individual and linked to his state of mind, as well as neurobiological factors linked to the physiology of the brain or certain internal neurochemical processes. However, the impact of the direct environment is greater because of the constant return of the perceptual system to attentional resting-state.

Primarily, this variation is directly linked to higher cognitive processes: it is a system for controlling the PI period, the setpoint of which is modulated by the absolute effectiveness of the first acquisition A_1 or more precisely its establishment time in relation to the efficiency of these processes. If absolute effectiveness is not reached quickly enough, in relation to a low power of the high-level cognitive processes, there will be a reduction in the PI period, so that the growing acquisition $A(n,\varphi)$ reaches its absolute effectiveness very quickly, and thus allows more consistent development of these processes, for more efficient processing of the integrated input; whereas if absolute effectiveness is reached over a sufficiently long period of time, so that the higher cognitive processes are sufficiently consistent, there will be an increase in the PI period to save energy. All the absolute effectivenesses are reached at the last passage, but the one due to attention is the determining factor in the variation of this PI period, thus leading to the durations of establishment of the absolute effectivenesses of all the other acquisitions in the sequence. In other words, the higher cognitive processes due to attention form the guiding principle of this control system. There is integration synchronisation in a PI sequence. The variation in the period involves all the sensory modalities concerned in the corresponding sequence, with attention (A_1) as the driving force. All the inputs (conscious and subliminal) from the different modalities are integrated by the same mechanism, generating a synchronous evolution of the psychophysical loops of the inputs involved. Sustained attention on a particular modality, which can lead to a reduction in the PI period, can not only generate more consistent perception on that modality, but also more consistent pseudo-conscious and subliminal perceptions on all the other modalities in the same sequence, because generating a greater speed of integration of all the vectors involved in the sequence.

Ultimately, this variation of the PI period is a variation in perceptual speed, more precisely the speed of integration of the effective vectors, and therefore of the entire PI process, generated by the psychophysical loops; thus, inducing the speed of stimulus processing. For a given duration of stimulus focus, the more (short) periods there are, the more vectors will be integrated over that duration; and so, with a reduced PI period, the brain could process more stimuli in less time. But when the corresponding higher cognitive processes become substantial enough, this period can be increased to process an identical situation just as efficiently.

If there is too rapid a succession of inputs (due to changes in the types of stimuli or their intensity), the perceptual system may not have enough time to be adequately in absolute effectiveness, so that analysis of the inputs by the higher cognitive processes allows maximum processing efficiency, even if they are powerful enough. A reduction in the PI period is therefore necessary, to enable the perceptual system to reach absolute effectiveness more quickly. Conversely, if there aren't many input changes, absolute effectiveness may be sufficiently achieved for efficient treatment through inherent cognitive processes, and in this case the PI period will be increased so that absolute effectiveness is achieved over just enough time.

In a familiar environment, with a high degree of semantics and contextuality for the individual, there is little need for the PI period to be too short, because the analysis of familiar (or almost familiar) stimuli involves a set of very consistent cognitive processes. In a new environment, on the other hand, it is necessary to wait for the signals to be assimilated to a certain extent. So generally, for comprehension, it's hard to get started, because not only can the period be shortened by focusing on thought, but the higher cognitive processes are not yet very consistent or powerful. Once 'things' are understood, reflection and data analysis will be easier, and the functional dispositions linked to the subject will be more effective.

- ***PI period variation dysfunction***

Period variation is a normal psychophysical process of adaptation by the individual in relation to constant changes in the environment in order to be able to interact with it effectively. The period varies according to the control system with absolute effectiveness setpoint linked to environmental modulations. However, when this absolute effectiveness set point is not correctly followed, a certain psychophysical disorder may occur:

- In the case where the PI period should be reduced, in order to generate absolute effectiveness more quickly, and to allow efficient processing of inputs by the higher cognitive processes: there may be processing difficulties for too rapid changes in the environment if this reduction is not efficient enough.

- In the case where the PI period should be increased, in an environment well controlled by the individual or with a high degree of semanticism, and where the higher cognitive processes would be efficient enough to process the incoming inputs, with the instruction of a low-intensity rhythm of absolute effectivenesses: if the increase is not efficient enough, it produces an intense rhythm of useless absolute effectivenesses, which may give rise to unsuspected action expectations.

Consequently, the variation of the PI period is a necessary mechanism for the individual, for its constant adaptation to the environment and the dynamics of its perceptual consciousness.

Notion of psychophysical unit of temporal measurement

Time is not an observable variable, but it is measurable. Our current convention of 'objective' temporal measurement, using the second as the elementary unit of measurement, originated in astronomical observation: the passage of days and seasons, induced by the rotation of the earth on itself and its revolution around the sun, as well as that of the moon around the earth. A periodicity of events is therefore necessary to measure time. And in order to be as accurate as possible in our scale of measurement, the choice of second must be as invariable as possible (a cesium atomic clock is precise in that the chemical element has an oscillation frequency of 9.192.631.770 hertz, defining the second). This whole arsenal gives us a very regular scale for measuring time, without taking account of the stars, and so we have a certain independence of measurement, unbiased by irregularities in time sampling: this is what we commonly call "Universal Time".

As for the subjective estimate of time, it must undoubtedly come from within, i.e. from physiological factors influencing the brain. An appropriate rhythmic time-measurement event must then be detected. But despite this, this event must be aperiodic, because it must induce a temporal measurement which is not as regular as that of the second.

The variation in the value of the period τ creates a succession of irregular temporal sequences. Since we are talking about time, let's consider this PI period as a temporal ***moment***. The moment can then represent a psychophysical unit of subjective temporal measurement, but it must be understood as an amodal and irregular 'unit', since it only takes into account the pre-semantic vector aspect of perceptual integration, and can change quantitatively from one PI sequence to another, due to the mechanisms of period variation. The PI moment thus provides a temporal measure, but in an imprecise and subjective way. And our continuous temporal perception and estimation is a function of the number and size of these subjective moments.

