Handbook of Elementary Informational Philosophy and Informational Formalism

$\mathfrak{z}$-language for the Design of Conscious Informational Systems

Anton P. Železnikar

Ljubljana, December 25, 2005

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December 20, 2005

$\mathfrak{z}$-language
for the Design of
Informational
Conscious Systems

$$\left(\underline{\alpha_i};\overline{\alpha_i}\right)\in\Phi\left\lceil\left(\underline{\mathfrak{z}};\overline{\mathfrak{z}}\right)\right\rceil$$

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Contents

List of Figures

List of Tables

1 Basic Informational Constituents

1.1 Philosophy

Informational formalization concerns the abstraction and the symbolism of real and mind objects in the sense of their expression. That, being met in the real informational world, is informational entities being informationally connected in some way and, then, structured meaningly (e.g., grammatically, reasonably) into larger and more complex informational entities (e.g., formulas, schemes, formula systems). This means that informational operands (entities) are connected by operators (links) and structured by parenthesis pairs.

Ethnic languages are being, in fact, informationally formalized languages where sentences represent formulas, paragraphs represent formula systems, etc. Even more abstract are artificial languages as mathematics, chemistry, programming languages, etc. All of them are symbolic, structured and, some of them, well-structured, that is meaningly unambiguous (exact).

Everything informational concerns the conscious, and the informational is the substabce of the conscious — the informationally conscious. The space of informational-conscious phenomenalism is called informational conscious space or, precisely, informational conscious system, ICS.

1.2 Informational Comma and Informational Semicolon

The *comma*, $,$, separates informational operands in an operand sequence, as shown in Subsect. 1.3. Another application occurs within floor parenthesis pair, that is, $\lfloor\ \rfloor$, in a formula φ specification, for instance,

$$\varphi\left\lfloor \alpha_1, \alpha_2, \ldots, \alpha_{n_\varphi} \right\rfloor$$

The operand sequence within floor parentheses represent an ordered sequence. If $\varphi_{\rightarrow}\left\lfloor \alpha_1, \alpha_2, \ldots, \alpha_{n_\varphi} \right\rfloor$, this denotation represents the formula

$$\alpha_1 \models \alpha_2 \models \ldots \models \alpha_{n_\varphi}$$

As an abbreviating application, the comma occurs in a formula case

$$\alpha \models \beta, \gamma \quad \text{meaning the formula sequence} \quad \alpha \models \beta; \alpha \models \gamma$$

The *semicolon*, $;$, has two functions: it separates formulas in a formula sequence or formula system and, simultaneously, suggests the parallel informing of formulas, that is,

$$\varphi_i; \varphi_j \quad \text{means} \quad \varphi_i \Vdash\!\!= \varphi_j$$

where $\Vdash\!\!=$ is the operator of parallel informing of operands. Besides, formulas φ_i and φ_j can be informationally connected through common operands.

1.3 Informational Operands

Operands correspond to the representatives of real (sensed) and mind (experienced) informational entities.

1.3.1 Simple Informational Operands

A general operand marker, a kind of *operand joker*, is introduced and symbolized by α. Lower case letters of the Greek alphabet are used as operands, that is,

$$\alpha, \beta, \gamma, \ldots, \zeta$$

Informational formulas as operands are denoted by φ, subformulas by ψ, etc. A special symbol representing informational nothing or the not-yet-known something is $\square$.

Unambigously recognizable upper case Greek letters

$$\Gamma, \Delta, \Theta, \ldots, \Psi, \Omega$$

denote various methodological and complex informational operands, for instance, informational gestalt, Γ, general decomposition of operands, Δ, formula system, Φ, etc.

In the domain of mind and informational entities, lower case Fraktur letters are used as operand representatives, that is,

$$\mathfrak{a}, \mathfrak{b}, \mathfrak{c}, \ldots, \mathfrak{z}$$

By symbol $\mathfrak{z}$ consciousness as informational entity is denoted.

For the so-called informing operands, that is, entities symbolizing explicitly the entities being declared as informings of operand entities, the upper case Fraktur letters are used as representatives, that is,

$$\mathfrak{A}, \mathfrak{B}, \mathfrak{C}, \ldots, \mathfrak{Y}$$

Some exceptions in this sequence denote methodological informational operands, for instance, $\mathfrak{M}$ for metaphysicalistic decomposition, $\mathfrak{P}$ for parenthesizing, $\mathfrak{R}$ for operand rotation, etc. Letter $\mathfrak{Z}$ is reserved for the name of formalistic informational language, also in the sense being a formal language for conscious system phenomenalism. Thus, the abbreviation for the general formal informational language is $\mathfrak{Z}$-language.

Lower and upper case Latin letters can be used for informational operands denotations. However, these letters are reserved for usual numerical subscripts and measure operands and only exceptionally used in informational expressions as informational operands. For numerical subscripts lower case Latin letters are used,

$$a, b, c, \ldots, z$$

For characteristic measure operands the blackboard alphabet

$$\mathbb{A}, \mathbb{B}, \mathbb{C}, \ldots, \mathbb{Z}$$

is used. For instance, correspondingly subscribed and superscribed letter $\mathbb{N}$ is used for measures concerning informational formulas schemes, etc.

1.3.2 Underlined and Overlined Informational Operands

An *underlined* informational operand, denoted by $\underline{\alpha}$, named α, is called informon. In general, informon represents a complex meaning of the name α and is a conscious entity within a conscious system. That means, if name α is called to consciousness, informon $\underline{\boldsymbol{\alpha}}$ begins to emerge as the meaning of the name.

An *overlined* informational operand, denoted by $\overline{\boldsymbol{\alpha}}$, named α, is called entropon. In general, entropon represents a complex chaotic stuff of the name α and is a subconscious entity within a conscious system. That means, if name α is called to consciousness, entropon $\overline{\boldsymbol{\alpha}}$ is used for conscious meaning emerging of the name. In this view, informon and entropon build a mutually impacting and dependent pair of informational entities.

1.3.3 Subscribed Informational Operands

Operand representatives can be subscribed by meaningful subscript using recognizable abstract symbols and/or words and phrases of an ethnic language. English is taken to represent a universal subscript language for operands. Thus, for the lower case Greek letter alphabet,

$$\alpha_{\text{subscript}}, \beta_{\text{subscript}}, \gamma_{\text{subscript}}, \ldots, \zeta_{\text{subscript}}$$

Usually, in an informational formula φ, the operands are subscribed by integers, for instance,

$$\alpha_1, \alpha_2, \ldots, \alpha_{n_\varphi}$$

In formula systems, for formula φ_i, then operands are subscribed by double integer subscripts,

$$\alpha_1, \alpha_{i2}, \ldots, \alpha_{in_{\varphi_i}}$$

etc.

By meaningful subscipts, operands become self-explanatory. For instance, operand symbol μ_{meaning} denotes meaning (certainly, of something). Symbols $\varphi_{\rightarrow}$, $\varphi_{\leftarrow}$, $\varphi_{\rightleftarrows}$ and $\varphi_{\rightarrow,\leftarrow}$ denote logically transparent serial formula, reverse serial formula, biserial formula and split biserial formula, respectively.

The upper case Greek letters are usually subscribed solely by informational operator symbols, for instance, gestalts $\Gamma_{\rightarrow}$, $\Gamma_{\leftarrow}$, $\Gamma_{\rightleftarrows}$ and $\Gamma_{\rightarrow,\leftarrow}$ correspond to formulas $\varphi_{\rightarrow}$, $\varphi_{\leftarrow}$, $\varphi_{\rightleftarrows}$ and $\varphi_{\rightarrow,\leftarrow}$, respectively. Similarly, the so-called non-circular formula systems are denoted by $\Phi_{\rightarrow}$, $\Phi_{\leftarrow}$, $\Phi_{\rightleftarrows}$ and $\Phi_{\rightarrow,\leftarrow}$ representing serial, reverse serial, biserial and split biserial formula systems.

The subscribed lower case Fraktur letters are used to denote operands representing entities belonging to sensual and conscious experience. Subscripts are taken as words and phrases from ethnic languages and, in this way, operands become self-explanatory. The letter of the operand is usually the first lover case letter of the subscript. For instance, operand named $\mathfrak{c}_{\text{consciousness}}$ represents the meaning belonging to the word consciousness in English, operand $\mathfrak{b}_{\text{Bewusstsein}}$ has the similar meaning in German. Characteristic subscribed and superscribed operands belong to the so-called metaphysicalistic decomposition, written as

$$\alpha,\ \mathfrak{I}_\alpha,\ \mathfrak{i}_\alpha,\ \mathfrak{C}_\alpha,\ \mathfrak{c}_\alpha,\ \mathfrak{E}_\alpha,\ \mathfrak{e}_\alpha$$

where α is the object of metaphysicalistic decomposition, $\mathfrak{I}_\alpha$ is α's (intentional) informing, $\mathfrak{i}_\alpha$ is α's intention, $\mathfrak{C}_\alpha$ is α's (counterintentional) counterinforming, $\mathfrak{c}_\alpha$ is α's counterintention, $\mathfrak{E}_\alpha$ is α's (intentional) informational embedding, and $\mathfrak{e}_\alpha$ is α's (intentional) informational embedment.

The upper case Fraktur letters, denoting informings of informational operands, are subscribed by participles of verbs and verb phrases of ethnic languages and are, in this way, self-explanatory. It is important to introduce the informing of an informational operand (entity) into the context of informational philosophy, explicating to some extent the role of operands (inner) informing. This faculty becomes meaningful especially within a conscious environment where strong elementary circular support in the informational emerging of operand and its informing is transparently presented.

Informational operands can be subscribed by distinguished operator symbols to point out the operational character of the operands. Such characteristic subscripts are, for instance, $\rightarrow, \leftarrow, \rightleftarrows$, etc. For details see Subsubsect. 1.4.5.

1.3.4 Superscribed Informational Operands

Informational operands can be meaningfully superscribed using transparent abstract symbols defining the character of the denotator. Usually, the cyclic $\circlearrowleft$ and the parallel $\|$ symbol, or both, are put into the superscript. Examples can be seen in the following Subsubsection and elsewhere in the Handbook.

1.3.5 Simultaneously Subscribed and Superscribed Informational Operands

Subscripts and superscripts of an operand can be reasonably combined to delover a compact and transparent presentation. For instance, for the upper cas Greek letters we have

$\Delta_{\rightarrow}^{\circlearrowleft}$	General circular serial decomposition.
$\Gamma_{\leftarrow}^{\circlearrowleft\|}$	General circular parallel serial gestalt.
$\Phi_{\rightleftarrows}^{\circlearrowleft\|}$	Circular biserial formula system.
$\Phi_{\triangleright}^{\triangledown}$	General expression of formula system depending on superscript $\triangledown$ and subscript $\triangleright$, where for superscipt $\triangledown \in \{\lambda, \circlearrowleft, \|, \circlearrowleft\|\}$ and for subscript $\triangleright \in \{\rightarrow, \leftarrow, \rightleftarrows, (\rightarrow, \leftarrow)\}$. λ denotes an empty place.

1.4 Informational Operators

Operators correspond to informational links between operands. Informational operands are *binary* links, that is, concern their left and their right operand. The definition of operator joker is something not known so far in mathematics. Mathematical formulas does not use a universal operator which can be replaced with another operator, that is, particularized according to application in a later use of the formula. Partucularization of the joker means its subscription depending on operands enclosing the binary operator.

1.4.1 Informational Operator Joker

The general informational operator, a kind of *operator joker*, is introduced and symbolized by

$$\models$$

Operator $\models$ can be seen as a replacement for any other, general or subscribed operator. It has also the function to generalize certain types of informational formulas, enabling their very formal treatment in context of different measures characterizing them.

1.4.2 Basic Informational Operators of Joker Type

In principle, operators of the informational concern the verb *to inform*. This verb seems to possess a universal meaning, especially the one concerning consciousness. Verbs in ethnic languages represent the happening going on in the sense of informing. Thus, verbs can be postponed to characteristic general informational operators, changing to some extent the meaning of linguistic expression. For instance, subscribing the general joker $\models$ by the verb *to be*, that is, $\models_{\mathsf{be}}$, this operator is read as *inform(s) to be*, or in concrete cases of speech as *am*, *is*, and *are*. Because of the importance of the verb *to be* in language and phgilosophy, a separate autonomous joker will be defined for such a purpose (see Subsubsect. 1.4.3).

Within theoretical research and practical use, the following informational operators of joker type are

$$\models, \not\models, \Dashv, \not\Dashv, \VDash, \not\VDash, \DashV, \not\DashV, \vdash, \not\vdash, \dashv, \not\dashv, \Vdash, \not\Vdash, \dashV, \not\dashV$$

with the following meanings:

- $\models$ general operator joker,
- $\not\models$ general operator joker, non-informing,
- $\Dashv$ reverse general operator joker,
- $\not\Dashv$ general operator joker, reverse, non-informing
- $\VDash$ parallel operator joker,

- $\|\!\not\models$ parallel operator joker, non-informing,
- $=\!\!\|$ reverse parallel operator joker,
- $\not=\!\!\|$ reverse parallel operator joker, non-informing,
- $\vdash$ circular general operator joker,
- $\nvdash$ circular general operator joker, non-informing,
- $\dashv$ circular reverse general operator joker,
- $\not\dashv$ circular reverse general operator joker, non-informing,
- $\|\!\vdash$ circular parallel general operator joker,
- $\|\!\nvdash$ circular parallel general operator joker of non-informing,
- $\dashv\!\|$ circular parallel reverse general operator joker,
- $\not\dashv\!\|$ circular parallel reverse general operator joker, non-informing.

