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Triplicity and codes of culture: Impact of informational regularities

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Three addresses always inspire confidence, even in tradesmen.
Oscar Wild

Informational approach in cultural studies now puts forth, so investigations of a specific kind occur rather prospective, which establish *links* between different branches within this approach. The present paper is devoted to one of such links, connecting properties of human *memory* with the phenomenon of the *threshold* of perception. (Of course, both these fields are considered in the framework of the informational approach.) As a result, we shall come to some *general regularities* of human behavior, culture, etc., the most interesting of these regularities being related to the structure of works of art.

Advantageous triplicity: many-sided arguments

Earlier (see, e.g., Golitsyn & Petrov, 1995) a problem was considered which occurs rather important for psychology, anthropology, art studies, etc. The problem concerns *optimal encoding* of the information to be kept (stored) by any device of memory (let this memory belong to the human being, or let it be a computer system, and so forth). The heart of the matter is the task of the most *economic 'non-motivated classification'* of a set of objects (Sukhotin, 1983).

Let us suppose a set of $\boldsymbol{B}$ objects described by a set of parameters (features, scales), each parameter consisting of several gradations. We shall use these parameters simply to *classify* objects – exactly such is the aim of non-motivated classification (in contrast to 'motivated classifications' which are applied to distinguish between useful objects and non-useful ones). If we have $\boldsymbol{\beta_\alpha}$ parameters with $\boldsymbol{\alpha}$ gradations ('words'), then the number of possible classes

$$\boldsymbol{N = \prod_{\alpha} \alpha^{\beta}_{\alpha}},$$

symbol $\boldsymbol{\Pi}$ designating the operation of multiplying. [For instance, when classifying persons, we use one parameter with two gradations (gender: men or women) and two parameters with three gradations (age: young, middles, or old; education: non-educated, middle school, high school). Hence, the number of possible combinations $\boldsymbol{N} = 2^1 \times 3^2 = 18$ classes.] How many gradations ('words') should we use to realize such a description? – Evidently, the number of such 'words'

$$\boldsymbol{W = \sum_{\alpha} \alpha\, \beta_\alpha}.$$

[In the previous example we should use $\boldsymbol{W} = 2\times1 + 3\times2 = 8$ gradations, or 'words.']

The informational optimization in such case means nothing else than the *economy of the total number of 'words'* (gradations used) under quite evident condition – sufficient description of the given number of objects:

$$N \geq B,$$

$$W \rightarrow min.$$

The solution of this system of equations comes to rather non-trivial result: only those parameters should be used which possess

$$\alpha = 2 \text{ or } \alpha = 3,$$

i.e., only *binary or ternary parameters*. [In fact, the most economic way to describe the above 18 objects, is to use a set of one two-gradation parameters and two three-gradation parameters – we need only 8 'words,' whereas all other descriptions occur to be not so economic; e.g., when using 5 two-gradation parameters ($N = 2^5 = 32 > 18$) we need $2 \times 5 = 10$ 'words,' and if to use 3 three-gradation parameters ($N = 3^3 = 27 > 18$) we need $3 \times 3 = 9$ 'words.'] So *ternary codes* occur belonging to rather 'advantageous' elements of different systems of the information keeping.

There exist some other theoretical arguments in favor of ternary codes – as rather advantageous for the information processing. Out of these arguments, we shall dwell upon the situation which takes place while visual *perception of color properties* of objects, in the conditions of *changing illumination* – see, e.g., Golitsyn & Petrov, 2005. [In general, quite the same is the situation in any continuum, when it is necessary to organize the perception of a certain property of objects, in the conditions of the background which may be changing.]

Here let us suppose that we have spectral photodetectors possessing *bell-like distribution of the response*: the peak value of the signal falls on a definite wavelength, whereas both at shorter wavelengths and longer ones, the signal is decreasing. [Such bell-like characteristic of the response is natural for any continuum to be perceived.] How to determine the color of the object perceived, e.g., whether the given apple is red or green? The only way to do this, is to compare the signal reflected from the object – with the signal from the background (e.g., from the sun or from another source of light). However, such a comparison comes to the result which occurs ambiguous: each photodetector with bell-like characteristic possesses two 'decreasing branches' of its spectral dependence, hence a perceiver is not capable of deciding which of these branches he/she is dealing with. Moreover, it is impossible to determine the color of the object, even when resorting to the help of two types of detectors, possessing differing peak wavelengths.