Over a certain objective duration Δt, if the PI moments are relatively short, the duration felt may seem long relative to Δt. Whereas if these moments are relatively long, the felt duration may appear short relative to Δt. The measurement of a duration Δt is made up of several unequal units and whether this duration is long or short depends on the number and size of the PI moments that make it up:

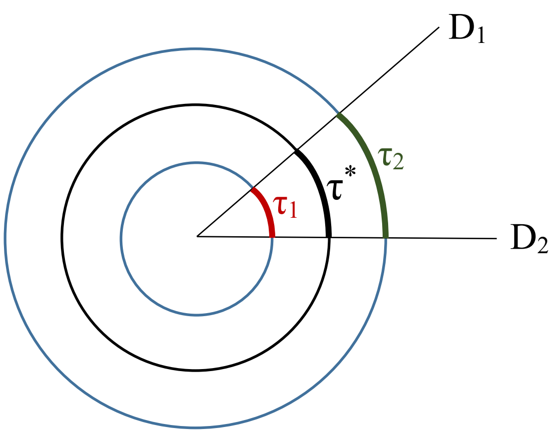
- When the moment is short, the temporal units are more numerous. But although the individual refers to this moment for a temporal measure, he is not phenomenally aware of the speed at which these units succeed one another, but only of the events. This gives rise to a subjective consciousness of perception time that is longer than the duration of events, resulting in temporal overestimation.

- When the moment is long, there are fewer temporal units. This results in a shorter subjective consciousness of perceptual time on events, leading to temporal underestimation.

The PI moment is an aperiodic marker of the course of events. However, over an estimated duration Δt, there cannot be a succession of identical moments (constant variation of the PI period); the subjective temporal measurement is much more complex.

○ The PI moment is a temporal reference point on which the individual bases himself, it induces the feeling of time. Let Δt /τ be the subjective temporal counting ratio corresponding to the estimation of the duration Δt from a (mean) value τ of the PI moment. With a change in moment value from τ to τ`, the estimate of Δt will change. To have the same time estimation duration with the new moment value τ`, we then need to consider a duration Δt`, so that Δt`/τ` = Δt /τ. So Δt` is a psychophysical temporal equivalent of Δt. It should be understood from this, that the subjective experience of the PI moment is always the same: τ is psychologically equivalent to τ`, although numerically different, and it is in this aspect that the PI moment represents a subjective 'unit' of time measurement. It is a kind of constant temporal impulse on the individual. We all and always experience the same Time, but each of us measures it differently and in different situations.

To illustrate this, let's use the following figure:



Let a duration Δt, represented by a complete turn corresponding to the perimeter of a circle, be estimated by the moment τ, corresponding to an arc of a circle bounded by the straight lines D_1 and D_2.

We assume that τ^* is an exact moment of the individual, a psychophysical unit of temporal measurement in phase with the measurement of terrestrial time, i.e. in exact correspondence with our watches. So Δt^* measured by the unit τ^* is a subjective measurement perfectly equal to the conventional objective measurement. Let τ_1 and τ_2 be two PI moments such that $\tau_1 < \tau^* < \tau_2$; then the duration Δt_1 measured by τ_1 and that Δt_2 measured by τ_2 will be such that $\Delta t_1 < \Delta t^* < \Delta t_2$ as is the case in the figure showing the difference in size of the three corresponding circles. However, the three circles are covered by the same number N of arcs relating to the corresponding moment ($\Delta t = N.\tau$); in other words, in a subjective way, corresponding to each individual's own feeling, the three measured durations are in temporal equivalence: we write $\Delta t_1^* = \Delta t^* = \Delta t_2^*$. Although the objective durations Δt are different, the individual will feel the duration Δt_1 as Δt^*, or the duration Δt_2 as Δt^*, depending respectively on the moment τ_1 or the moment τ_2. This is a psychophysical equivalence of temporal measurement that is translated mathematically as:
$N = \Delta t_1 / \tau_1 = \Delta t^*/\tau^* = \Delta t_2 / \tau_2$; where N corresponds indeed to the number of arcs of measurement τ, having to fill the whole circle of measurement Δt.

- This notion of 'psychological sensitivity' of time measurement, in relation to the moment of priority integration, makes it possible to understand the subjective relativity of temporal measurement, such as, for example, a second that can be experienced as very long by an individual, or conversely an hour that can be experienced as very short. When we talk about experience, we are talking about the subjective duration normally felt by the individual, a feeling generated by the rhythm of the succession of their own PI moments. This is simply a matter of changing the psychophysical frame of reference for temporal measurement; in the sense that we all, with a few variations, measure time in the same way, because we subjectively measure time with PI moments within a certain common interval of 'normality'. Beyond and below this range, however, there are significant changes in our subjective estimation of time, ranging from psychological or psychiatric pathologies to extreme cases that are impossible to achieve under normal conditions. For example, for an individual who functions with an extremely short PI moment compared to normal, his psychophysical measure of time would be made up of several very small units, so that one second would be experienced as extremely long; and conversely, for an individual who functions with an extremely large PI moment, his psychophysical measure of time would be made up of much fewer, but larger units, so that one hour would be experienced as extremely short. This is therefore a change of frame of reference, because for another individual in the 'normal' frame of reference, he will only see the experience of the individual in question, in the first case in one second, and in the second case in one hour.

- One subtlety to bear in mind is that a subjective time measurement is not like a clockwork mechanism, dependent on an accumulation of sequences. This is because, in addition to the interweaving of several mechanisms, there are psychological and memory phenomena to take into account. What's more, a clockwork mechanism is extrinsic, in the sense that when we don't pay attention to the clock, it continues to function, whereas in subjective measurement, attention is the functional principle. For example, in the objective measure, the past two years are undoubtedly longer than yesterday's day, due to the accumulation of more seconds; whereas the day that has just passed can be considered quite long, and the two years can be considered to have passed too quickly; this depends on the events considered, which have psychological influences, and undoubtedly some of the most significant at this level.

- Although PI is a process of integrating sensory inputs, it is not the accumulation of events that will ipso facto determine our estimate of duration, but rather the number of PI sequences. For example, boredom or waiting can seem interminable without us having performed many actions, or being overwhelmed by the succession or change of stimuli. Or again, if we remain focused for a long time on any object, the reduction of the PI moment due to intense attentional capture will cause us to overestimate the actual duration of focus on this object. There have been no external qualitative variations in inputs, but an integration of several effective vectors counted, as in the case of a large number of different actions for which we have to cope. The repetition of a constant event (such as counting to 100 at a regular rate) may have an estimated duration of short or long, depending on the individual's psychological disposition. If a stimulus is integrated with a very short PI moment, this generates a greater number of effective vectors in a given timeframe, and thus induces phenomenal downstream consciousness and faster processing of the stimulus by high-level cognitive processes. So, over a very short period of time, the stimulus may appear faster than if it had been integrated with a longer PI moment. However, there may be an inversion of temporal estimation over a longer duration of focus on the stimulus, as a set of short moments will retrospectively cause this duration to be overestimated.