The corresponding meanings of the use of these operators are the following:

$\alpha \models \beta$	α informs β,
$\alpha \not\models \beta$	α does not inform β,
$(\alpha =\!\!\mid \beta) \rightleftharpoons (\beta \models \alpha)$	α is being informed by β,
$(\alpha \not=\!\!\mid \beta) \rightleftharpoons (\beta \not\models \alpha)$	α is not being informed by β,
$(\alpha \|\!\models \beta) \rightleftharpoons (\alpha; \beta)$	α informs in parallel with β (formula system),
$\alpha \|\!\not\models \beta$	α does not inform in parallel with β,
$(\alpha =\!\!\| \beta) \rightleftharpoons (\beta; \alpha)$	α is being informed reversely in parallel with β (formula system),
$\alpha \not=\!\!\| \beta$	α is not being informed reversely in parallel with β,
$(\alpha \vdash \beta) \rightleftharpoons (\alpha \models \beta; \beta \models \alpha)$	α informs circularly β,
$\alpha \nvdash \beta$	α does not inform circularly β,

$(\alpha \dashv \beta) \rightleftharpoons (\beta \models \alpha; \alpha \models \beta)$	α is being informed circularly by β,
$\alpha \not\dashv \beta$	α is not being informed circularly by β,
$(\alpha \Vdash \beta) \rightleftharpoons (\alpha; \beta; \alpha \models \beta; \beta \models \alpha)$	α informs in parallel and circularly with β,
$\alpha \nVdash \beta$	α does not inform in parallel and circularly with β,
$(\alpha \dashV \beta) \rightleftharpoons (\beta; \alpha; \beta \models \alpha; \alpha \models \beta)$	α is being informed reversely, in parallel and circularly with β,
$\alpha \not\dashV \beta$	α is not being informed reversely, in parallel and circularly with β.

A different, to some extent more precise determination of general operator jokers is possible, particularly in cases of concrete informational situations.

1.4.3 Operator Jokers of Informational Being

As mentioned in Subsubsect. 1.4.2, operator jokers of informational being concern the verb *to be.* Those operators enable a direct expression of language situations concerning the verb *to be.*

Within ethnic language research and practical use, the following operator jokers of Informational Being can be introduced:

$$\Mapsto, \not\Mapsto, \Mapsfrom, \not\Mapsfrom, \Vert\!\Mapsto, \Vert\!\not\Mapsto, \Mapsfrom\!\Vert, \not\Mapsfrom\!\Vert, \mapsto, \not\mapsto, \mapsfrom, \not\mapsfrom, \Vert\!\mapsto, \Vert\!\not\mapsto, \mapsfrom\!\Vert, \not\mapsfrom\!\Vert$$

Individual operator meanings are as follows:

$\Mapsto$	operator joker of Being
$\not\Mapsto$	operator joker of Being, non-informing,
$\Mapsfrom$	operator joker of Being, reverse
$\not\Mapsfrom$	operator joker of Being, reverse, non-informing,
$\Vert\!\Mapsto$	operator joker of Being, parallel
$\Vert\!\not\Mapsto$	operator joker of Being, parallel, non-informing,

$\mathrel{\Leftarrow\!\!\Vert}$	operator joker of Being, reverse, parallel
$\mathrel{\not\Leftarrow\!\!\Vert}$	operator joker of Being, reverse, parallel, non-informing,
$\mapsto$	operator joker of Being, circular
$\not\mapsto$	operator joker of Being, circular, non-informing,
$\mathrel{\leftarrow\!\!\mid}$	operator joker of Being, circular, reverse
$\mathrel{\not\leftarrow\!\!\mid}$	operator joker of Being, circular, reverse, non-informing,
$\mathrel{\Vert\!\!\mapsto}$	operator joker of Being, circular, parallel
$\mathrel{\Vert\!\!\not\mapsto}$	operator joker of Being, circular, parallel, non-informing,
$\mathrel{\leftarrow\!\!\Vert}$	operator joker of Being, circular, reverse, parallel
$\mathrel{\not\leftarrow\!\!\Vert}$	operator joker of Being, circular, reverse, parallel, non-informing.

1.4.4 Subscribed Informational Operators

Subscribed informational operators denote the narrower meaning of the operands, where subscripts are taken from ethnic languages as well as from the domain of operator symbols. The widest class of subscribed operators belong to the class

$\models_{\text{subscript}},\ \text{subscript} \in \{\text{verbal forms in ethnic language, operators}\}$

Thus, $\models_{\text{verb}}$ and $\models_{\Diamond}$, where

$$\Diamond \in \left\{ \begin{array}{l} \models, \not\models, \mathrel{=\!\mid}, \mathrel{\not=\!\mid}, \mathrel{\Vert\!=}, \mathrel{\Vert\!\not=}, \mathrel{=\!\Vert}, \mathrel{\not=\!\Vert}, \vdash, \nvdash, \dashv, \not\dashv, \Vdash, \nVdash, \mathrel{\dashv\!\Vert}, \mathrel{\not\dashv\!\Vert}, \\ \mathrel{\mid\!\!\Rightarrow}, \mathrel{\mid\!\!\not\Rightarrow}, \mathrel{\Leftarrow\!\!\mid}, \mathrel{\not\Leftarrow\!\!\mid}, \mathrel{\Vert\!\!\Rightarrow}, \mathrel{\Vert\!\!\not\Rightarrow}, \mathrel{\Leftarrow\!\!\Vert}, \mathrel{\not\Leftarrow\!\!\Vert}, \mapsto, \not\mapsto, \mathrel{\leftarrow\!\!\mid}, \mathrel{\not\leftarrow\!\!\mid}, \mathrel{\Vert\!\!\mapsto}, \\ \mathrel{\Vert\!\!\not\mapsto}, \mathrel{\leftarrow\!\!\Vert}, \mathrel{\not\leftarrow\!\!\Vert}, \rightleftharpoons, \equiv, \end{array} \right\}$$

Usual mathematical and logical autonomous operators are

$$=, -.\times, /, =, \cup, \cap, \Longrightarrow,$$

applied in numerical measures and logical connections of entities.

1.4.5 Informational Operator-like Subscripts and Superscripts

Operator-like subscripts are used for determination of the character belonging to an operand or operator. A series of such operator-like subscripts and superscripts are, for instance,

$$\rightarrow, \leftarrow, \rightleftarrows, \triangleright, (\rightarrow, \leftarrow), \circlearrowleft, \|, \models$$

1.4.6 Some Autonomous Informational Operators

Operator of conscious, subconscious, and superconscious generation concerning the meaning of a named entity in ICS, is denoted by

$$\longrightarrow$$

Such an operator in the context $\alpha \longrightarrow \beta$ reads α generates β in an ICS.

$\longrightarrow, \Diamond, \rightleftharpoons, \equiv, \models\!\!\rightarrow, \Longrightarrow, =,$

1.4.7 Informational Operator Composition

Operator composition enables the expression of linguistically composed verbal phrases. Operator composition is basic and recursively composite. It can be extended to arbitrary depth retaining strictly the binary nature of operatots within the composition. In this view one distinguish simple ans composite operator composition.

Simple operator composition (operator $\circ$) in an informational transition $\alpha \models \beta$ is defined by (definitional operator $\rightleftharpoons_{\mathsf{def}}$)

$$(\alpha \models \beta) \rightleftharpoons_{\mathsf{def}} (\alpha \models_{\alpha} \circ \models_{\beta} \beta)$$

In this expression, operator composition is $\models_{\alpha} \circ \models_{\beta}$.

1.5 Informational Enclosing Pairs

Different enclosing pairs (parentheses, ceil parentheses, floor parenthesis, angle parentheses, braces, brackets, etc.) can be defined.

1.5.1 Informational Parentheses Pairs

Parenthesis pairs, '(', ')', *enclose* entities, that is, composite operands, irrespective of their formal length, belonging together. They enable the exact expression composite entities due to the binary nature of operators, in the form of well-structured subformulas and formulas, being meaningly (expressionally, syntactically, grammatically) unambiguous.

For instance, in a lengthy informational formula,

$$\alpha_1 \models \Big(\alpha_2 \models \Big(\alpha_3 \models \Big(\boxed{\alpha_4 \models (\alpha_5 \models (\alpha_6 \models (\alpha_7 \models (\alpha_8 \models \alpha_9))))}\Big)\Big)\Big)$$

the framed composite subformula

$$\alpha_4 \models (\alpha_5 \models (\alpha_6 \models (\alpha_7 \models (\alpha_8 \models \alpha_9))))$$

is made to be distinguished as operand entity within the well-formed formula.

Another application of parenthesis pair functions as an enclosure of system formulas declared as formula system Φ. The formula system is denoted by

$$(\varphi_1; \varphi_2; \ldots; \varphi_{n_\Phi}) \quad \text{or} \quad \begin{pmatrix} \varphi_1; \\ \varphi_2; \\ \vdots \\ \varphi_{n_\Phi} \end{pmatrix}$$

1.5.2 Informational Floor Parenthesis Pairs

Informational floor parenthesis pairs, '$\lfloor$', '$\rfloor$', are used for the implicit expression of informational formulas constituted as well-formed strucures of operands, binary operators, and parenthesis pairs. Informational operands, $\alpha_1, \alpha_2, \ldots, \alpha_{n_\varphi}$ are enclosed in floor parenthesis pair as, for instance, in formula $\varphi\lfloor\alpha_1, \alpha_2, \ldots, \alpha_{n_\varphi}\rfloor$. Such a denoration guaranties the unique expansion of the formula in its scheme.

1.5.3 Informational Ceil Parenthesis Pairs

Informational ceil parenthesis pairs, '$\lceil$', '$\rceil$', are used for the expression of the so-called informational Being-of. In an ethnic language, phrases something$_1$ of something$_2$, something$_2$ something$_1$, and
something$_2$'s something$_1$ are used quite often. A more general term for this king of expressions is called *informational concerning*. That is, meaningly, something$_1$ concerns something$_2$. Formaly, this situation is denoted by

$$\mathfrak{s}_{\text{something}_1}\left\lceil \mathfrak{s}_{\text{something}_2}\right\rceil$$

In general, $\alpha\lceil\beta\rceil$ reads *operand* α *informationally concerns operand* β.. For a transparent presentation in informational graphs, expression $\alpha\lceil\beta\rceil$ can be replaced by transition $\alpha \models_\Psi \beta$ to make possible an explicit access to operand β. Thus,

$$\alpha\lceil\beta\rceil \rightleftharpoons (\alpha \models_\Psi \beta)$$

1.5.4 Informational Angle Parenthesis Pairs

Informational angle parenthesis pairs, $\langle\,\rangle$, are used only in the mathematical sense for making complexly parenthesized expressions transparent. For instance, ...

,

1.5.5 Informational Bracket Pairs

Informational bracket parenthesis pairs, $[\,]$, are used only in the mathematical sense for making complexly parenthesized expressions transparent. For instance, ...

1.5.6 Informational Brace Pairs

So far, informational brace parenthesis pairs, $\{\,\}$, are use only in the mathematical sense for denoting mathematical sets. For instance,

$\nabla \in \{\lambda, \circlearrowleft\}$. A formula system can be treated as an informational set, for instance, in the framework of informational topological space [6].

2 Basic Informational Axioms

Can in the realm of the informational senseful basic axioms be observed? Here, obsevation has a similar meaning as in physics. Physics as an empirical science does not proceed from axioms it relies on observation as a conscious experience and experimental activity. In an informational environment, the informed observes how things and beings inform and how the informer observes the impact of his/her own informing. In this context informing and being informed seem to be two relevant general principles.

In physics, particles impact the surrounding space-time where other particles exist and are being impacted by other particles in the space-time. In this way, particles behave as the informer and the informed (impacted) entities. In the informational, informational entities inform other informational entities and are being informed by other informational entities. This seems to be a reasonable principle serving as the background in searching a formal way to the so-called informational axiomatism.

According to the general belief in science and, especially, in mathematics, a theory is called *axiomatic*, if at the top of the theory basic concepts and basic assumptions can be placed and, then, the further meaning of the theory by means of definitions and proofs can be derived[1]. The informational theory is whether a theory of physics either of mathematics; its supervenience stands between the physical supervenience and the phenomenal supervenience.

The axiomatism of the informational can be reasonably applied as general principles in physics and mathematics. Informational axioms concern the sorts of causalism and logic known in sciences. They are a product of pure consciousness, mastering the observation of real and mental worlds.

[1]In [3], p. 1, the following dictum is read: *Der Terminus „axiomatisch" wird teils in weiterem, teils in engerem Sinne gebraucht. In der weitesten Bedeutung des Wortes nennen wir die Entwicklung einer Theorie axiomatisch, wenn die Grundbegriffe und Grundvoraussetzungen als solche an die Spitze gestellt werden, und aus ihnen der weitere Inhalt der Theorie mit Hilfe Definitionen und Beweisen logisch abgeleitet wird. In diesem Sinne ist die Geometrie von* EUCLID*, die Mechanik von* NEWTON*, die Thermodynamik von* CLAUSIUS *axiomatisch begründet worden.*

2.1 Basic Informational Transition

To step into formal details of a primitive axiomatization, some additional steps have to be concretized. As, already, the notion of informational operand and informational operator is known, the most primitive informational formula, called basic informational transition, can be put together.