Only if to use *three types* of photodetectors, it occurs possible to determine the color of the object perceived. [For instance, the situation becomes clear, when the signal from the first type of detectors is low, from the second type is large, and from the third type is negligible.] Namely because of the fact that three-detector scheme of spectral information processing is the most advantageous, exactly such variant was used by the Nature in the process of the biological evolution, and this version was realized in the case of some higher mammals, including human beings. [It is interesting to note that quite analogous scheme of the information processing

dealing with color, was realized in the eye of a frog: though it has only one type of spectral detectors, there exist three types of adipose cells, played by light filters; so practically three types of spectral detectors are formed.] To use more types of detectors, is superfluous; it is enough to have three types, and extra types would require extra resource expense. (Nevertheless, four-type version was tried in the process of the evolution, but afterwards this version was rejected.)

So we have rather weighty many-sided arguments in favor of triplicity, which occurs to be advantageous in various procedures of the information processing. For our further consideration, only two consequences of this advantageous triplicity are important:

– the volume of the first step of the *human memory*, or the so-called "Magic Number Seven, Plus or Minus Two," that was discovered by Miller (see Golitsyn & Petrov, 1995); this psychological phenomenon corresponds to a 3-cell operative memory device, each cell having 3 states (gradations); so a total amount of $2^3 = 8$ different combination of states is possible;

– the relative *threshold of perception*, which is approximately constant for different ranges of stimuli values and is equal for different kinds of stimuli (i.e., different continua: intensity of light, sound, electric current, etc.); for different stimuli this threshold is near 12-15%; this phenomenon can be explained (Golitsyn & Petrov, 2007) on the basis of the above-mentioned 8-state memory device: when all 8 states are occupied (by the information which keeps the intensity of the given stimulus), to empty one of them means to lessen the stimulus intensity to 1/8 of its magnitude, i.e., to 12.5%, and when only 7 states are occupied, to add one state means to increase the stimulus to 1/7 of its magnitude, i.e., to 14.3% (exactly the phenomenon of relative threshold will become the basis for our further consideration).

In general, everywhere we can expect the domination of ternary structures. Now let us try to consider this *'spatial' phenomenon* (i.e., the phenomenon which reveals itself in a certain space: either real space or parametrical one) proceeding from quite *temporal considerations* (i.e., motives dealing with the time).

Search for non-accidental events and the threshold of perception

When speaking of temporal aspect, the main topic seems to become important for our further consideration: *perception of the sequence* of certain events which is accompanied by definite *emotions* of the recipient. Realizing such a consideration, we shall deal not with the events themselves, – but with their *probabilities*. [In other words, we shall disengage ourselves from concrete nature of the events perceived.] Exactly these probabilities are to be considered as the sources of perceiver's *emotions* (and not the events themselves).

Here the heart of the matter is the search for *regularities* within the 'world of events': possible statistical *links* which can be *established* between certain events perceived, the links found being capable of generating *positive emotions*. We suppose that a perceiver is a '*hedonic*

subject' (at least when he/she perceives this sequence of the events in question), with an inclination to *search for links*. Situations when such search takes place, can be rather various. Let us consider one of the most *typical situations* which can be outlined as follows.

There exists a certain *'lattice' of events* which are more or less *regular*. Example of such regular lattice is the sequence of dawns: they come every day, with a strict (or almost strict) 24-hour periodicity, so dawns are the 'knots' of this lattice. In turn, on the basis of this 'primary' periodicity, another kind of cycles (i.e., another lattice, which may be named 'secondary') may occur, for instance, Sundays: they form 7-day periodicity. Such regularly coming events forming the *secondary lattice*, may be rather important both for the *personality* or the entire *system of culture*: sometimes various customs appear, as well as some prejudices. For instance, during the First World War such a strange regularity was observed by soldiers: when they got a light from somebody's cigarette, each third act may occur fatal. (This regularity seems to be mystical, but its explanation is simple: while the first flash, a sniper can find his aim, while the second flash he corrects his back-sight, and at the third one he makes a shot, which occurs mortal!)

How to establish such *secondary periodicity* built on the basis of the primary one, i.e., the periodicity working within the lattice of primary events? And first of all, *how many secondary events* should be at the disposal of the subject (observer of these events), in order he/she could conclude about their periodicity? Two secondary events? or maybe three? or four? – This task can be solved very easy.

Really, let the probability to meet the given secondary event in a certain position within the lattice (in the given 'knot') be p_k; for instance, if $p_k = .2$, it means that *statistically* this secondary event can be met in one knot out of every five ones. For instance, a person plays roulette every day; one day he/she wins a large sum, then after four 'waste' days, he again wins a large sum, and so on. Hence, sooner or later he may conclude that these happy secondary events are subdued to cyclic regularity, with the period of 5 knots (the events are not accidental).