- Our estimation of time may seem paradoxical, depending on our attention on the current events, or retrospectively, on the duration of a completed event. With a short PI moment and a very active focus on stimulus changes (e.g. completing different tasks in a short space of time), we have the impression that time 'passes' quickly, because of the effect of the many changes in stimulus type; we have the impression that these events pass quickly, but at the end of these many tasks, we will overestimate the time. Whereas with a long PI moment and little activity, or a satisfying and non-reflective activity, we have the impression that time 'passes' slowly, but at the end it will seem to have passed more quickly than we thought, because of the retrospective temporal underestimation we make of it.

- When we pay attention to time itself, this leads to more input from the idea of time, due to a division into many small sequences. Focusing on time is akin to interminable waiting because there is no attention on the activities in progress. Focusing on the idea of time is an internal focus, i.e. attention on thought, and a sustained focus on thought often leads us to believe that we have spent much more time on it (we often overestimate the duration of a fleeting daydream). But paradoxically, a very active focus on thought, such as intense reflection or obsessive, preoccupying thought, makes us underestimate time, and we always realise at the end that the time has 'passed' much more quickly than we thought ('we took our time'): in this case the PI moments are generally small, but the strong memory impact of attention on the thought inputs that followed in quick succession gives us the feeling of the brevity of the whole.

- Novelty can lead to a reduction in the PI moment and allow the perceptual system to integrate as many effective vectors as possible in a short space of time, thus ensuring better processing. However, with habituation, the corresponding cognitive processes being sufficiently consistent and powerful to process this novelty (which is no longer novel), the system will instead seek to increase the PI moment (regulation by absolute effectiveness setpoint). In this way, an environment to which we become accustomed seems 'faster'. We can then interpret the evolution of the individual's estimation of time through the ages, because the more experience there is, the more a habit is established. As they grow older, children's PI moment may initially be reduced, as they are learning about life, resulting in a general tendency to overestimate time. But experience and experimentation mean that our high-level cognitive processes become fairly consistent across the board, giving us the ability to process information from our environment with fewer effective vectors, due to a general increase in the PI moment, resulting in a general tendency to underestimate time, and time seems to pass more quickly. Even if there is a change of environment, an overall temporal overestimation in this case would only be transient, especially as the fundamental differences between environments can become superficial with life experience. From childhood through adulthood to old age, the factors influencing the variation in the PI moment evolve, with psychological factors becoming increasingly important, although environmental factors still have a fairly strong impact.

○ ***Dreams*:** the actual duration of the dream is very short, yet we always overestimate this duration. During a dream, we can assume that the PI moment is extremely short. In the dream state, it is mainly internal vectors that are generated, in addition to a few effective external vectors (sound, touch, smell) of very low impact, and internal somatic vectors due to the general physiological state of the individual. There is an automatic physiological mechanism for reducing the PI moment (with no absolute effectiveness setpoint linked to attention to a physical stimulus, as in the awake state); the external environment does not principally modify the PI moment. This extreme reduction in the PI moment leads to massive internal integration of vectors, resulting in an inevitable temporal overestimation, as well as a highly effective reconsolidation of the deep cognitive processes linked to these vectors.

- ***Spacetime measurement***

The notion of perceptual instant transcends the simple subjective temporal measure, extending also to an inherent spatial dimension. This conjunction allows us to evaluate spatial parameters such as heights, distances and lengths, intrinsically linked to our perception of the present moment.

This moment of space, intertwined with the moment of time, is not static and can be subject to significant variations. The influence of the environment on spatial perception is clearly illustrated by scenarios such as an individual moving from an urban environment to a desert; this abrupt change of environment can lead to distortions in the evaluation of distances, where an individual accustomed to city life may underestimate the expanse of desert.

In this way, the subjectivity of spatiotemporal experience is rooted in both the external characteristics of the environment and the cerebral mechanisms intrinsic to the individual.

Power of consciousness acquisition

The period of the PI sequence varies from one situation to another for the individual. This variation determines the speed with which we integrate signals from the direct environment. As the value of this period τ varies constantly, the same stimulus can be processed with different PI period values. This means that the same psychophysical vector V can be acquired more or less quickly as a function of the period τ. From this we can deduce a power (noted P) inversely proportional to this period τ, the mathematical form of which is then $P = V/\tau$. This is a consciousness acquisition power that can only be considered at the end of a priority integration sequence.

In a continuous perception dynamic, the value of the power will vary constantly from one PI sequence to the next, this irregularity being due to parameters such as: the allocation of the individual's AAV to the changes in the input forces (all of which varies the amplitude of the psychophysical vector), and the variation in the value of the period τ.

A distinction can be made between local and global power:

- Local acquisition power relates to a single stimulus (a single input), so the formula amounts to: $P_{i|j} = V_{i|j}/\tau$.
- The global acquisition power of the stimulus concerns all the inputs taken into account during a priority integration sequence, so the formula is: $[P_i] = [V_i]/\tau$.
  $[P_i] = P_{i|1} + \frac{1}{\tau}\sum_{j=1}^{i-1}(A_{j+1}.F_j) + \frac{1}{\tau}\sum_{j=i+1}^{39}(A_j.F_j) + \frac{1}{\tau}\sum_{j=40}^{n}(A_{40}.F_j)$

-• In the attentional resting-state (without voluntary focusing), the strongest local vector is $V_{1|1} = \varphi.F_1$ due to the element of greatest force. But when the individual voluntarily focuses his attention on this same element of greatest force, the local vector of perception also equals $V_{1|1}$. We therefore obtain identical vectors in both cases. However, there may be different PI periods, because attentional capture in the second case can reduce the value of the period, generating greater local power during voluntary focusing than during the attentional resting-state. The reduction in the period τ generates the integration of more effective vectors of the stimulus over a sustained attentional period; the processing of this stimulus by the higher cognitive processes is therefore more consistent and faster. During sustained attention over a given duration, there will be greater number of priority integration sequences, then be reduced.

- ***Internal focus power***

Internal focus can also vary the period of a PI sequence, generating a period-dependent power. We can then define a local internal focus power: $P_p = V_p/\tau$.