Basic informational transition consists of a general informational operator $\models$ (operator joker), being of binary nature, of its left-side operand α and its right-side operand β. Basic informational transition is an informational formula, that is,

$$\alpha \models \beta$$

This formula reads: Operand α informs operand β, and operand β is being informed by operand α. Thus, the informational impacting of informer (informant) α reaches the informationally impacted observer β. The term informational observer is appropriate for observing means a β-perceived nature of the object α. Thus, the β-image of the received object α is in any case β-specific.

Axiom 1 ***Basic informational transition.*** *Expressed in $\mathfrak{Z}$-language, the following meaning is delivered:*

$$(\alpha \models \beta) \rightleftharpoons (\alpha \models_\alpha \circ \models_\beta \beta)$$

Operator composition $\models_\alpha \circ \models_\beta$ means that the resulting operator between operands α and β is substabtially impacted by the left operand α and the right operand β. In this way, the left part of operator composition, $\models_\alpha$, determines the informing ability of operand α and the right part of operator composition, $\models_\beta$, determines the informedness ability of operand β. In this way, operator $\models_\beta$ filters the informing of operand α, determines the perceiving capability of β. □

In language, the choice of a verb or a veral phrase between two substantives or substantival phreses depends on the use of language, giving meaning to the substantival parts and the verbal part. In this sense, as a rule of meaning in the language, an arbitrary verbal phrase must fit the left and the right substantival phrase. In sound expression, specific rules can be followed in building up the so-called basic soun transitions. In image, the problem can be raised, how to distinguish image basic operands and operators connecting them.

2.2 Informational Externalism

Informational externalism takes a general view that entities (things, objects, particles, waves, processes, properties, minds, etc.) inform and, by their informing, impact a wide informational environment, the realm of existing informational spaces. This yields the following verbal and formal axiom.

Axiom 2 ***Informational externalism.*** *Informational entity, denoted by α, informs the possible informational realm, denoted by ▯, formally,*

$$\alpha \models ▯$$

Wide informational realm ▯ is being informed by α. □

The formal difference between basic transition $\alpha \models \beta$ and externalism axiom $\alpha \models$ ▯ is the following: in basic transition, operand α informs a concrete operand β while, in case of the externalism axiom, operand α informs a non-concrete, not-yet determined, informational realm ▯. In this situation, the informer α performs as something broadcasting its existence in the surrounding informational realm.

2.3 Informational Internalism

Informational internalism represents a general view that entities (things, objects, particles, waves, processes, properties, minds, etc.) are being informed and, by informing of other entities, being impacted by a wide informational environment, by the realm of existing informational spaces. This yields the following verbal and formal axiom.

Axiom 3 ***Informational internalism.*** *Informational entity, denoted by α, is being informed by possible informational realm, denoted by ▯, formally,*

$$▯ \models \alpha$$

Wide informational realm ▯ *informs* α. $\square$

The formal difference between basic transition $\alpha \models \beta$ and internalism axiom ▯ $\models \alpha$ is the following: in basic transition, operand β is being informeed by a concrete operand α while, in case of the internalism axiom, operand α is being informed by a non-concrete, not-yet determined, informational realm ▯. In this situation, the informed α performs as something being broadcasted by the existence of the surrounding informational realm.

2.4 Informational Metaphysicalism

Informational metaphysicalism represents a general view that entities constitute in themselves (things, objects, particles, waves, processes, properties, minds, etc.) and, in this sense, inform to themselves and are being informed by themselves, possessing the realm of the inner informational spaces. This yields the following verbal and formal axiom.

Axiom 4 ***Informational metaphysicalism.*** *Informational entity, denoted by* α, *informs to itself and is being informed by itself. Formally,*

$$\alpha \models \alpha$$

Entity α*'s informational realm informs itself and is informed by itself.* $\square$

The formal difference between basic transition $\alpha \models \beta$ and metaphysicalism axiom $\alpha \models \alpha$ is the following: in basic transition, operand β is being informed by operand α while, in case of the methaphysicalism axiom, operand α informs and is being informed by itself. In this situation, operand α performs as something broadcasting as α and receiving as α.

The term *metaphysicalism* formalizes the term *metaphysical*, representing the entirety of a being's information, especially conscius experience, where informational circularity plays a substantial role in conscious emerging of information and performs as a kind of dynamic memory during conscious informing. In this respect, metaphysicalism $\alpha \models \alpha$ is the necessary initial step proceeding into details of a serial operand-operator development of the primitive metaphysicalism loop. The feedback arrow in informational graph of metaphysicalism in Table 1 is the path being developed through the informing of the entity α in a serial and also a parallel way, building an array of different serial formulas interpreting formally the meaning of the initial operand α. By metaphysicalistic decomposition, presented later in this handbook, e complex meaning of operand α comes in existence.

2.5 Informational Phenomenalism

Informational phenomenalism unites the concepts of informational externalism, internalism, and metaphysicalism. As such, operand α communicates with its exteriority according to the state of inner situation of its informational development. In this sense, the informational phenomenalism axiom can be formulated.

Axiom 5 ***Informational phenomenalism.*** *Informational entity, denoted by α, informs phenomenally, that is externalistically, internalistically and metaphysicalistically, according to the axiom, expressed as,*

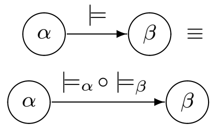
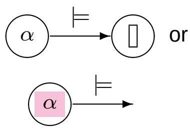
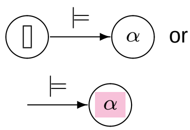
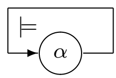
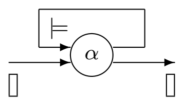
$$\begin{pmatrix} \alpha \models \square; \\ \square \models \alpha; \\ \alpha \models \alpha \end{pmatrix}$$

Entity α's informational realm informs and is being informed by environment $\square$, and informs itself and is informed by itself. $\square$

The parenthesis pair (,) encloses the three basic transitions into the phenomenalism formula system.

2.6 Overview of Basic Axioms

Table 1 shows an overview of the five basic informational axioms by axiom names, formal expressions, and informational graphs. These axioms determine on the formal level toigether with the use of parenthesis pairs the design of informationalm formulas and informational formukla systems. One can say that these axcioms are syntax rules

Basic axioms	Formal expressions	Informational graphs
Informational transition: α **informs** β *means* α **informs** α-dependent **and** β-dependent β	$(\alpha \models \beta) \rightleftharpoons (\alpha \models_{\alpha} \circ \models_{\beta} \beta)$	
Informational externalism: α **informs** $\square$ or α **informs**	$\alpha \models \square$ or $\alpha \models$	
Informational internalism: α **is being informed by** $\square$ or α **is being informed**	$\square \models \alpha$ or $\models \alpha$	
Informational metaphysicalism: α **informs** α *and* α **is being informed by** α	$\alpha \models \alpha$	
Informational phenomenalism: α informs *and* α is being informed *and* α informs α *and* α is being informed by α	$\begin{pmatrix} \alpha \models \square; \\ \square \models \alpha; \\ \alpha \models \alpha \end{pmatrix}$	

Legend:

and — formula parallelism semicolon, ‘;’
informs — operator joker, $\models$, on the informer side
is being informed by — operator joker, $\models$, on the side of the informed
and — operator composition operator, ‘$\circ$’

means — meaning operator, $\rightleftharpoons$
$\equiv$ — graph equivalence operator
or — formula and graph alternatives
$\square$ — informational joker for informational indefiniteness, informational emptyness, non-yet determinateness

Table 1: Verbal, formal, and graphical presentation of basic informational axioms.

for construction of informationally well-formed formulas and formula systems.

On the other side, the axioms carry important semantic message on the facts, where information or informational entities come from, how do they emerge out of the informational environment or background, being wether physical, informational, or both. The circular organization of informational methaphysicalism and phenomenalism enables at last but not least the informational expression of mind and conscious entities, their dynamics and informational perplexedness, offering the complexity needed for a formula system to perform as conscious and selfconscious system.

2.7 A Comparison between Informational Axioms, $\mathfrak{Z}$-language, and ZF

In mathematics, ZF is an abbreviation for Zermelo-Fraenkel Set Theory. Informational phenomenalism introduces the concept of informational formula systems, say Φ. Formula system is constituted by $\Phi \rightleftharpoons (\varphi_1; \varphi_2, \ldots; \varphi_{n_\Phi})$, a set by $S = \{a_1, a_2, \ldots, a_{n_S}\}$. The difference between the two is essential:

Elements of system Φ are informational formulas, elements of S just thing-representing items.

System Φ is informationally emergent in respect to occurring formulas. Set S is, as soon as being defined, a stable collection of elements.

Formulas of Φ are mutually dependent through common informational operands and, in this and other way, emergent; elements of S represent a consistent and stable collection of objects.

Formulas of system Φ do not represent an ordered set of elements and, in this respect, approach the unorderedness of set S.

On an abstract level, system Φ can be compared with set S. It is possible to construct the so-called topological informational spaces, as described in detail, in [6]. Topological approach sheds light on a deeper understanding of informational phenomenalism from an innovative mathematival point of view. In fact, $\mathfrak{Z}$-language is constituted recursively by informational axioms.

3 Informational Formulas

Informational formulas can be understood to be formalized expressions of sentences in an ethnic language, however, not only that. They can represent any informationally connected structure from the world of image, sound, and/or other sensual and/or spiritual domain. Informational formulas can be expressed *implicitly*, representing a class of formulas or *explicitly*, being determined concretely by operands, operators, and parentheses pairs.

3.1 General Type of Informational Formula

The most general *implicit* denotation of an informational formula is

$$\varphi_{\triangleright}^{\triangledown}\left\lfloor \alpha_1, \alpha_2, \ldots, \alpha_{n_{\varphi_{\triangleright}^{\triangledown}}} \right\rfloor;\ \triangledown \in \{\lambda, \circlearrowleft\};\ \triangleright \in \{\rightharpoonup, \leftharpoondown, \rightleftarrows, (\rightharpoonup, \leftharpoondown)\}$$

Superscript λ denotes the non-circular formula (empty superscript) and superscript $\circlearrowleft$ the circular formula. Subscripts $\rightharpoonup, \leftharpoondown, \rightleftarrows, (\rightharpoonup, \leftharpoondown)$ denote serial, reverse serial, biserial and split biserial formula, respectively. Subscript $n_{\varphi_{\triangleright}^{\triangledown}}$ denotes the number of listed operands α_i occurring in formula $\varphi_{\triangleright}^{\triangledown}$. Another measure concerning informational formula is its length, $\ell_{\varphi_{\triangleright}^{\triangledown}}$, being equal to the number of operators occurring in the formula.

According to the values of superscript $\triangledown$ and subscript $\triangleright$, concrete forms of formulas can be expanded from the general type of informational formula, as shown in the following subsections.

3.2 Informational Serial Formulas

Denotation of informational serial formulas is given generally by the expression

$$\varphi_{\triangleright}\left\lfloor \alpha_1, \alpha_2, \ldots, \alpha_{n_{\varphi_{\triangleright}}} \right\rfloor;\ \triangleright \in \{\rightharpoonup, \leftharpoondown, \rightleftarrows, (\rightharpoonup, \leftharpoondown)\}$$

Serial formulas mimic structures of non-circular (non-tautological) sentences and other possible non-linguistical expressions and representations (image, sound, sensual, and spiritual information).

3.2.1 Informational Serial Formula

Informational serial (non-circular) formula

$$\varphi_{\rightarrow}\lfloor\alpha_1, \alpha_2, \ldots, \alpha_{n_{\rightarrow}}\rfloor$$

where $n_{\rightarrow}$ is the number of formula operands and being defined by operand expansion, presented schematically as

$$\mathfrak{S}\lceil\varphi_{\rightarrow}\lfloor\alpha_1, \alpha_2, \ldots, \alpha_{n_{\rightarrow}}\rfloor\rceil \rightleftharpoons (\alpha_1 \models \alpha_2 \models \ldots \models \alpha_{n_{\rightarrow}})$$

and, in a concrete way, by parenthesizing (setting parenthesis pairs within) the scheme (see Sect. 4.2.1).

3.2.2 Informational Reverse Serial Formula

Informational reverse serial (non-circular) formula

$$\varphi_{\leftarrow}\lfloor\alpha_1, \alpha_2, \ldots, \alpha_{n_{\leftarrow}}\rfloor$$

where $n_{\leftarrow}$ is the number of formula operands and being defined by operand expansion, presented schematically, using the reverse general operator joker $=\!\mid$, as

$$\mathfrak{S}\lceil\varphi_{\leftarrow}\lfloor\alpha_1, \alpha_2, \ldots, \alpha_{n_{\leftarrow}}\rfloor\rceil \rightleftharpoons (\alpha_1 =\!\mid \alpha_2 =\!\mid \ldots =\!\mid \alpha_{n_{\leftarrow}})$$

or, also, using the general operator joker $\models$, as

$$\mathfrak{S}\lceil\varphi_{\leftarrow}\lfloor\alpha_1, \alpha_2, \ldots, \alpha_{n_{\leftarrow}}\rfloor\rceil \rightleftharpoons (\alpha_{n_{\leftarrow}} \models \ldots \models \alpha_2 \models \alpha_1)$$

and, in a concrete way, by parenthesizing (setting parenthesis pairs within) the scheme (see Sect. 4.2.2).