But when exactly (i.e., at which occurrence) the person can conclude about the periodicity mentioned? when he/she starts to *perceive the regularity*? – This question seems to be very important, because exactly the regularities observed introduce certain *ordering* in human's life, and they provide his/her due behavior while interactions with the surroundings. Moreover, in the case of *works of art*, exactly *search for regularities* is one of the main perceptual procedures; it is accompanied with *positive emotion* when the regularity is found.

Evidently, the regularity is felt at that moment when the person sees: the *probability of accidental occurrence* of the secondary event *at this knot* is negligible, i.e., it is less than the relative *threshold of perception*. Hence, the formula for the probability to meet the event in question, n times in 'due' positions (relating to strict secondary periodicity), equals

$$p_n = (p_k)^n \leq T,$$

T being the above mentioned relative threshold of perception.

Now we should take into account that the threshold $T \approx .15$ (see the consideration in the previous Section), and the value n should be *integer*. So, for the most widespread situation when $p_k = .5$, we have

$$n \geq 3.$$

Really, if $n = 2$ (i.e., the event was met only two times in due positions), then $p_2 = .25$. So, the *probability of accidental occurrence* of such situation is *not small* (it exceeds the above relative threshold) and is perceived as 'usual,' more or less habitual. But when $n = 3$, the probability $p_3 = .125$, and this event should be felt as not accidental, i.e., evidencing in favor of the *regularity* to be found: periodical behavior of secondary events. Of course, further, when $n = 4$ (and $p_4 = .0625$) or more, this regularity is confirmed, becoming more and more reliable, and even boring, hence generating *negative emotions*. However, namely the moment of the *first discovery* of the regularity is the most striking for the person, as well as for resulting *positive emotion*. Moreover, exactly this positive emotion determines the perception of the entire sequence of the events.

Naturally, this moment (of resulting positive emotion) depends on the value p_k: in order the second appearance of secondary event would be surely treated as the indicator of a periodical regularity, – the value of p_k should be less than $\sqrt{T} \approx .39$. And of course, secondary events possessing lesser values of p_k , being repeated two times in due positions (knots of the primary lattice), are perceived as 'accidentally quite unbelievable'! Example of such low-probable event was presented earlier: a large sum won by a person playing roulette. [Apropos, when dealing with the perception of devices of art, the value $\sqrt{T} \approx .39$ responds to the 'threshold of realizing,' i.e., reflexive understanding of deliberate, intentional usage of any device – see Petrov, 2002.]

Nevertheless, the most widespread situation responds to the above mentioned version: $p_k = .5$, i.e., the case of a binary choice – the given secondary event should either be met at this place, or not, with equal probabilities of both versions. Such version is typical at least when the first repetition of the secondary event, i.e., when $n = 2$, because of unknown a-priori probability of the event considered. (The subject proceeds – though implicitly – from the concept of maximal likelihood.) And at the second repetition ($n = 3$) the sequence of events becomes perceived as evidently quite regular, because $p_3 = .125 < T$. So again we see *ternary structures* as those ones which are 'dictated' by *expectations* inherent in the perceptual procedures.

[Meanwhile, it seems reasonable to consider the situation of not so strict, but 'soft' periodicity: when the secondary event falls not exactly on 'due' knot, but maybe on the previous knot or next one, i.e., on one out of these three knots. In such a case, the probability to meet occasionally the given secondary event at its due place or near it, equals for the second 'soft'

meeting $p_2 = 1 - (1 - p_k)^3$ which for $p_k =$ .5 responds to $p_2 =$ .875, and for the third 'soft' meeting $p_3 = .875^2 =$ .766, and so on. Only if p_k is rather small, such 'soft' periodicity can be felt more or less soon, e.g., if $p_k =$ .2, then $p_2 =$ .488, $p_3 =$ .238, and only $p_4 =$ .116 < T. In other words, in such soft case the periodicity is felt only after the fourth meeting with the secondary event observed. Probably such are situations in the sphere of folk tokens dealing with weather, which were investigated by Kharuto, 2007.]

From partial psychological and cultural regularities – to general ones

The above considerations permit not only to establish links between different branches of the informational approach (or between different models derived in the framework of this approach), but also to come to some rather non-trivial conclusions concerning various psychological and cultural regularities, even having gnosiological sounding. However, before turning to these regularities, it is desirable to outline the *borderlines* of the phenomenon in question: the triplicity – should it be met everywhere, in all spheres and all situations? – Of course, no!