But we cannot consider a 'global internal focus power' (just as we do not consider a global internal focus vector), however, we can consider a power sum ΣP_p relative to the thought input: $\Sigma P_p = \Sigma V_p/\tau$.

$$\Sigma P_p = P_P + \frac{1}{\tau}\sum_{i=1}^{38}(A_{i+1}.F_i) + \frac{1}{\tau}\sum_{i=39}^{n}(A_{40}.F_i)$$

Concept of psychophysical energy of consciousness acquisition

Within the framework of the psychophysical dynamics of consciousness, perceptual integration occurs through discrete sequences of priority integration. Each stimulus present in a sequence is represented by a local acquisition vector, defined by the relation V = A.F; this local vector can be considered as an acquisition energy associated with this stimulus during the sequence. It represents the effective impact of this stimulus in the process of becoming conscious at the moment in question. Since several stimuli are present simultaneously during the same sequence, their respective contributions aggregate. The overall acquisition of consciousness associated with this sequence is then defined by the sum of the local vectors [V]. This global vector thus represents the total energy mobilized by the perceptual system during the PI sequence, resulting from the set of interactions between the present stimuli and the degrees of attention attributed to them.

When considering a longer perceptual duration T, comprising several PI sequences, the **total energy of consciousness acquisition** corresponds to the accumulation of global vectors over the course of integration cycles. It can be expressed as the sum of successive global vectors:

$E = \sum [V]$

Or, in the specific case where the perceptual configuration remains approximately stable over a short interval, using the approximate expression:

$E(T) \approx [V].(T/ \tau)$

Thus, within this theoretical framework, the vector of consciousness acquisition represents an 'instantaneous' energy associated with an integration sequence, whereas the acquisition energy over a duration T corresponds to the accumulation of these 'instantaneous' contributions over time. The temporal energy E then corresponds to the accumulation of 'instantaneous' perceptual effects over several priority integration cycles.

-● In an environment characterized by frequent changes, the perceptual system is required to process a greater number of stimuli over a given time period. In this case, the priority integration period τ tends to decrease, which increases the frequency of integration cycles. This decrease in τ generally leads to an increase in acquisition power, and consequently to a higher total acquisition energy over a given time period. Conversely, in a relatively stable environment, where perceptual variations are limited, the perceptual system tends to optimize its energy expenditure by increasing the PI period. The increase in τ then reduces the frequency of integration cycles and generally leads to lower acquisition power. Under these conditions, however, established higher-order cognitive processes still allow for the efficient processing of relevant stimuli.

The perceptual system thus dynamically adjusts the value of the period τ, suggesting the existence of a principle of energy optimization in the process of consciousness acquisition, aimed at maintaining a balance between cognitive efficiency and energy cost.

Fundamental state of consciousness

The global power of consciousness acquisition reflects a state of perceptual consciousness imposed by the mechanism of priority integration. Each PI sequence is an *undergone fundamental state*, parameterised by three variables: the force of the inputs, the AAV associated with them, and the value of the priority integration period. Since the global power [P] is the sum of several local powers, and since each local power is determined by these three parameters, there can be a very large possible number of fundamental states experienced per PI sequence, due to the same inputs.

This fundamental state of perceptual consciousness is a basis directly due to the inputs of the PI sequence, but does not correspond to the feeling of a subjective state of consciousness influenced by several other cerebral processes. We can, however, consider this state to be the foundation of the higher layers of consciousness, in that it differs from all the cognitive implications that it generates for the individual; it is a kind of mathematical state of consciousness, even before the phenomenal impression of the environment. The qualitative character of this fundamental state of consciousness is to be considered globally in a PI sequence, although its constituents are of different modalities.

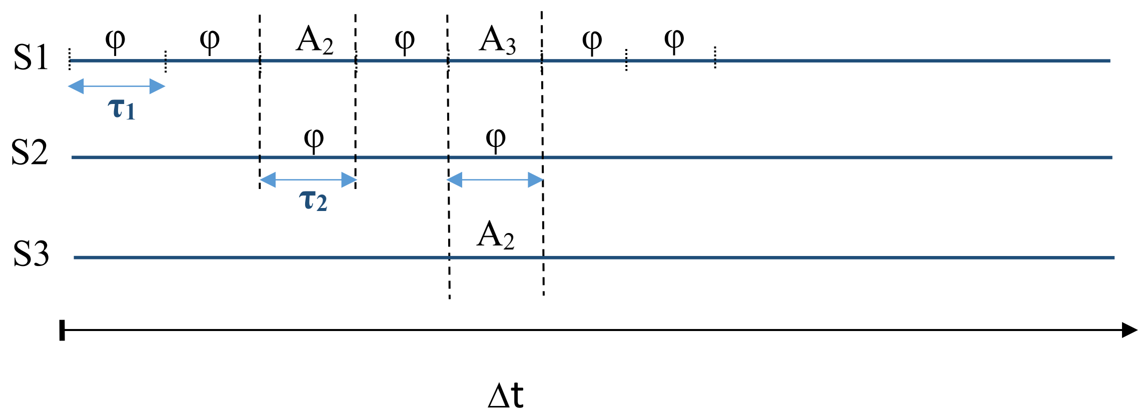
It is a PI sequence which, in the end, will determine a instantaneous state of perceptual consciousness, which could be considered as a micro-state. And following a continuous dynamic of perception, it is the successive assembly of several indistinguishable micro-states, each relating to a PI sequence, which will induce a global state which is imposed on the individual; although this state must not be confused with the individual's feeling of consciousness, it is the basis on which this feeling of consciousness is constructed. Since a PI sequence is pre-semantic and pre-contextual, each microstate is independent, i.e. there is no direct causal link from one microstate to another (although elements of one sequence may indirectly influence the value of the PI period of the following sequence). The psychophysical dynamics of consciousness must therefore be understood as an uninterrupted succession of these micro-states of consciousness, generating a more general state of consciousness, shaped by the memory of the impression of these micro-states in the brain.

- ***Attentional dynamics***

Continuous perceptual dynamic is the product of a connection of different representations, in space and time, structured according to a logic of priority integrations. The dynamics of variation in the parameters of the PI sequence underpin the mechanism for adapting the perceptual system to environmental modulations.

This perceptual dynamic includes a very complex attentional dynamic, having as its principle the instantaneous focus on an input, due to changes (thus to the psychophysical characteristics of perception) that generate a chaotic function of the set of attentional efforts (Δ_i), like the chaos of environmental changes.