3.2.3 Informational Biserial Formula

Informational biserial (non-circular) formula

$$\varphi_{\rightleftarrows}\lfloor\alpha_1, \alpha_2, \ldots, \alpha_{n_{\rightleftarrows}}\rfloor$$

where $n_{\rightleftarrows}$ is the number of formula operands and being defined by operand expansion, presented schematically as

$$\mathfrak{S}\lceil\varphi_{\rightleftarrows}\lfloor\alpha_1, \alpha_2, \ldots, \alpha_{n_{\rightleftarrows}}\rfloor\rceil \rightleftharpoons \\ \big(\alpha_1 \models \alpha_2 \models \ldots \models \alpha_{n_{\rightleftarrows}} \models \alpha_{n_{\rightleftarrows}-1} \models \ldots \models \alpha_2 \models \alpha_1\big)$$

and, in a concrete way, by parenthesizing (setting parenthesis pairs within) the scheme (see Sect. 4.2.3).

3.2.4 Informational Split Biserial Formula

Informational split biserial (non-circular) formula

$$\varphi_{\rightarrow,\leftarrow}\left\lfloor \alpha_1, \alpha_2, \ldots, \alpha_{n_{\rightarrow,\leftarrow}} \right\rfloor$$

where $n_{\rightarrow,\leftarrow}$ is the number of formula operands, being defined by operand expansion, presented schematically as

$$\mathfrak{S}\left\lceil \varphi_{\rightarrow,\leftarrow}\left\lfloor \alpha_1, \alpha_2, \ldots, \alpha_{n_{\rightarrow,\leftarrow}} \right\rfloor \right\rceil \rightleftharpoons \begin{pmatrix} \alpha_1 \models \alpha_2 \models \ldots \models \alpha_{n_{\rightarrow,\leftarrow}}; \\ \alpha_{n_{\rightarrow,\leftarrow}} \models \ldots \models \alpha_2 \models \alpha_1 \end{pmatrix}$$

and, in a concrete way, by parenthesizing (setting parenthesis pairs within) the scheme (see Sect. 4.2.4). The scheme shows that split biserial formula is, in fact, a formula system consisting of serial and reverse serial formula, that is,

$$\varphi_{\rightarrow,\leftarrow}\left\lfloor \alpha_1, \alpha_2, \ldots, \alpha_{n_{\rightarrow,\leftarrow}} \right\rfloor \rightleftharpoons \begin{pmatrix} \varphi_{\rightarrow}\left\lfloor \alpha_1, \alpha_2, \ldots, \alpha_{n_{\rightarrow}} \right\rfloor; \\ \varphi_{\leftarrow}\left\lfloor \alpha_1, \alpha_2, \ldots, \alpha_{n_{\leftarrow}} \right\rfloor \end{pmatrix}$$

For split biserial formula, $n_{\rightarrow,\leftarrow} = n_{\rightarrow} = n_{\leftarrow}$.

3.3 Informational Circular Formulas

Denotation of informational circular serial formulas is given generally by the expression

$$\varphi_{\triangleright}^{\circlearrowleft}\left\lfloor \alpha_1, \alpha_2, \ldots, \alpha_{n_{\varphi_{\triangleright}^{\circlearrowleft}}} \right\rfloor; \ \triangleright \in \{\rightarrow, \leftarrow, \rightleftarrows, (\rightarrow, \leftarrow)\}$$

Circular serial formulas mimic structures of circular (tautological) sentences and other possible circular non-linguistical expressions and representations (image, sound, sensual, and spiritual information).

3.3.1 Informational Circular Serial Formula

Informational circular serial formula

$$\varphi_{\rightarrow}^{\circlearrowleft}\left\lfloor \alpha_1, \alpha_2, \ldots, \alpha_{n_{\rightarrow}^{\circlearrowleft}} \right\rfloor$$

where $n_{\rightarrow}^{\circlearrowleft}$ is the number of formula operands, being defined by operand expansion, presented schematically as

$$\mathfrak{S}\left\lceil \varphi_{\rightarrow}^{\circlearrowleft}\left\lfloor \alpha_1, \alpha_2, \ldots, \alpha_{n_{\rightarrow}^{\circlearrowleft}} \right\rfloor \right\rceil \rightleftharpoons \left(\alpha_1 \models \alpha_2 \models \ldots \models \alpha_{n_{\rightarrow}^{\circlearrowleft}} \models \alpha_1\right)$$

and, in a concrete way, through parenthesizing (setting parenthesis pairs within) the scheme (see Sect. 4.3.1).

3.3.2 Informational Circular Reverse Serial Formula

Informational circular reverse serial formula

$$\varphi_{\leftarrow}^{\circlearrowleft}\left\lfloor \alpha_1, \alpha_2, \ldots, \alpha_{n_{\leftarrow}^{\circlearrowleft}} \right\rfloor$$

where $n_{\leftarrow}^{\circlearrowleft}$ is the number of formula operands, being defined by operand expansion, using the informational reverse general operator joker $=\!\mid$, presented schematically as

$$\mathfrak{S}\left\lceil \varphi_{\leftarrow}^{\circlearrowleft}\left\lfloor \alpha_1, \alpha_2, \ldots, \alpha_{n_{\leftarrow}^{\circlearrowleft}} \right\rfloor \right\rceil \rightleftharpoons \left(\alpha_1 =\!\mid \alpha_2 =\!\mid \ldots =\!\mid \alpha_{n_{\leftarrow}^{\circlearrowleft}} =\!\mid \alpha_1\right)$$

or, also, using the general operator joker $\models$, as

$$\mathfrak{S}\left\lceil \varphi_{\leftarrow}^{\circlearrowleft}\left\lfloor \alpha_1, \alpha_2, \ldots, \alpha_{n_{\leftarrow}^{\circlearrowleft}} \right\rfloor \right\rceil \rightleftharpoons \left(\alpha_1 \models \alpha_{n_{\leftarrow}^{\circlearrowleft}} \models \ldots \models \alpha_2 \models \alpha_1\right)$$

and, in a concrete way, by parenthesizing (setting parenthesis pairs within) the scheme (see Sect. 4.3.2).

3.3.3 Informational Circular Biserial Formula

Informational circular biserial formula

$$\varphi_{\rightleftarrows}^{\circlearrowleft}\left\lfloor \alpha_1, \alpha_2, \ldots, \alpha_{n_{\rightleftarrows}^{\circlearrowleft}} \right\rfloor$$

where $n_{\rightleftarrows}^{\circlearrowleft}$ is the number of formula operands, being defined by operand expansion, presented schematically as

$$\mathfrak{S}\left[\overset{\circlearrowleft}{\varphi}_{\rightleftarrows}\left\lfloor \alpha_1, \alpha_2, \ldots, \alpha_{\overset{\circlearrowleft}{n}_{\rightleftarrows}}\right\rfloor\right] \rightleftharpoons \\ \left(\alpha_1 \models \alpha_2 \models \ldots \models \alpha_{\overset{\circlearrowleft}{n}_{\rightleftarrows}} \models \alpha_1 \models \alpha_{\overset{\circlearrowleft}{n}_{\rightleftarrows}} \models \ldots \models \alpha_2 \models \alpha_1\right)$$

and, in a concrete way, by parenthesizing (setting parenthesis pairs within) the scheme (see Sect. 4.3.3). Seen from the scheme, informational circular biserial formula is bicircularly concerning operand α_1.

3.3.4 Informational Circular Split Biserial Formula

Informational circular split biserial formula

$$\overset{\circlearrowleft}{\varphi}_{\rightarrow,\leftarrow}\left\lfloor \alpha_1, \alpha_2, \ldots, \alpha_{\overset{\circlearrowleft}{n}_{\rightarrow,\leftarrow}}\right\rfloor$$

where $\overset{\circlearrowleft}{n}_{\rightarrow,\leftarrow}$ is the number of formula operands, being defined by operand expansion, presented schematically as

$$\mathfrak{S}\left[\overset{\circlearrowleft}{\varphi}_{\rightarrow,\leftarrow}\left\lfloor \alpha_1, \alpha_2, \ldots, \alpha_{\overset{\circlearrowleft}{n}_{\rightarrow,\leftarrow}}\right\rfloor\right] \rightleftharpoons \begin{pmatrix} \alpha_1 \models \alpha_2 \models \ldots \models \alpha_{\overset{\circlearrowleft}{n}_{\rightarrow,\leftarrow}}; \\ \alpha_{\overset{\circlearrowleft}{n}_{\rightarrow,\leftarrow}} \models \ldots \models \alpha_2 \models \alpha_1 \end{pmatrix}$$

and, in a concrete way, by parenthesizing (setting parenthesis pairs within) the scheme (see Sect. 4.2.4). The scheme shows that split biserial formula is, in fact, a formula system consisting of circular serial and circular reverse serial formula, that is,

$$\overset{\circlearrowleft}{\varphi}_{\rightarrow,\leftarrow}\left\lfloor \alpha_1, \alpha_2, \ldots, \alpha_{\overset{\circlearrowleft}{n}_{\rightarrow,\leftarrow}}\right\rfloor \rightleftharpoons \begin{pmatrix} \overset{\circlearrowleft}{\varphi}_{\rightarrow}\left\lfloor \alpha_1, \alpha_2, \ldots, \alpha_{\overset{\circlearrowleft}{n}_{\rightarrow}}\right\rfloor; \\ \overset{\circlearrowleft}{\varphi}_{\leftarrow}\left\lfloor \alpha_1, \alpha_2, \ldots, \alpha_{\overset{\circlearrowleft}{n}_{\leftarrow}}\right\rfloor \end{pmatrix}$$

For circular split biserial formula, $\overset{\circlearrowleft}{n}_{\rightarrow,\leftarrow} = \overset{\circlearrowleft}{n}_{\rightarrow} = \overset{\circlearrowleft}{n}_{\leftarrow}$.

3.4 Remarks Concerning Informational Formulas

The study of formal structure of informational formulas (and informational formula schemes in particular) leads to the belief that sentences of an ethnic language and other sentence-like mind constructions can be adequately presented by formulas. Formalization offers some kinds of possibilities to analyze and synthesize sentences by means of a formal concept.

For a serial and reverse serial formula $\varphi_{\rightarrow}\lfloor\alpha_1,\alpha_2,\ldots,\alpha_{n_\rightarrow}\rfloor$ and $\varphi_{\leftarrow}\lfloor\alpha_1,\alpha_2,\ldots,\alpha_{n_\leftarrow}\rfloor$, operand arguments of formulas are ordered and concretly listed as $\alpha_1,\alpha_2,\ldots,\alpha_{n_\rightarrow}$ and $\alpha_1,\alpha_2,\ldots,\alpha_{n_\leftarrow}$, while informational operator jokers $\models$ figuring in the schematic expansion of formulas do not occur in the formula symbols at all. According to Axiom 1, operator jokers $\models$ depend on their operand context, that is, on concrete formula parenthesizing. To present this situation within a complex formula context (perenthesized expansion), let us introduce the concept of subformula ψ of a formula, using operator $\Subset$.

If $\psi_1 \Subset \varphi_{\rightarrow}\lfloor\alpha_1,\alpha_2,\ldots,\alpha_{n_\rightarrow}\rfloor$ and $\psi_2 \Subset \varphi_{\leftarrow}\lfloor\alpha_1,\alpha_2,\ldots,\alpha_{n_\leftarrow}\rfloor$, both subformulas ψ_1 and ψ_2 are well-formed formulas entering into formulas $\varphi_{\rightarrow}\lfloor\alpha_1,\alpha_2,\ldots,\alpha_{n_\rightarrow}\rfloor$ and $\varphi_{\leftarrow}\lfloor\alpha_1,\alpha_2,\ldots,\alpha_{n_\leftarrow}\rfloor$. This sort of entering is manifested as, for instance,

$$
\begin{aligned}
&\varphi_{\rightarrow}\lfloor\alpha_1,\alpha_2,\ldots,\alpha_{n_\rightarrow}\rfloor \rightleftharpoons \\
&\quad \varphi_{\rightarrow}\lfloor\alpha_1,\alpha_2,\ldots,\alpha_i,\psi_{1\rightarrow}\lfloor\alpha_{i+1},\ldots,\alpha_{i+j}\rfloor,\alpha_{i+j+1},\ldots,\alpha_{n_\rightarrow}\rfloor; \\
&\varphi_{\leftarrow}\lfloor\alpha_1,\alpha_2,\ldots,\alpha_{n_\leftarrow}\rfloor \rightleftharpoons \\
&\quad \varphi_{\rightarrow}\lfloor\alpha_1,\alpha_2,\ldots,\alpha_i,\psi_{2\leftarrow}\lfloor\alpha_{i+1},\ldots,\alpha_{i+j}\rfloor,\alpha_{i+j+1},\ldots,\alpha_{n_\leftarrow}\rfloor
\end{aligned}
$$

Subformulas $\psi_{1\rightarrow}\lfloor\alpha_{i+1},\ldots,\alpha_{i+j}\rfloor$ and $\psi_{2\leftarrow}\lfloor\alpha_{i+1},\ldots,\alpha_{i+j}\rfloor$ are substantially different formulas although they are using the same operands. Operators in these subformulas are counterdirected and formulas with subformulas can be differently parenthesized.