When considering the roots of this phenomenon, we proceeded from considerations which possessed quite definite *specificity*: in all cases we did not deal with the "content" of objects (or events) perceived, their *own features*. Really, the non-motivated classification is destined not to single out objects which are useful for the subject, – but simply to keep information about various objects. As well, the three-detector procedure of determining spectral characteristics of objects, does not concern any "usefulness" of objects perceived. Finally, the lattice of "secondary" events was considered without any connection with the nature of these events. If we wished to take into account the "content" (own properties) of objects or events discussed, the *triplicity* may occur *not advantageous*. For instance, positive emotion which accompanies the detecting of the regularity (periodicity), is treated as being caused exactly by the regularity detected, – but not by those events which occur periodical. (So if these events themselves are sad, accompanying emotion would be negative, and the phenomenon of triplicity should not take place.) That is why in some concrete situations the behavior of the subject (as well as the behavior of any informational system, including the system of culture) may occur not subdued to the principle of triplicity.

But much more interesting are situations giving *maximal chances* to this principle. Appropriate conditions take place primarily in the sphere of art, where the disinterested perception plays important role. For some adjacent fields, more or less similar situations are typical. Maybe, due to the principle of triplicity, we find *three main colors* in each *national school of painting* (Gribkov & Petrov, 1996), *three main personages* in fairy tales, various prosaic works (e.g., three musketeers), etc., *ternary structures* in *religion* (trinity), *philosophy*,

and other fields. For instance, in *anthropology* we see *three "main colors"* in primitive cultures: red, white, and black, – being symbols of three main substances of human beings (blood, sperm, and faeces, respectively). Many other examples can be used to corroborate the principle of triplicity in various kinds of art.

In future, it seems prospective to consider the phenomenon of *musical melody* in the light of this principle. In fact, the listener is constantly waiting for a certain regularity to be discovered, i.e., the repetition of definite features of sounds. (The number of such features can be also not more than three, because of the limited 8-state volume of the above mentioned first step of our memory, let these features be, for instance, the tonality, the loudness, and so on.) For oeuvres of the so-called 'light music' (e.g., jazz) dealing with orderings which function at short distances (involving the first step of the memory or the second one, responding to time intervals up to 3 seconds), the composer may use only one kind of repetition to be expected. But for oeuvres of 'serious' music (e.g., symphonies) which deal with larger spaces (up to several hours, responding to the functioning of the third step of memory – having non-limited volume), the total number of the features used can be much more, as far as they may work at different levels: one set of features at the level of instant sounding, another set linking certain perceptual 'blocks,' other sets providing repetition on more and more high levels (scales).

As well, prospective may be the application of the approach derived, to some problems of *poetical structures*. Here rather important role should be played by the *three-mechanism* model of the *language processes*. (Appropriate model contains such mechanisms as associative, grammatical, and correlational, and all the wealth of our mental world is provided due to the interactions of these three mechanisms – see, e.g., Golitsyn & Petrov, 1995, 2007.) The phenomenon of *rhyme*, together with its possible (in future) borders, can be considered in the light of 'pleasure' received due to certain phoneme repetition (which is governed by the triplicity). The very existence of the *free verse*, together with the criteria of its distinction from 'classical' verse, can be also considered proceeding from the principle of the triplicity (and maybe also three-parametric structure).

But the realm of the phenomenon considered is not limited by the sphere of arts: due to its universal (non-specific) character, it is capable of penetrating many other spheres, especially those ones which are based on *unconscious processes*. For instance, the *three-dimensional semantic space* which is inherent in most perceptual processes (namely such space is usually fixed in experiments using semantic differential techniques, starting from Osgood et al., 1957), is one of the consequences of the principle of the triplicity. Moreover, the *three-dimensionality of* our *perceptual space* (in which we live) can be hopefully ascribed to the same principle: we wish to receive positive emotions when perceiving various objects and/or phenomena, hence, it is

desirable to plunge them in the three-dimensional space. At least, both ‘spatial’ and ‘temporal’ motives are constantly “pushing” us to such worldview.

So maybe in general, we are living in a very *strange world*, determined mainly by our desire to receive positive emotions, under conditions of quite definite properties of our memory and appropriate informational processes? And going further, maybe exactly here we can find the key to the famous ‘*antropial principle*,’ i.e., the riddle of the very existence of the world in which we live?

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We hope further efforts to establish links between different branches of the informational approach can result not only in growing self-consistency of this approach, but also in various findings both of concrete character and rather general one.

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