In any environment, sustained attention on one stimulus will occur over several priority integration sequences continuously, or this attention may be interfered with briefly by another attentive perception on another stimulus, over one or a few priority integration sequences, without interfering with the attentional perceptual continuity of the first. Over a given duration Δt, there may be a variation in the allocation of acquisitions on the same stimulus; for example, a stimulus may be allocated the acquisition A_1 (φ) over several sequences, then allocated a secondary acquisition A_i (e.g. pseudo-consciously and in this case the PI period is determined by attention on another stimulus), and then reallocated the first acquisition A_1, etc..



It is assumed that sustained attention is globally on stimulus S1, predominantly inducing acquisitions of attention φ. But there are interferences (S2 and S3) which may appear very briefly without breaking the dominant impression of sustained attentional continuity on S1. In this attentional dynamic, the focus on S1 will generate local power. As the period τ is mainly modulated by attention on the corresponding element, there are local power variations, generating global power variations, the whole inducing a succession of varying fundamental micro-states. A general fundamental state of consciousness then encompasses both sustained attention and interference, characterising its aspect as an undergone state.

- There are several psychophysical parameters which together contribute to attentional dynamics, but which respect a certain algorithm of vectorial integration priorities (stimuli and thought): there is the attentional resting-state, the changes and variations in intensity, the absolute effectiveness, the cognitive objectives and the internal focus. All of these parameters have a global and continuous effect on attentional dynamics:

.. The attentional resting-state takes priority, in the sense that it is a passive tendency. Here, absolute PI takes into account the most salient stimuli, and there is a passive global perception during a PI sequence, integrating any number of environmental stimuli in decreasing order of their respective intensities.

.. The changes and variations in intensity attract the individual's attention; including, for example, for vision, changes in position or the appearance of a new signal in the visual field, for hearing a new sound or a change in volume (in tonality and other characteristics of hearing), or for touch a new sensation, etc.

.. The absolute effectiveness setpoint enables the high-level cognitive processes to process the signals in their variations, with efficiency for the most appropriate cognitive adaptation.

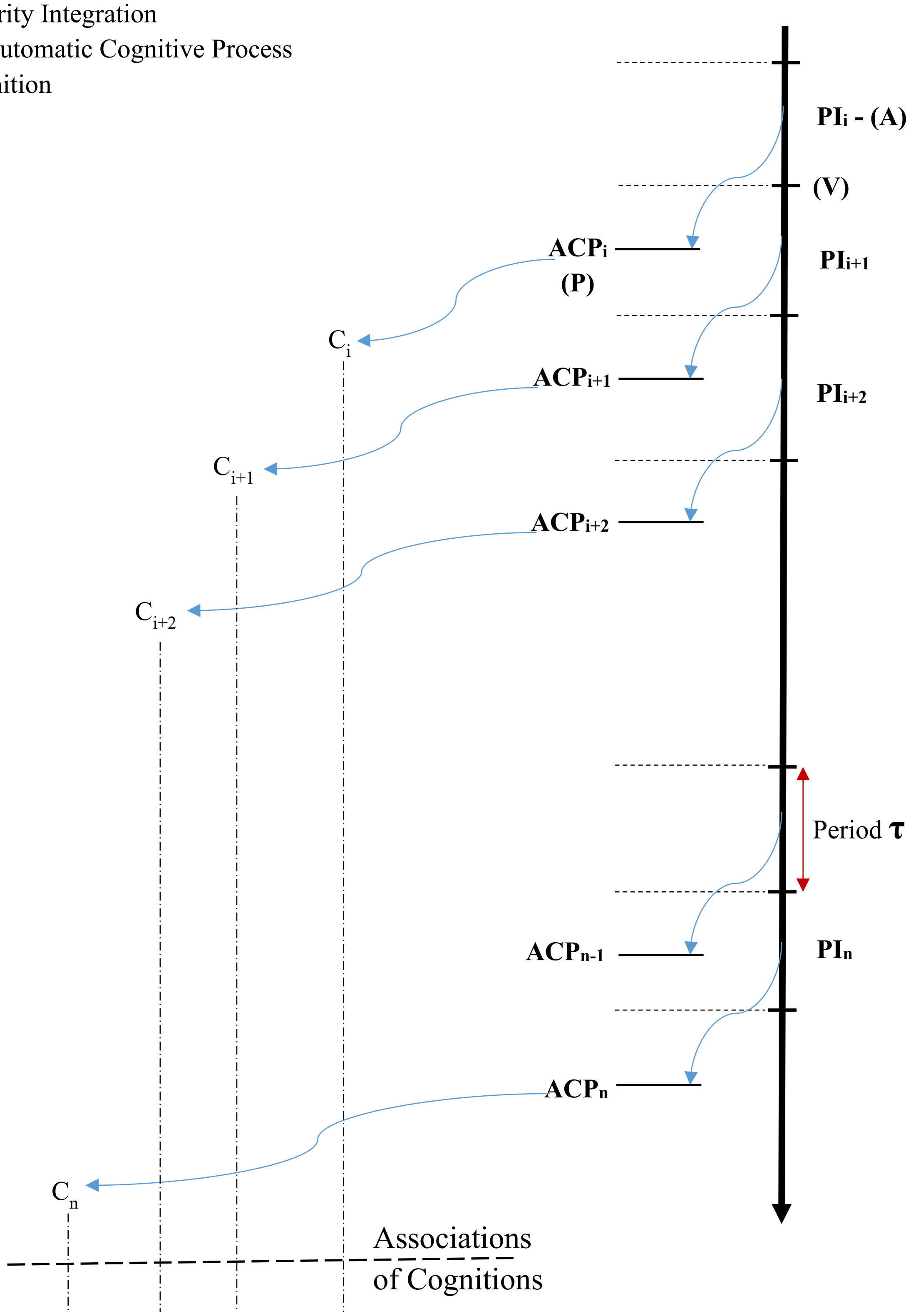
.. The cognitive objectives can be seen from two angles, voluntary and involuntary; voluntary in the sense of conscious access, where the individual has set himself some kind of objective (ranging from low access awareness to high access awareness) in relation to his direct environment; and involuntary in the sense that it is the individual's cognitive past (the complex organisation of his neuronal connections and his memory baggage) which will be a basic unconscious indirect determinant of his immediate interaction with his direct environment.