Let j = 3 for subformulas $\psi_{1\rightarrow}$ and $\psi_{2\leftarrow}$, thus,

$$
\begin{aligned}
&\psi_{1\rightarrow}\lfloor\alpha_{i+1},\alpha_{i+2},\alpha_{i+3}\rfloor \rightleftharpoons (\alpha_{i+1} \models (\alpha_{i+2} \models \alpha_{i+3})) \quad \text{and} \\
&\psi_{2\leftarrow}\lfloor\alpha_{i+1},\alpha_{i+2},\alpha_{i+3}\rfloor \rightleftharpoons ((\alpha_{i+1} \dashv\!\!\!= \alpha_{i+2}) \dashv\!\!\!= \alpha_{i+3})
\end{aligned}
$$

Here, for operators on the same positions in the main formulas there is, according to transition Axiom 1,

$$(\alpha_{i+1} \models (\alpha_{i+2} \models \alpha_{i+3})) \rightleftharpoons$$
$$(\alpha_{i+1} \; \models_{\alpha_{i+1}} \circ \models_{(\alpha_{i+2} \models \alpha_{i+3})} \; (\alpha_{i+2} \models \alpha_{i+3})) \quad \text{and}$$
$$((\alpha_{i+1} \mathrel{=\!\!|} \alpha_{i+2}) \mathrel{=\!\!|} \alpha_{i+3}) \rightleftharpoons$$
$$((\alpha_{i+1} \mathrel{=\!\!|} \alpha_{i+2}) \; \mathrel{=\!\!|}_{(\alpha_{i+1} \mathrel{=\!\!|} \alpha_{i+2})} \circ \mathrel{=\!\!|}_{\alpha_{i+3}} \; \alpha_{i+3})$$

One sees how the yellowed (shaded) operator compositions depend on the concrete context being parenthesized in both informational formulas and, within this parentesizing, the subformulas can be identified.

In an ethnic language, operand-operator expansion of informational formulas suggests some specific and interesting cases of the use of language. Usually, between two nouns, for instance, only paricular verbs or verb phrases can be set, according to the use of language. Such word order has a usual meaning understood by the majority of an etnic group.

Example 1 Contexts in an Ethnic Language. *In a three word phrase context units existing, for instance, of a noun phrase, verb phrase and noun phrase, denoted formally by*

$$\mathfrak{n}_{\text{noun\_phtase1}} \models_{\text{verb\_phrase}} \mathfrak{n}_{\text{noun\_phrase2}},$$

operator $\models_{\text{verb\_phrase}}$ *must be matched to operands* $\mathfrak{n}_{\text{noun\_phrase1}}$ *and* $\mathfrak{n}_{\text{noun\_phrase2}}$*, accordingly to the use of an ethnic language. By example, it becomes evident that, in general,*

$$(\mathfrak{n}_{\text{noun\_phrase1}} \models_{\text{verb\_phrase}} \mathfrak{n}_{\text{noun\_phrase2}}) \not\rightleftharpoons$$
$$(\mathfrak{n}_{\text{noun\_phrase2}} \models_{\text{verb\_phrase}} \mathfrak{n}_{\text{noun\_phrase1}})$$

In a normal situation, for a verb phrase $\models_{\text{verb\_phrase}}$ *there does not hold in general* $\mathfrak{n}_{\text{noun\_phrase1}} \models_{\text{verb\_phrase}} \mathfrak{n}_{\text{noun\_phrase2}}$ *and simultaneously* $\mathfrak{n}_{\text{noun\_phrase2}} \models_{\text{verb\_phrase}} \mathfrak{n}_{\text{noun\_phrase1}}$*. For instance,*

$$(\mathfrak{d}_{\text{dog}} \models_{\text{barks\_at}} \mathfrak{c}_{\text{cat}}) \not\rightleftharpoons (\mathfrak{c}_{\text{cat}} \models_{\text{barks\_at}} \mathfrak{d}_{\text{dog}});$$
$$(\mathfrak{h}_{\text{house}} \models_{\text{stands\_on}} \mathfrak{g}_{\text{ground}}) \not\rightleftharpoons (\mathfrak{g}_{\text{ground}} \models_{\text{stands\_on}} \mathfrak{h}_{\text{house}})$$

These examples meet the use of language and, through that, correspond to the associative principle of mind. In a disassociative context, *the right-hand expressions of operator $\not\models$ can be chosen (e.g., in dis-associative poetry). A fragile situation could occur in, for example,*

$$(\mathfrak{t}_{\text{teachers}} \models_{\text{teach}} \mathfrak{s}_{\text{students}}) \not\models (\mathfrak{s}_{\text{students}} \models_{\text{teach}} \mathfrak{t}_{\text{teachers}})$$

In some kinds of schools students can be smarter than teachers. ■

3.5 Subformulas of Informational Formulas

3.5.1 Measures and Well-formedness Concerning Subformulas

Subformulas, ψ in an informational formula, φ, concern different measures, as for instance, number of operands in a formula, n_φ, its length (number of formula operators), ℓ_φ, and the number of all possible subformulas in a formula, $\mathbb{N}_\varphi$. Subscripts and superscripts of symbols for these measures will be fitted correspondingly to particular cases of formulas.

The basic question is, what is the subformula in an informational formula? Formula is a well-formed structure, that is, the sequence of adequately parenthesized operand and operator sequences, corresponding to the binary nature of informational operators. Subformula is just an informational formula — basic or complex — entering into formula. This relation is denoted as $\psi \Subset \varphi$.

3.5.2 Subformula Definition

Definition 1 *Formula ψ_i, is a* subformula *of formula φ, denoted by $\psi_i \Subset \varphi$, $i = 1, 2, \ldots, \mathbb{L}_\varphi$, where subformula ψ_i occurs in φ as a simple operand or as a formula within φ enclosed in the parenthesis pair. Additionally, formula φ is by definition a subformula of itself, that is, $\varphi \Subset \varphi$.* □

3.5.3 Subformulas of General Type of Formula

The most general relation of a subformula $\psi_{\triangleright}^{\triangledown}\lfloor \alpha_i, \alpha_{i+1}, \ldots, \alpha_j \rfloor$ inclusion (operator $\Subset$) in informational formula $\varphi_{\triangleright}^{\triangledown}\left\lfloor \alpha_1, \alpha_2, \ldots, \alpha_{n_{\varphi_{\triangleright}^{\triangledown}}} \right\rfloor$

is

$$\psi_{\triangleright}^{\triangledown}\lfloor \alpha_i, \alpha_{i+1}, \ldots, \alpha_j \rfloor \Subset \varphi_{\triangleright}^{\triangledown}\left\lfloor \alpha_1, \alpha_2, \ldots, \alpha_{n_{\varphi_{\triangleright}^{\triangledown}}} \right\rfloor;$$
$$\triangledown \in \{\lambda, \circlearrowleft\};\ \triangleright \in \{\rightarrow, \leftarrow, \rightleftarrows, (\rightarrow, \leftarrow)\}$$

where superscript $\triangledown$ and subscript $\triangleright$ in both subformula and formula are being only conditionally equal, that is, $\triangledown_{\psi_{\triangleright}^{\triangledown}} = \triangledown_{\varphi_{\triangleright}^{\triangledown}}$ and $\triangleright_{\psi_{\triangleright}^{\triangledown}} = \triangleright_{\varphi_{\triangleright}^{\triangledown}}$. The conditionality concerns circular and biserial subformulas. As a rule, subformula $\psi_{\triangleright}^{\triangledown}\lfloor \alpha_i, \alpha_{i+1}, \ldots, \alpha_j \rfloor$ can be circular only randomly, that is, as a rule, there is, $\psi_{\triangleright}\lfloor \alpha_i, \alpha_{i+1}, \ldots, \alpha_j \rfloor$. Further, a subformula is never biserial or split biserial. The only possible subformula forms are $\psi_{\rightarrow}\lfloor \alpha_i, \alpha_{i+1}, \ldots, \alpha_j \rfloor$ and $\psi_{\leftarrow}\lfloor \alpha_i, \alpha_{i+1}, \ldots, \alpha_j \rfloor$. Thus, consequently,

$$\psi_{\triangleright_{\psi}}\lfloor \alpha_i, \alpha_{i+1}, \ldots, \alpha_j \rfloor \Subset \varphi_{\triangleright}^{\triangledown}\left\lfloor \alpha_1, \alpha_2, \ldots, \alpha_{n_{\varphi_{\triangleright}^{\triangledown}}} \right\rfloor;$$
$$\triangleright_{\psi} \in \{\rightarrow, \leftarrow\};\ \triangledown \in \{\lambda, \circlearrowleft\};\ \triangleright \in \{\rightarrow, \leftarrow, \rightleftarrows, (\rightarrow, \leftarrow)\}$$

For this general type of the subformula inclusion in a formula, the number of listed formula operands is $n_{\varphi_{\triangleright}^{\triangledown}}$. In schematic expansion of circular and biserial type of formulas, the number of occurring operands in expansion is being greater than in non-circular serial and reverse serial formulas.

Another very important measure concerning subformulas is the number of subformulas in a formula of general type, $\mathbb{L}_{\varphi_{\triangleright}^{\triangledown}}$. This number strongly depends on the concrete type of the formula.

4 Informational Formula Schemes

Informational formula schemes are like formulas with omitted parenthesis pairs (de-parenthesized, schematized formulas), however, usually informational formulas are consctucted by conctete settings of parenthesis pairs in exisiting informational schemes. An informational scheme can be grasped as a meaning emerging out of informational possibilities of the scheme. In the mind, sentence scheme appears first, then it will be parenthesized by setting interpunctions and, in this way, proceeding to a more precise or precise meaning of the sentence. Schemes can be grasped as formalized expressions of meaningly yet undetermined sentences in an ethnic language. In a similar way, schemes can represent any informationally connected structures from the world of image, sound, and/or other sensual and/or spiritual domain.

Also, the basic question is, how many formulas can be parenthesized out of an informational scheme. This number, $\mathbb{N}_\varphi$, depends on the type of formula φ or it scheme $\mathfrak{S}\lceil\varphi\rceil$.

4.1 General Type of Informational Formula Scheme

The most general denotation of an informational formula scheme is

$$\mathfrak{S}\left\lceil \varphi_{\triangleright}^{\triangledown}\left\lfloor \alpha_1, \alpha_2, \ldots, \alpha_{n_{\varphi_{\triangleright}^{\triangledown}}} \right\rfloor\right\rceil; \triangledown \in \{\lambda, \circlearrowleft\}; \triangleright \in \{\rightarrow, \leftarrow, \rightleftarrows, (\rightarrow, \leftarrow)\}$$

Superscript λ denotes the non-circular formula scheme (empty superscript) and superscript $\circlearrowleft$ the circular formula scheme. Subscripts $\rightarrow, \leftarrow, \rightleftarrows, (\rightarrow, \leftarrow)$ denote serial, reverse serial, biserial and split biserial formula scheme, respectively. Subscript $n_{\varphi_{\triangleright}^{\triangledown}}$ denotes the number of operands α_i occurring in formula scheme $\varphi_{\triangleright}^{\triangledown}$.

According to the values of superscript $\triangledown$ and subscript $\triangleright$, concrete forms of formula schemes can be expanded from the general type of informational formula, as shown in the following subsections.

The number of formulas obtained by parenthesizing scheme $\mathfrak{S}\left\lceil \varphi_{\triangleright}^{\triangledown}\left\lfloor \alpha_1, \alpha_2, \ldots, \alpha_{n_{\varphi_{\triangleright}^{\triangledown}}} \right\rfloor\right\rceil$ is

$$\mathbb{N}_{\varphi_\triangleright^\triangledown} = \frac{1}{\ell_{\varphi_\triangleright^\triangledown}+1}\binom{2\ell_{\varphi_\triangleright^\triangledown}}{\ell_{\varphi_\triangleright^\triangledown}}$$

4.2 Informational Serial Formula Schemes

Denotation of informational serial formula scheme is given generally by the expression

$$\mathfrak{S}\lceil \varphi_\triangleright \lfloor \alpha_1, \alpha_2, \ldots, \alpha_{n_{\varphi_\triangleright}} \rfloor \rceil; \; \triangleright \in \{\rightarrow, \leftarrow, \rightleftarrows, (\rightarrow, \leftarrow)\}$$

Serial formula schemes mimic structures of non-circular (non-tautological) sentence schemes and other possible non-linguistical scheme expressions and representations (image, sound, sensual, and spiritual information).

The number of formulas obtained by parenthesizing general serial scheme $\mathfrak{S}\lceil \varphi_\triangleright \lfloor \alpha_1, \alpha_2, \ldots, \alpha_{n_{\varphi_\triangleright}} \rfloor \rceil$ is

$$\mathbb{N}_{\varphi_\triangleright} = \frac{1}{\ell_{\varphi_\triangleright}+1}\binom{2\ell_{\varphi_\triangleright}}{\ell_{\varphi_\triangleright}}$$

4.2.1 Informational Scheme of Serial Formula

Informational serial (non-circular) formula scheme

$$\mathfrak{S}\lceil \varphi_\rightarrow \lfloor \alpha_1, \alpha_2, \ldots, \alpha_{n_\rightarrow} \rfloor \rceil$$

where $n_\rightarrow$ is the number of formula operands, being defined by operand expansion, presented schematically, using the general operator joker $\models$, as

$$\mathfrak{S}\lceil \varphi_\rightarrow \lfloor \alpha_1, \alpha_2, \ldots, \alpha_{n_\rightarrow} \rfloor \rceil \rightleftharpoons (\alpha_1 \models \alpha_2 \models \ldots \models \alpha_{n_\rightarrow})$$

The number of operands in this scheme is $\ell_\rightarrow = n_\rightarrow - 1$, thus, parenthesizing (setting parenthesis pairs within the scheme) delivers

$$\mathbb{N}_\rightarrow = \frac{1}{n_\rightarrow}\binom{2(n_\rightarrow - 1)}{n_\rightarrow - 1}$$

differently parenthesized serial formulas.