.. The internal focus takes place almost independently of the direct environment, although there may be an illusion of involuntary forcing of thought, as this depends on the degree of resilience of each individual and the effort of thought Δ_p in close relation to the instantaneous PI sequence generated by signals from the direct environment, especially as these signals are triggers for internal automatic thought processes.

- ***Dynamic perceptual consciousness process diagram***

In PI sequence the acquisitions (A) are allocated to the different inputs, which results in each input acquiring a vector (V) generating a power (P) at the end of the sequence. The latter is the main psychophysical characteristic of the corresponding automatic cognitive processes (ACP), which take place in parallel with the following PI sequences.

PI: Priority Integration
ACP: Automatic Cognitive Process
C: Cognition



- The ACP_i are superior but first-order cognitive processes, triggered automatically by the inputs of the corresponding PI_i sequences (characterised by the senses that convey them, their intensities, the AAV allocated to them and the speed of integration by the value of the period τ). These are the cognitive processes specific to the different cerebral cortices linked to each corresponding sensory modality. A global ACP is made up of visual, auditory and other ACP, depending on the types of input that make up a PI sequence. Thus, visual ACP are specific to the visual cortex inducing visual recognition of the stimulus concerned, auditory ACP are specific to the auditory cortex, and so on.

- ACP are correlated with the fundamental states of consciousness experienced, specific to global power values. As a result, these states change with each ACP_i triggered. The result is the cognition C_i (linked respectively to the ACP_i) which forms the set of higher-order cognitive processes. It is at this level that the semantics and contextualisation of the stimulus take place for the individual, thanks in particular to subtle mechanisms stemming, among other things, from complex memory coding. PI sequences cannot be performed in parallel, however, a cognition C_i can occur at the same time as one or more subsequent PI sequences, and other previous and subsequent cognitions C. It is then Associations of occurring Cognitions that can bring about the overall cohesion of an object or an event in the environment, inducing the conscious coherence determined by human culture.

Conclusion

In this work we have tried to understand the mechanisms of consciousness by means of a certain symbolic representation; the differentiation between sensory modalities is not taken into account. It is from this that we arrive at the establishment of mathematical formulae on the dynamic psychophysical mechanisms of consciousness, which can allow an explanation and a mechanistic description of the basic phenomena linked to it, and leading specifically to the concept of the fundamental state of consciousness.

The combination of the absolute value of psychophysical acquisition and the strength of the stimulus is used to evaluate perception. The simultaneous global perception of several stimuli is due to successive psychophysical awarenesses of them, where only the first, due to attention, is fully conscious. Attention to thought inhibits secondary sensory stimuli. The dysfunction of perceptual consciousness results from the non-application of priority integration rules. The priority integration period induces subjective temporal measurement. Variation in this period gives rise to the two concepts of consciousness acquisition power and energy, contributing to a basic state of consciousness.

The theory thus established is based on concepts developed through mathematical reasoning and a psycho-cognitive approach. It is a theoretical reflection in which the neurosciences can serve as empirical evidence through neural correlates. Ultimately, it is more of an explanatory tool, making it possible to devise a mechanistic basis for understanding human consciousness, and perhaps any other form of consciousness.

Postface

Neurophysiological correlates

Mathematical theories have the property of existing in an autonomous form, but this quality is also their weakness. In the natural sciences, and in biology in particular, the constraints on theory are much more severe than in mathematics. Of course, the theory must be irreproachable in its internal coherence and logic, and therefore satisfy the mathematicians. But it must also adhere strictly to an external reality.

Jean Pierre Changeux (L'homme neuronal)

We will briefly present a few neurobiological correlates, without going into the physiological subtleties of the brain. These correlates help us to better understand the application of the theory's concepts. Overall, we can observe that cortical connectivity, associated with the thalamo-cortico-thalamic loop mechanism, correlates with the priority integration process hypothesis. We attempt to substantiate this point below using a few extracts from articles. It is important to note that these correlations are only suppositions, and we do not claim that they are absolutely exact or exhaustive. It should be emphasised that the functional connectivity of the brain is extremely complex, and the information we present here is a succinct description of the many details that neuroscience can reveal about brain activity.

Global aspect

Our point of view is consistent with a perspective on perceptual consciousness that emphasises initial quantitative similarities between different sensory modalities, followed by specific integration in each sensory cortex, creating distinct qualitative features.

Indeed, at the first stage of sensory perception, stimuli can be coded in a similar way in terms of action potentials and basic neuronal activity. However, it is in the specific sensory cortices that these signals are processed, interpreted and integrated to create distinct perceptual experiences.

Integration in each sensory cortex involves the use of specialised neural circuits, modality-specific processing mechanisms and unique brain connections to give each modality its own quality and subjective experience. This approach reflects the way in which the brain manages the diversity of sensory information to form our conscious perception of the world.

Our description highlights the thalamus (a subcortical neural nucleus in the center of the brain that plays a key role in brain function) as a hub for input signals before they travel to the cerebral cortex, as well as the crucial role of the thalamic reticular nucleus (a part of the thalamus with a direct link to all the other thalamic nuclei) in regulating inhibition and excitation within the thalamo-cortico-thalamic loops. The thalamic reticular nucleus is involved in modulating the activity of thalamic relay cells, which may contribute to regulating the transmission of sensory information to the cerebral cortex.

The idea that the thalamic reticular nucleus could be involved in modulating inhibition according to the intensity of sensory signals seems consistent with sensory processing mechanisms. This modulation may play a role in determining the priority of more salient or stronger sensory signals. The thalamic reticular nucleus is a key component of the brain's sensory processing regulation system, and its precise mechanisms are the subject of ongoing research to better understand how the brain processes and integrates sensory information.

Basic hypotheses

By the concept of priority integration, the theory initially suggests the existence of an area in the brain where sensory inputs converge before travelling to the cortex. From this perspective, the thalamus is seen as a plausible match. At this stage, the theory proposes a quantitative selection of the various inputs before they are integrated into perceptual consciousness. To carry out this process, it is postulated that an element capable of simultaneously managing information from different inputs in a synchronous manner is required. The thalamic reticular nucleus (TRN) is suggested as a candidate that could play a crucial role in this capacity for selective processing of stimuli, by regulating the various appropriate modulations to be made. Secondly, the theory puts forward the idea of a system of looped reintegration of modulated inputs, correlated with the thalamo-cortico-thalamic loops regulated by the TRN. The latter can be seen as a subtle and complex calculator providing an inhibition process leading to selective processing of inputs, in line with the priority integration rules.

Thalamo-cortico-thalamic (TCT) loops

A priority integration sequence is characterised by an extremely rapid execution process, requiring the simultaneous consideration of multiple inputs of different and identical modalities. Each input generates an iterative reintegration loop (psychophysical loop) which amplifies the signal through the psychophysical acquisition process.

" Sensory signals en route to the cortex undergo profound signal transformations in the thalamus." (1)
" Virtually all sensory information enters the neocortex by way of the thalamus. The transfer of sensory signals from periphery to cortex is not simply a one-to-one relay, but a dynamic process involving reciprocal communication between cortex and thalamus. " (2)
" This curious organization suggests that the cortex must have a strong influence on thalamic activities and thereby on its own sensory input." (2)
" Each loop is self-contained and modulated by sensory input. Altogether, the specific, ventrobasal neurons in the thalamus serve to introduce sensory input to a self-sustaining feedback loop that is sustained by the non-specific, contralateral TCT loops relaying information about the current cognitive state of the brain." (3)
" From the dynamics of facilitation, it also follows that the excitation evoked by each impulse would increase with the firing frequency of the corticogeniculate neuron. A feedback system operating in this way can be viewed as a neuronal amplifier regulating the gain in the frequency domain." (4)

Thalamic reticular nucleus in TCT loops

In a psychophysical loop, the dynamic modulation of integrated and reintegrated vectors is the functional mechanism of the priority integration sequence, leading to psychophysical awareness. The priority integration process involves an increasing dynamic division by the psychophysical integration variable (k) on each input in the sequence, inducing degrees of attention allocated to simultaneously integrated stimuli.

" The TRN therefore has a major role in the control of the thalamo-cortical loop and in all the functions of the thalamus. It is also often considered an 'active node' in the thalamus. Thus, the TRN serves as a link through which different cortical areas and thalamic nuclei can interact, by modifying thalamocortical transmission via inhibitory connections formed by reticular neurons on different relay neurons. " (5)
" The TRN modulates thalamocortical transmission through inhibition. Thus, TRN inhibition appears more dynamic than previously recognized, having a graded rather than an all-or-none impact on thalamocortical transmission. " (6)

Collateral connections, at the thalamo-cortical and cortico-thalamic links, can serve to inform the TRN of the amount required for inhibition on the relay cell of the thalamic nucleus; leading to an adequate division of the signal originating from the pilot input and modulated by feedback from the cortex.

" This nucleus receives excitatory drive from both thalamocortical and corticothalamic axon collaterals and, in return, TRN neurons project to thalamic nuclei to inhibit activity in a state-dependent manner." (6)

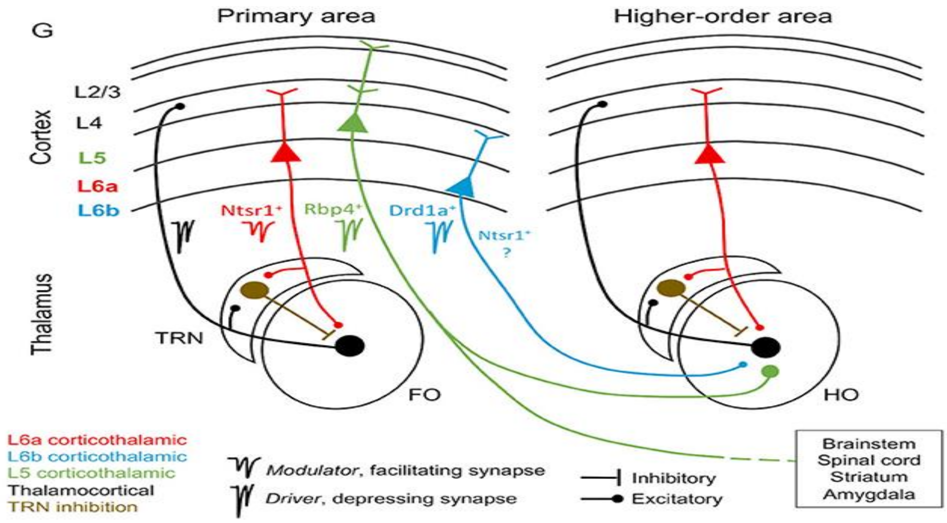
Intra-TRN connections can generate an appropriate distribution of inhibitions between different relay cells; corresponding to the allocation of different integration variables (k) to each loop associated with a distinct input. In addition, electrical synapses between the internal cells of the TRN have the particularity of synchronising groups of neurons, as well as enabling faster transmissions than chemical transmissions.

" The physiological role of intra-TRN connections is still debated at present, but it seems clear that these connections are important for distributing inhibition and controlling the excitability of neighboring neurons and thus modulo-controlling the state of excitability of the TRN more globally. " (5)
" Another feature of the TRN is that it has electrical synapses that are known to generate synchronous activity within a network of neurons." (5)

Thought inputs

The process of psychophysical awareness could be the main focus of the TRN calculations on the Thalamus nuclei during TCT loops. Access to thought is the result of a mechanism similar to that of perceiving a stimulus, there is also a process of 'psychophysical' awareness of an element of thought. However, the two mechanisms operate independently. The priority integration mechanism is made up of externally generated inputs, i.e. stimuli from the direct environment, but the generation of internal thought inputs is much more complex. Thus, the element of thought is no longer exactly like a modulated vector, because it returns as an input, into the psychophysical system of integration, like an external effective vector.

Psychophysical awareness, being the principle of the priority integration mechanism, may have as its substrate the TCT loop involving the L4 and L6a layers in the neocortex. Thus, for a First Order (FO) nucleus, the input coming from the peripheral sensory organs will trigger this loop until the psychophysical awareness of the stimulus. On the other hand, the thought element will concern the High Order (HO) nucleus, where the afferent comes from the L5 and L6b layers, as a driver (thought input). And for there to be an awareness of this thought element, the same circuit via the TCT loop as in the FO core will act. So, then the process of psychophysical awareness is the loop involving L4 and L6a, whether for stimuli or for an element of thought.



This image is from the article (7), Figure 1. (Image under CC BY 4.0 license).