4.2.2 Informational Scheme of Reverse Serial Formula

Informational reverse serial (non-circular) formula scheme

$$\mathfrak{S}\lceil\varphi_{\leftarrow}\lfloor\alpha_1,\alpha_2,\ldots,\alpha_{n_{\leftarrow}}\rfloor\rceil$$

where $n_{\leftarrow}$ is the number of formula operands, being defined by operand expansion, presented schematically, using the reverse general operator joker $\dashv$, as

$$\mathfrak{S}\lceil\varphi_{\leftarrow}\lfloor\alpha_1,\alpha_2,\ldots,\alpha_{n_{\leftarrow}}\rfloor\rceil \rightleftharpoons (\alpha_1 \dashv \alpha_2 \dashv \ldots \dashv \alpha_{n_{\leftarrow}})$$

or, also, using the general operator joker $\models$, as

$$\mathfrak{S}\lceil\varphi_{\leftarrow}\lfloor\alpha_1,\alpha_2,\ldots,\alpha_{n_{\leftarrow}}\rfloor\rceil \rightleftharpoons (\alpha_{n_{\leftarrow}} \models \ldots \models \alpha_2 \models \alpha_1)$$

The number of operands in these schemes is $\ell_{\leftarrow} = n_{\leftarrow} - 1$, thus, parenthesizing (setting parenthesis pairs within the scheme) delivers

$$\mathbb{N}_{\rightarrow} = \frac{1}{n_{\leftarrow}}\binom{2(n_{\leftarrow}-1)}{n_{\leftarrow}-1}$$

differently parenthesized reverse serial formulas.

4.2.3 Informational Scheme of Biserial Formula

Informational biserial (non-circular) formula scheme

$$\mathfrak{S}\left\lceil\varphi_{\rightleftarrows}\left\lfloor\alpha_1,\alpha_2,\ldots,\alpha_{n_{\rightleftarrows}}\right\rfloor\right\rceil$$

where $n_{\rightleftarrows}$ is the number of formula operands, being defined by operand expansion, presented schematically, using the general operator joker $\models$, as

$$\mathfrak{S}\left\lceil\varphi_{\rightleftarrows}\left\lfloor\alpha_1,\alpha_2,\ldots,\alpha_{n_{\rightleftarrows}}\right\rfloor\right\rceil \rightleftharpoons \left(\begin{array}{c}\alpha_1 \models \alpha_2 \models \ldots \models \alpha_{n_{\rightleftarrows}} \models \\ \alpha_{n_{\rightleftarrows}-1} \models \ldots \models \alpha_2 \models \alpha_1\end{array}\right)$$

The number of operators in this scheme is $\ell_{\rightleftarrows} = 2(n_{\rightleftarrows} - 1)$, thus, parenthesizing (setting parenthesis pairs within the scheme) delivers

$$\mathbb{N}_{\rightleftarrows} = \frac{1}{2n_{\rightleftarrows}-1}\binom{4(n_{\rightleftarrows}-1)}{2(n_{\rightleftarrows}-1)}$$

differently parenthesized biserial formulas.

4.2.4 Informational Scheme of Split Biserial Formula

Informational split biserial (non-circular) formula scheme

$$\mathfrak{S}\left\lceil \varphi_{\rightarrow,\leftarrow}\left\lfloor \alpha_1, \alpha_2, \ldots, \alpha_{n_{\rightarrow,\leftarrow}}\right\rfloor\right\rceil$$

where $n_{\rightarrow,\leftarrow}$ is the number of formula operands. Uusing the general operator joker $\models$, this scheme denotation can be expanded into a system of two schemes, that is,

$$\mathfrak{S}\left\lceil \varphi_{\rightarrow,\leftarrow}\left\lfloor \alpha_1, \alpha_2, \ldots, \alpha_{n_{\rightarrow,\leftarrow}}\right\rfloor\right\rceil \rightleftharpoons \left(\begin{array}{l} \alpha_1 \models \alpha_2 \models \ldots \models \alpha_{n_{\rightarrow,\leftarrow}}; \\ \alpha_{n_{\rightarrow,\leftarrow}} \models \alpha_{n_{\rightarrow,\leftarrow}-1} \models \ldots \models \alpha_1 \end{array} \right)$$

The number of operators in each of the schemes is $\ell_{\rightarrow,\leftarrow} = n_{\rightarrow,\leftarrow} - 1$, thus, parenthesizing (setting parenthesis pairs within the scheme system) delivers

$$\mathbb{N}_{\rightarrow,\leftarrow} = \left[\frac{1}{n_{\rightarrow,\leftarrow}} \binom{2(n_{\rightarrow,\leftarrow}-1)}{n_{\rightarrow,\leftarrow}-1} \right]^2$$

differently parenthesized split biserial formulas.

4.3 Informational Circular Formula Schemes

Denotation of informational circular serial formula scheme is given generally by the expression

$$\mathfrak{S}\left[\varphi_{\triangleright}^{\circlearrowleft}\left\lfloor \alpha_1, \alpha_2, \ldots, \alpha_{n_{\varphi_{\triangleright}^{\circlearrowleft}}}\right\rfloor\right]; \; \triangleright \in \{\rightarrow, \leftarrow, \rightleftarrows, (\rightarrow, \leftarrow)\}$$

Circular serial formula schemes mimic structures of circular (tautological) sentence schemes and other possible non-linguistical scheme expressions and representations (image, sound, sensual, and spiritual information).

The number of circular formulas obtained by parenthesizing general circular serial scheme $\mathfrak{S}\left[\varphi_{\triangleright}^{\circlearrowleft}\left\lfloor \alpha_1, \alpha_2, \ldots, \alpha_{n_{\varphi_{\triangleright}^{\circlearrowleft}}}\right\rfloor\right]$ is

$$\mathbb{N}_{\varphi_{\triangleright}^{\circlearrowleft}} = \frac{1}{\ell_{\varphi_{\triangleright}^{\circlearrowleft}} + 1} \binom{2\ell_{\varphi_{\triangleright}^{\circlearrowleft}}}{\ell_{\varphi_{\triangleright}^{\circlearrowleft}}}$$

4.3.1 Informational Circular Scheme of Serial Formula

Informational circular serial formula scheme

$$\mathfrak{S}\left[\varphi_{\rightarrow}^{\circlearrowleft}\left\lfloor\alpha_1,\alpha_2,\ldots,\alpha_{n_{\rightarrow}^{\circlearrowleft}}\right\rfloor\right]$$

where $n_{\rightarrow}^{\circlearrowleft}$ is the number of formula operands, being defined by operand expansion, presented schematically, using the general operator joker $\models$, as

$$\mathfrak{S}\left[\varphi_{\rightarrow}^{\circlearrowleft}\left\lfloor\alpha_1,\alpha_2,\ldots,\alpha_{n_{\rightarrow}^{\circlearrowleft}}\right\rfloor\right] \rightleftharpoons \left(\alpha_1 \models \alpha_2 \models \ldots \models \alpha_{n_{\rightarrow}^{\circlearrowleft}} \models \alpha_1\right)$$

The number of operands in this scheme is $\ell_{\rightarrow}^{\circlearrowleft} = n_{\rightarrow}$, thus, parenthesizing (setting parenthesis pairs within the scheme) delivers

$$\mathbb{N}_{\rightarrow}^{\circlearrowleft} = \frac{1}{n_{\rightarrow}^{\circlearrowleft}+1}\binom{2n_{\rightarrow}^{\circlearrowleft}}{n_{\rightarrow}^{\circlearrowleft}}$$

differently parenthesized circular serial formulas.

4.3.2 Informational Circular Scheme of Reverse Serial Formula

Informational circular reverse serial formula scheme

$$\mathfrak{S}\left[\varphi_{\leftarrow}^{\circlearrowleft}\left\lfloor\alpha_1,\alpha_2,\ldots,\alpha_{n_{\leftarrow}^{\circlearrowleft}}\right\rfloor\right]$$

where $n_{\leftarrow}^{\circlearrowleft}$ is the number of circular formula operands, being defined by operand expansion, presented schematically, using the reverse general operator joker $=\!\!|$, as

$$\mathfrak{S}\left[\varphi_{\leftarrow}^{\circlearrowleft}\left\lfloor\alpha_1,\alpha_2,\ldots,\alpha_{n_{\leftarrow}^{\circlearrowleft}}\right\rfloor\right] \rightleftharpoons \left(\alpha_1 \dashv \alpha_2 \dashv \ldots \dashv \alpha_{n_{\leftarrow}^{\circlearrowleft}} \dashv \alpha_1\right)$$

or, also, using the general operator joker $\models$, as

$$\mathfrak{S}\left[\varphi_{\leftarrow}^{\circlearrowleft}\left\lfloor\alpha_1,\alpha_2,\ldots,\alpha_{n_{\leftarrow}^{\circlearrowleft}}\right\rfloor\right] \rightleftharpoons \left(\alpha_1 \models \alpha_{n_{\leftarrow}^{\circlearrowleft}} \models \ldots \models \alpha_2 \models \alpha_1\right)$$

The number of operands in these schemes is $\ell_{\leftarrow}^{\circlearrowleft} = n_{\leftarrow}$, thus, parenthesizing (setting parenthesis pairs within the circular schemes) delivers

$$\mathbb{N}_{\leftarrow}^{\circlearrowleft} = \frac{1}{n_{\leftarrow}^{\circlearrowleft}+1}\binom{2n_{\leftarrow}^{\circlearrowleft}}{n_{\leftarrow}^{\circlearrowleft}}$$

differently parenthesized circular reverse serial formulas.

4.3.3 Informational Circular Scheme of Biserial Formula

Informational circular biserial formula scheme

$$\mathfrak{S}\left[\varphi_{\rightleftarrows}^{\circlearrowleft}\left\lfloor\alpha_1, \alpha_2, \ldots, \alpha_{n_{\rightleftarrows}^{\circlearrowleft}}\right\rfloor\right]$$

where $n_{\rightleftarrows}^{\circlearrowleft}$ is the number of formula operands, being defined by operand expansion, presented schematically, using the general operator joker $\models$, as

$$\mathfrak{S}\left[\varphi_{\rightleftarrows}^{\circlearrowleft}\left\lfloor\alpha_1, \alpha_2, \ldots, \alpha_{n_{\rightleftarrows}^{\circlearrowleft}}\right\rfloor\right] \rightleftharpoons \begin{pmatrix} \alpha_1 \models \alpha_2 \models \ldots \models \alpha_{n_{\rightleftarrows}} \models \alpha_1 \models \\ \alpha_{n_{\rightleftarrows}} \models \alpha_{n_{\rightleftarrows}-1} \models \ldots \models \alpha_2 \models \alpha_1 \end{pmatrix}$$

The number of operators in this scheme is $\ell_{\rightleftarrows} = 2n_{\rightleftarrows}$, thus, parenthesizing (setting parenthesis pairs within the scheme) delivers

$$\mathbb{N}_{\rightleftarrows}^{\circlearrowleft} = \frac{1}{2n_{\rightleftarrows}^{\circlearrowleft}+1}\binom{4n_{\rightleftarrows}^{\circlearrowleft}}{2n_{\rightleftarrows}^{\circlearrowleft}}$$

differently parenthesized circular biserial formulas.

4.3.4 Informational Circular Scheme of Split Biserial Formula

Informational circular split biserial formula scheme

$$\mathfrak{S}\left[\varphi_{\rightarrow,\leftarrow}^{\circlearrowleft}\left\lfloor\alpha_1, \alpha_2, \ldots, \alpha_{n_{\rightarrow,\leftarrow}^{\circlearrowleft}}\right\rfloor\right]$$

where $n_{\rightarrow,\leftarrow}^{\circlearrowleft}$ is the number of formula operands. Using the general operator joker $\models$, this scheme denotation can be expanded into a system of two circular schemes, that is,

$$\mathfrak{S}\left[\varphi^{\circlearrowleft}_{\rightarrow,\leftarrow}\left\lfloor\alpha_1,\alpha_2,\ldots,\alpha_{n^{\circlearrowleft}_{\rightarrow,\leftarrow}}\right\rfloor\right] \rightleftharpoons \begin{pmatrix} \alpha_1 \models \alpha_2 \models \ldots \models \alpha_{n^{\circlearrowleft}_{\rightarrow,\leftarrow}} \models \alpha_1; \\ \alpha_1 \models \alpha_{n^{\circlearrowleft}_{\rightarrow,\leftarrow}} \models \ldots \models \alpha_1 \end{pmatrix}$$

The number of operators in each of the schemes is $\ell^{\circlearrowleft}_{\rightarrow,\leftarrow} = n^{\circlearrowleft}_{\rightarrow,\leftarrow}$, thus, parenthesizing (setting parenthesis pairs within the circular scheme system) delivers

$$\mathbb{N}^{\circlearrowleft}_{\rightarrow,\leftarrow} = \left[\frac{1}{n^{\circlearrowleft}_{\rightarrow,\leftarrow}+1}\binom{2n^{\circlearrowleft}_{\rightarrow,\leftarrow}}{n^{\circlearrowleft}_{\rightarrow,\leftarrow}}\right]^2$$

differently parenthesized circular split biserial formulas.

4.4 Number of Informational Formulas out of a Scheme

The most basic question is how many formulas can be concretely parenthesized out of a formula scheme. Such a data is essential in evaluating the number of possible formulas which can result out of different types of schemes. A scheme perenthesizing represents an exact meaning expressed by means of the well-formedness of a formula. Thus, for instance, for an ethnic sentence scheme (without any interpunction and syntactic rule), several or many meanings can result when interpunctions are inserted. Interpunctions and syntactic structure of a sentence give the precise meaning to the concrete sentence. Table 2 lists the numbers of formulas resulting out of schemes with lengths ℓ_φ and $\ell^{\circlearrowleft}_\varphi$. The later concern the operand rotation presented in Sect. **??**. The proofs for formulas used in Table 2 can be found elsewhere in stydy [**?**].