"L5 CT pathways can drive the postsynaptic neurons and initiate a transthalamic corticocortical circuit by which cortical areas communicate with each other. For this reason, L5 CT pathways place the thalamus at the heart of information transfer through the cortical hierarchy." *(7)*

"The giant terminals carried by L5 axons can drive their own messages to thalamic neurons via non-reciprocal projections, and then feedforward these messages to a different, hierarchically higher cortical area, forming a transthalamic corticocortical circuit." *(7)*

"Very recent studies suggest that some CT neurons emanating from deep layer 6 (L6b) have distinct anatomical and physiological properties from neurons emanating from both L6a and L5 and could represent a third CT circuit." *(7)*

"In this context, L5 CT projection provides driver input to thalamic neurons, similarly to the ascending, feedforward inputs whereas L6 cortical feedback modulates thalamic relay neurons." *(7)*

"They suggest that thalamic synchronization by the TRN can be a mechanism to recruit neuronal populations for sensory representations." *(7)*

Psychophysical dysfunction and pathophysiology

A psychophysical dysfunction is characterised by a disorganisation of the priority integration sequence, involving a disruption of the psychophysical acquisition parameters. This may result in inadequate synchronisation between input impulses and cortical feedback, within the TCT loops, and also a defect in the TRN generating an incoherent calculation of the inhibitions to be performed.

" These synchronous activities are at the origin of the pathophysiological oscillatory rhythms in the thalamocortical loop. Because of this characteristic, the TRN is therefore particularly important in the genesis of these oscillations." (5)
" Our work may also provide insight as to how abnormalities in this circuit could lead to certain pathophysiological conditions." (2)

Subjective temporal measurement

Each priority integration sequence is the rhythm of an integration of different inputs, resulting in a temporal dynamic of perception. So, unlike our objective convention of measuring time, where the second must remain as constant as possible, here the unit of measurement, which is the moment (or period of the sequence) of priority integration, can vary quantitatively from one sequence to another, resulting in an inaccurate temporal estimate compared with an objective measurement. In particular, the theory suggests that this moment is the irregular 'ticking' of an 'internal clock', which is not a localised neuronal complex, or even a specific fixed network due to a neuronal interconnection of different cerebral areas, but rather a distributed system resulting from the whole dynamic game of multisensory integration, involving the whole brain; therefore not a kind of internal clock per se arising from a process whose sole purpose is temporal counting, but an indirect process of subjective temporal measurement arising from this periodic dynamic of multimodal integration.

" Temporal representations do not rely on a specific set of neurons and any network is potentially an 'automatic processor' for temporal processing. " (8)
" In either case, temporal information is nevertheless automatically and implicitly represented at early stages of sensory analysis. " (8)
" Time perception is intrinsically contained in the temporal dynamics of the brain and naturally derives from the very temporal structuring of neural processes. " (8)
" A pre-semantic temporal network is used to process content, i.e. the content itself does not create temporal integration. " (9)

" This observation points to a common underlying temporal machinery, i.e. that processed information is temporally segmented into successive units of approximatively 30-40 ms; these elementary processing units should not be understood as 'physical constants', but as operating ranges with some variability. "(9)
" Rhythmic brain activity is nonstationary and displays on-and-off oscillatory bursts, which would serve irregular ticks to the hypothetical clock. " (10)
" The α '(alpha brainwave 7-14 Hz)' clock hypothesis presented here is not about counting time per se; rather, it is about counting events spontaneously and endogenously instantiated as α burst. It is important that we do not interpret such counting mechanism as an explicit and overt counting process, but as an automatic parsing and time-stamping mechanism of internal events." (10)

Fundamental state of consciousness

The priority integration process is a basic unconscious perceptual activity, which takes place, periodically, in an extremely short space of time, thus allowing the very rapid passage from one set of simultaneous inputs to another set of inputs; in other words, allowing consciousness to pass very rapidly from one representation to another. The succession of priority integration sequences creates a dynamic of perceptual consciousness. Each priority integration sequence is characteristic of a fundamental microstate of consciousness, which is a basic pre-semantic and pre-contextual state, inducing a subjective consciousness of the present, the feeling of a temporal instant.

" As there are numerous thalamo-cortico-thalamic loops throughout the cortex, this process takes place simultaneously across many different regions of the brain during conscious perception. It is this ability to support large-scale synchronised events between remote brain regions that may provide for coherent perception. " (3)
" These different observations indicate the existence of a universal process of temporal integration underlying the mental machinery. This process is believed to be basic for maintenance and change of perceptual identity. Owing to the omnipresence of this kind of temporal segmentation, it is suggested to use this process for a pragmatic definition of the states of being conscious or the 'subjective presence'. "(9)
" This oscillatory process, which is apparently implemented in the corticothalamic pathway, provides a formal framework for complexity reduction, and is argued to be the neuronal basis for the creation of primordial events or the building blocks of conscious activity. Within this theoretical framework, the elementary integration units

are also responsible for an effortless access of sensory information. Automatically (without necessity of any reasoning), temporal integration units of some tens of milliseconds bind spatially and temporally distributed information together. It is important to stress again that these integration units in their duration are not defined by what is processed as information, but that they are prior to any content to be processed. " (9)

" Observations made within different experimental situations provide evidence of the operative importance of a temporal integration mechanism, which may even be important for an understanding of what one usually refers to as 'consciousness'. Although these observations have been made in different contexts, a common underlying principle can be extracted in spite of some observational diversities. " (9)

" Lehmann and coworkers proposed to consider the temporal evolution of the topography of the scalp electric field, because it represents the sum of all momentarily active sources in the brain, irrespective of their frequency. This way, one obtains a global measure of momentary brain activity with high temporal resolution. The topography does not change randomly and continuously over time, but remains stable for ~80–120 ms; these periods of quasi-stability are termed "EEG microstates". Cognition and perception have been found to vary as a direct function of the prestimulus microstate, and microstates can characterize qualitative aspects of spontaneous thoughts. This result indicates that they index different types of mental processes. Alterations of microstates have been reported in schizophrenia, depression, and Alzheimer's disease and as a function of drug administration and hypnosis. " (11)

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About the author:

The author, Mouhamad Diagne, is an independent researcher in the field of consciousness sciences. Fascinated by perceptual mechanisms and psychophysical representations, he has been developing for several years an approach combining symbolic formalism and mathematical-cognitive reflections.

He does not claim to belong to any specific academic school, but places his research within a rigorous intuitive modeling approach, based on empirical observations, mathematical reasoning and a symbolic interpretation of perceptual awareness.

This theory has therefore been developed independently. It is not based on classical experimental validation, but on an alternative theoretical model, proposed as a possible tool for understanding the elementary mechanisms of consciousness.

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