Example 2 A Sentence Scheme and to It Corresponding Sentences. *Let us study informationally, in a formal way, the following sentence:* A dog has bitten the son of the teacher while being on the travel in Africa. *The operands of this sentence are* $\mathfrak{d}_{\mathsf{a\_dog}}$, $\mathfrak{s}_{\mathsf{the\_son}}$, $\mathfrak{t}_{\mathsf{the\_teacher}}$, *and*

ℓ_φ	In regular case: $\mathbb{N}_\varphi = \dfrac{1}{\ell_\varphi + 1}\dbinom{2\ell_\varphi}{\ell_\varphi}$	In case of operand rotation: $\mathbb{N}^{\circlearrowleft}_{\varphi^\circlearrowleft} = \dfrac{\ell_{\varphi^\circlearrowleft}}{\ell_{\varphi^\circlearrowleft} + 1}\dbinom{2\ell_{\varphi^\circlearrowleft}}{\ell_{\varphi^\circlearrowleft}}$
1	1	1
2	2	4
3	5	15
4	14	56
5	42	210
6	132	792
7	429	3,003
8	1,430	11,440
9	4,862	43,758
10	16,796	167,960
11	58,786	646,646
12	208,012	2,496,144
13	742,900	9,657,700
14	2,674,440	37,442,160
15	9,694,845	145,422,675
16	33,277,807	532,444,913
17	122,442,467	2,061,521,933
18	477,638,700	8,597,496,600
19	1,767,263,200	33,578,000,800
20	6,564,120,476	131,282,409,523
21	24,466,266,818	513,791,603,182
22	91,482,565,217	2,012,616,434,783
23	343,059,612,500	8,576,490,312,500
24	1,289,904,160,000	30,957,699,840,000
25	4,861,946,538,462	121,548,663,461,500

Legend:

$$\ell_\varphi \in \left\{\ell_{\rightarrow}, \ell_{\leftarrow}, \ell_{\rightleftarrows}, \ell_{\rightarrow,\leftarrow}, \ell^{\circlearrowleft}_{\rightarrow}, \ell^{\circlearrowleft}_{\leftarrow}, \ell^{\circlearrowleft}_{\rightleftarrows}, \ell^{\circlearrowleft}_{\rightarrow,\leftarrow}\right\};$$

$$\ell^{\circlearrowleft}_\varphi \in \left\{\ell^{\circlearrowleft}_{\rightarrow}, \ell^{\circlearrowleft}_{\leftarrow}, \ell^{\circlearrowleft}_{\rightleftarrows}, \ell^{\circlearrowleft}_{\rightarrow,\leftarrow}\right\}, \text{ see Sect. } \textbf{??}$$

Table 2: Number of causal parenthesizing possibilities of a formula φ of length ℓ_φ in a serial and circular serial case and, with operand rotation, in a circular scheme of length $\ell^{\circlearrowleft}_\varphi$, in the rightmost column.

$\mathfrak{t}_{\text{the\_travel}}$, *and* $\mathfrak{a}_{\text{Africa}}$. *The operators are:* $\models_{\text{has\_bitten}}$, $\models_{\text{of}}$, $\models_{\text{while\_being\_on}}$ *and* $\models_{\text{in}}$. *The informational scheme of this sentence is, word by word,*

$$\mathfrak{d}_{\text{a\_dog}} \models_{\text{has\_bitten}} \mathfrak{s}_{\text{the\_son}} \models_{\text{of}} \mathfrak{t}_{\text{the\_teacher}} \models_{\text{while\_being\_on}} \mathfrak{t}_{\text{the\_travel}} \models_{\text{in}} \mathfrak{a}_{\text{Africa}}$$

This formula scheme has four operators, hence, $\ell_{\rightarrow} = 4$. *This means, according to Table 2,* $\mathbb{N}_{\rightarrow} = 14$. *Thus, in principle, 14 different sentences can be parenthesized out of the given scheme. The parenthesizings are, systematically, using the transparent feature of underlinig subformulas that belong together,*

1 $\mathfrak{d}_{\text{a\_dog}} \models_{\text{has\_bitten}} (\mathfrak{s}_{\text{the\_son}} \models_{\text{of}} (\mathfrak{t}_{\text{the\_teacher}} \models_{\text{while\_being\_on}} (\mathfrak{t}_{\text{the\_travel}} \models_{\text{in}} \mathfrak{a}_{\text{Africa}})))$

2 $\mathfrak{d}_{\text{a\_dog}} \models_{\text{has\_bitten}} (\mathfrak{s}_{\text{the\_son}} \models_{\text{of}} ((\mathfrak{t}_{\text{the\_teacher}} \models_{\text{while\_being\_on}} \mathfrak{t}_{\text{the\_travel}}) \models_{\text{in}} \mathfrak{a}_{\text{Africa}}))$

3 $\mathfrak{d}_{\text{a\_dog}} \models_{\text{has\_bitten}} ((\mathfrak{s}_{\text{the\_son}} \models_{\text{of}} \mathfrak{t}_{\text{the\_teacher}}) \models_{\text{while\_being\_on}} (\mathfrak{t}_{\text{the\_travel}} \models_{\text{in}} \mathfrak{a}_{\text{Africa}}))$

4 $\mathfrak{d}_{\text{a\_dog}} \models_{\text{has\_bitten}} ((\mathfrak{s}_{\text{the\_son}} \models_{\text{of}} (\mathfrak{t}_{\text{the\_teacher}} \models_{\text{while\_being\_on}} \mathfrak{t}_{\text{the\_travel}})) \models_{\text{in}} \mathfrak{a}_{\text{Africa}})$

5 $\mathfrak{d}_{\text{a\_dog}} \models_{\text{has\_bitten}} (((\mathfrak{s}_{\text{the\_son}} \models_{\text{of}} \mathfrak{t}_{\text{the\_teacher}}) \models_{\text{while\_being\_on}} \mathfrak{t}_{\text{the\_travel}}) \models_{\text{in}} \mathfrak{a}_{\text{Africa}})$

6 $(((\mathfrak{d}_{\text{a\_dog}} \models_{\text{has\_bitten}} \mathfrak{s}_{\text{the\_son}}) \models_{\text{of}} \mathfrak{t}_{\text{the\_teacher}}) \models_{\text{while\_being\_on}} \mathfrak{t}_{\text{the\_travel}}) \models_{\text{in}} \mathfrak{a}_{\text{Africa}}$

7 $((\mathfrak{d}_{\text{a\_dog}} \models_{\text{has\_bitten}} (\mathfrak{s}_{\text{the\_son}} \models_{\text{of}} \mathfrak{t}_{\text{the\_teacher}})) \models_{\text{while\_being\_on}} \mathfrak{t}_{\text{the\_travel}}) \models_{\text{in}} \mathfrak{a}_{\text{Africa}}$

8 $((\mathfrak{d}_{\text{a\_dog}} \models_{\text{has\_bitten}} \mathfrak{s}_{\text{the\_son}}) \models_{\text{of}} (\mathfrak{t}_{\text{the\_teacher}} \models_{\text{while\_being\_on}} \mathfrak{t}_{\text{the\_travel}})) \models_{\text{in}} \mathfrak{a}_{\text{Africa}}$

9 $(\mathfrak{d}_{\text{a\_dog}} \models_{\text{has\_bitten}} ((\mathfrak{s}_{\text{the\_son}} \models_{\text{of}} \mathfrak{t}_{\text{the\_teacher}}) \models_{\text{while\_being\_on}} \mathfrak{t}_{\text{the\_travel}})) \models_{\text{in}} \mathfrak{a}_{\text{Africa}}$

10 $(\mathfrak{d}_{\text{a\_dog}} \models_{\text{has\_bitten}} (\mathfrak{s}_{\text{the\_son}} \models_{\text{of}} (\mathfrak{t}_{\text{the\_teacher}} \models_{\text{while\_being\_on}} \mathfrak{t}_{\text{the\_travel}}))) \models_{\text{in}} \mathfrak{a}_{\text{Africa}}$

11 $(\mathfrak{d}_{\text{a\_dog}} \models_{\text{has\_bitten}} \mathfrak{s}_{\text{the\_son}}) \models_{\text{of}} (\mathfrak{t}_{\text{the\_teacher}} \models_{\text{while\_being\_on}} (\mathfrak{t}_{\text{the\_travel}} \models_{\text{in}} \mathfrak{a}_{\text{Africa}}))$

12 $(\mathfrak{d}_{\text{a\_dog}} \models_{\text{has\_bitten}} \mathfrak{s}_{\text{the\_son}}) \models_{\text{of}} ((\mathfrak{t}_{\text{the\_teacher}} \models_{\text{while\_being\_on}} \mathfrak{t}_{\text{the\_travel}}) \models_{\text{in}} \mathfrak{a}_{\text{Africa}})$

13 $(\mathfrak{d}_{\text{a\_dog}} \models_{\text{has\_bitten}} (\mathfrak{s}_{\text{the\_son}} \models_{\text{of}} \mathfrak{t}_{\text{the\_teacher}})) \models_{\text{while\_being\_on}} (\mathfrak{t}_{\text{the\_travel}} \models_{\text{in}} \mathfrak{a}_{\text{Africa}})$

14 $((\mathfrak{d}_{\text{a\_dog}} \models_{\text{has\_bitten}} \mathfrak{s}_{\text{the\_son}}) \models_{\text{of}} \mathfrak{t}_{\text{the\_teacher}}) \models_{\text{while\_being\_on}} (\mathfrak{t}_{\text{the\_travel}} \models_{\text{in}} \mathfrak{a}_{\text{Africa}})$

Linguists and interpreters rarely think about the richness of possible meanings in the presented way. On the other side, they do not have the possibility of setting interpunction signs in the sense of the use of an ethnic language. However, the manifoldness of sentence meaning can be expressed formally by all possible well-formed formulas resulting out of a sentence scheme. The order of operands and operators, with a strict parenthesizing meaning syntax, both constitute the syntax, determining that which belongs meaningly together. And all of this determinates the meaning or, said in the most general way, the possible use of language, *irrespective of the language nature be ethnic, formal, or artificial.*

Let us examine the particular meanings concerning the listed cases 1–14. One of the interesting views is that of informational concerning replacing operator $\models_{\text{of}}$ *with parenthesis pair* $\lceil, \rceil$. *At the first glance, the most obvious unit is* $\mathfrak{s}_{\text{the\_son}}\lceil \mathfrak{t}_{\text{the\_teacher}} \rceil \rightleftharpoons (\mathfrak{s}_{\text{the\_son}} \models_{\text{of}} \mathfrak{t}_{\text{the\_teacher}})$ *occurring in lines 3, 5, 7, 9, and 13. A less common meaning is the form. The most complex meaning pertaining to informational concern is 11 and 12, where*

$$\underbrace{(\mathfrak{d}_{\text{a\_dog}} \models_{\text{has\_bitten}} \mathfrak{s}_{\text{the\_son}})}\lceil \underbrace{\mathfrak{t}_{\text{the\_teacher}} \models_{\text{while\_being\_on}} (\mathfrak{t}_{\text{the\_travel}} \models_{\text{in}} \mathfrak{a}_{\text{Africa}})} \rceil;$$

$$\underbrace{(\mathfrak{d}_{\text{a\_dog}} \models_{\text{has\_bitten}} \mathfrak{s}_{\text{the\_son}})}_{\text{concerner-functor}}\lceil \underbrace{(\mathfrak{t}_{\text{the\_teacher}} \models_{\text{while\_being\_on}} \mathfrak{t}_{\text{the\_travel}}) \models_{\text{in}} \mathfrak{a}_{\text{Africa}}}_{\text{concerned-argument}} \rceil$$

These sorts of meaning can certainly be understood in a formal informnational way. The linguist can find specific unambigous meaning representations out of formulas listed as 1–14. ■

At the end, Table 3 can be useful where at one place the most characteristic parameters concerning informational schemes are being recapitulated. In general, number of formulas will be denoted by $\mathbb{N}$ together with adequate superscript(s) and subscript. The general rule is that this number depends on formula φ length ℓ_φ, that is $\mathbb{N}_\varphi = \frac{1}{\ell_\varphi + 1}\binom{2\ell_\varphi}{\ell_\varphi}$. On this basis, Table 3 is presented. In this table the implicit formula expression of the form $\varphi^{\triangledown}_{\triangleright}\left\lfloor \alpha_1, \ldots, \alpha_{n^{\triangledown}_{\triangleright}} \right\rfloor$ is used. In this way, an implicit formula expression represents a class of formulas resulting out of its informational scheme, because by such an expres-

Formula	Formula length(s)	Number of possible formulas
$\varphi_{\rightarrow}\lfloor\alpha_1,\ldots,\alpha_{n_{\rightarrow}}\rfloor$	$\ell_{\rightarrow}=n_{\rightarrow}-1$	$\mathbb{N}_{\rightarrow}=\frac{1}{n_{\rightarrow}}\binom{2n_{\rightarrow}-2}{n_{\rightarrow}-1}$
$\varphi_{\leftarrow}\lfloor\alpha_1,\ldots,\alpha_{n_{\leftarrow}}\rfloor$	$\ell_{\leftarrow}=n_{\leftarrow}-1$	$\mathbb{N}_{\leftarrow}=\frac{1}{n_{\leftarrow}}\binom{2n_{\leftarrow}-2}{n_{\leftarrow}-1}$
$\varphi_{\rightleftarrows}\lfloor\alpha_1,\ldots,\alpha_{n_{\rightleftarrows}}\rfloor$	$\ell_{\rightleftarrows}=2n_{\rightleftarrows}-2$	$\mathbb{N}_{\rightleftarrows}=\frac{1}{2n_{\rightleftarrows}-1}\binom{4n_{\rightleftarrows}-4}{2n_{\rightleftarrows}-2}$
$\varphi_{\rightarrow,\leftarrow}\lfloor\alpha_1,\ldots,\alpha_{n_{\rightarrow,\leftarrow}}\rfloor$	$\ell_{\rightarrow,\leftarrow}=n_{\rightarrow,\leftarrow}-1$	$\mathbb{N}_{\rightarrow,\leftarrow}=\left(\frac{1}{n_{\rightarrow,\leftarrow}}\binom{2n_{\rightarrow,\leftarrow}-2}{n_{\rightarrow,\leftarrow}-1}\right)^2$
$\varphi_{\rightarrow}^{\circlearrowleft}\left\lfloor\alpha_1,\ldots,\alpha_{n_{\rightarrow}^{\circlearrowleft}}\right\rfloor$	$\ell_{\rightarrow}^{\circlearrowleft}=n_{\rightarrow}^{\circlearrowleft}$	$\mathbb{N}_{\rightarrow}^{\circlearrowleft}=\frac{1}{n_{\rightarrow}^{\circlearrowleft}+1}\binom{2n_{\rightarrow}^{\circlearrowleft}}{n_{\rightarrow}^{\circlearrowleft}}$
$\varphi_{\leftarrow}^{\circlearrowleft}\left\lfloor\alpha_1,\ldots,\alpha_{n_{\leftarrow}^{\circlearrowleft}}\right\rfloor$	$\ell_{\leftarrow}^{\circlearrowleft}=n_{\leftarrow}^{\circlearrowleft}$	$\mathbb{N}_{\leftarrow}^{\circlearrowleft}=\frac{1}{n_{\leftarrow}^{\circlearrowleft}+1}\binom{2n_{\leftarrow}^{\circlearrowleft}}{n_{\leftarrow}^{\circlearrowleft}}$
$\varphi_{\rightleftarrows}^{\circlearrowleft}\left\lfloor\alpha_1,\ldots,\alpha_{n_{\rightleftarrows}^{\circlearrowleft}}\right\rfloor$	$\ell_{\rightleftarrows}^{\circlearrowleft}=2n_{\rightleftarrows}^{\circlearrowleft}$	$\mathbb{N}_{\rightleftarrows}^{\circlearrowleft}=\frac{1}{2n_{\rightleftarrows}^{\circlearrowleft}+1}\binom{4n_{\rightleftarrows}^{\circlearrowleft}}{2n_{\rightleftarrows}^{\circlearrowleft}}$
$\varphi_{\rightarrow,\leftarrow}^{\circlearrowleft}\lfloor\alpha_1,\ldots,\alpha_{n_{\rightarrow,\leftarrow}^{\circlearrowleft}}\rfloor$	$\ell_{\rightarrow,\leftarrow}^{\circlearrowleft}=n_{\rightarrow,\leftarrow}^{\circlearrowleft}$	$\mathbb{N}_{\rightarrow,\leftarrow}^{\circlearrowleft}=\left(\frac{1}{n_{\rightarrow,\leftarrow}^{\circlearrowleft}+1}\binom{2n_{\rightarrow,\leftarrow}^{\circlearrowleft}}{n_{\rightarrow,\leftarrow}^{\circlearrowleft}}\right)^2$

Table 3: Implicit informational formula expression, $\varphi_{\triangleright}^{\triangledown}\left\lfloor\alpha_1,\ldots,\alpha_{n_{\triangleright}^{\triangledown}}\right\rfloor$*, presents a class of possible concretely parenthesized formulas, determined by number* $\mathbb{N}_{\triangleright}^{\triangledown}$*.*

sion, the concrete parenthesizing of formula is not explicitly defined.

4.5 Subschemes of Informational Schemes

4.5.1 Subscheme Definition

Definition 2 *Subscheme,* ς*, of a formula scheme,* $\mathfrak{S}\lceil\varphi\rceil$*, expressed by* $\varsigma \sqsubset \mathfrak{S}\lceil\varphi\rceil$*, is any sequence of operands and operators in the scheme* $\mathfrak{S}\lceil\varphi\rceil$*, beginning and ending with an operand. Operator (or relator)* $\sqsubset$ *is called the* subscheme inclusion *operator.* □

According to this definition, a single operand α is a subscheme of a scheme $\mathfrak{S}\lceil\varphi\rceil$ if it occurs in the scheme, that is, $\alpha \sqsubset \mathfrak{S}\lceil\varphi\lfloor\ldots,\alpha,\ldots\rfloor\rceil$.

Simultaneously, by definition, denoting or naming anything complex as operand α, an operand scheme $\mathfrak{S}\lceil\alpha\rceil$ is the subscheme of itself, that is, $\mathfrak{S}\lceil\alpha\rceil \sqsubset \mathfrak{S}\lceil\alpha\rceil$. In fact, a simple (non-complex) operand α is not being a proper formula scheme. In this view, a scheme $\mathfrak{S}\lceil\varphi\rceil$ is the subscheme of itself, $\mathfrak{S}\lceil\varphi\rceil \sqsubset \mathfrak{S}\lceil\varphi\rceil$. This definition is significant for the calculation of the number of subschemes in a formula scheme.

4.5.2 Number of Subschemes in a Scheme

A formula scheme $\mathfrak{S}\lceil\varphi\rceil \rightleftharpoons \left(\alpha_1 \models \alpha_2 \models \ldots \models \alpha_{n_\varphi}\right)$ can be systematically covered, in an overlapping way, by all possible subformulas, beginning with simple operands $\alpha_1, \alpha_2, \ldots, \alpha_{n_\varphi}$ of length $\ell = 0$, and following by all subformulas of $\ell = 1$, $\ell = 2$, up to the length $\ell = n_\varphi - 1$. Thus, subformulas are, systematically,

$$\begin{array}{ll}
\ell = 0 & \alpha_1, \alpha_2, \ldots, \alpha_{n_\varphi}, \\
\ell = 1 & \alpha_1 \models \alpha_2, \alpha_2 \models \alpha_3, \ldots, \alpha_{n_\varphi - 1} \models \alpha_{n_\varphi}, \\
\ell = 2 & \alpha_1 \models \alpha_2 \models \alpha_3, \alpha_2 \models \alpha_3 \models \alpha_4, \ldots, \alpha_{n_\varphi - 2} \models \\
 & \quad \alpha_{n_\varphi - 1} \models \alpha_{n_\varphi}, \\
\cdots & \ldots, \\
\ell = n_\varphi - 1 & \alpha_1 \models \alpha_2 \models \alpha_3, \ldots, \alpha_{n_\varphi - 2} \models \alpha_{n_\varphi - 1} \models \alpha_{n_\varphi}
\end{array}$$

Evidently, the number of subformulas $\varsigma_i \sqsubset \mathfrak{S}\lceil\varphi\rceil$ is, counting from the end situation ($\ell = n_\varphi - 1$),

$$1 + 2 + \cdots + n_\varphi = \tfrac{1}{2} n_\varphi (n_\varphi + 1)$$

Thus, for ς_i, $1 \leq i \leq \frac{1}{2} n_\varphi (n_\varphi + 1)$.

Fig. 1 shows graphically the coverage of formula scheme $\alpha_1 \models \alpha_2 \models \alpha_3 \models \alpha_4 \models \alpha_5 \models \alpha_6 \models \alpha_7 \models \alpha_8$ by all possible subformulas ς_i, where $1 \leq i \leq 36$. In the lowest row, where $\ell = 0$, there are simple operands $\alpha_1, \alpha_2, \alpha_3, \alpha_4, \alpha_5, \alpha_6, \alpha_7, \alpha_8$. A row higher, where $\ell = 1$, there are primitive transitions of the form $\alpha_i \models \alpha_{i+1}$, where $1 \leq i \leq 7$. In the row marked by $\ell = 2$, there are serial transition schemes $\alpha_i \models \alpha_{i+1} \models \alpha_{i+2}$, where $1 \leq i \leq 6$. Finally, the upmost subscheme is the scheme itself with $\ell = 7$.

The next question is, how does the number of subschemes in a scheme depend on the length oa various types of informational formulas. The number of all possible ς_i in formula scheme $\mathfrak{S}\lceil\varphi\rceil$ is

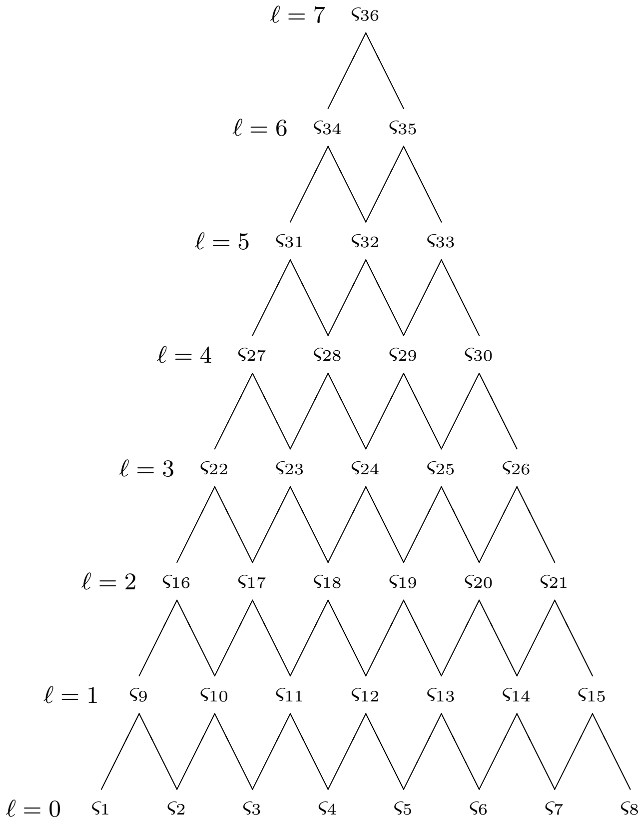


Figure 1: For the formula scheme $\alpha_1 \models \alpha_2 \models \alpha_3 \models \alpha_4 \models \alpha_5 \models \alpha_6 \models \alpha_7 \models \alpha_8$, *the tree of overlapping possible (36) subschemes* ς_i *is presented, where* $\frac{1}{2}8 \cdot 9 = 36$.

$$\mathbb{L}_{\mathfrak{S}\lceil\varphi\rceil} = \frac{1}{2}\left(\ell_{\mathfrak{S}\lceil\varphi\rceil} + 1\right)\left(\ell_{\mathfrak{S}\lceil\varphi\rceil} + 2\right) \quad \text{for} \\ \varphi \in \left\{\varphi_{\rightarrow}, \varphi_{\leftarrow}, \varphi_{\rightleftarrows}, \overset{\circlearrowleft}{\varphi}_{\rightarrow}, \overset{\circlearrowleft}{\varphi}_{\leftarrow}, \overset{\circlearrowleft}{\varphi}_{\rightleftarrows}\right\}$$

For the split formula case, where serial and reverse serial formula constitute the formula system, there is,

$$\mathbb{L}_{\mathfrak{S}\lceil\varphi\rceil} = \left(\ell_{\mathfrak{S}\lceil\varphi\rceil} + 1\right)\left(\ell_{\mathfrak{S}\lceil\varphi\rceil} + 2\right), \text{ where } \varphi \in \left\{\varphi_{\rightarrow,\leftarrow}, \overset{\circlearrowleft}{\varphi}_{\rightarrow,\leftarrow}\right\}$$

In a formula system, the sum of particular numbers $\mathbb{L}_{\mathfrak{S}\lceil\varphi\rceil}$ belonging to system formulas has to be considered.

5 Informational Formula Gestalts

xx

5.1 Informational Gestalt of Serial Formula

xx

5.2 Informational Gestalt of Reverse Serial Formula

xx

5.3 Informational Gestalt of Biserial Formula

xx

5.4 Informational Gestalt of Split Biserial Formula

xx

6 Informational Circular Gestalts

xx

6.1 Informational Circular Gestalt of Serial Formula

xx

6.2 Informational Circular Gestalt of Reverse Serial Formula

xx

6.3 Informational Circular Gestalt of Biserial Formula

xx

6.4 Informational Circular Gestalt of Split Biserial Formula

xx

7 Informational Frames

Informational frames are tools for the transparency and research of various informational situations occurring in formulas, schemes, gestalts, and formula systems. Their very basic idea is to devide the interiority of the frame from its exteriority. In this respect, a frame functions as a kind of transparent envelope.

Informational frames can be disjoint, embedded in one another, and intersecting, that is, possessing disjoint, including, and common areas of research interests. Their application can essentially interpret the meaning of formal expressionbs and, in this way, contribute to the necessary understanding of informational situations.

7.1 Single and Disjoint Informational Frames

An informational frame can be put anywhere in the configuration of expressins concerning informational formalism. In its very basic configuration, a frame is a box and, as a box, it can be understood appropriating an arbitrary form from the geometrical point of view, that is, rectangilar, oval, or anyhow closed curve as the frame envelope. In this way, informational framing can exceed any degree of formula well-formedness, scheme or gestalt compactness, and concern simultaneously differen parts of formulas constituting a formula system. The aim of such an idea roots in the possibility to bring together meaningly relevant parts being dispersed in a formula system.

7.2 Informational Frame Inclusion

7.3 Informational Frames Intersection

8 Advanced Informational Axioms

Advanced informational axioms embrace concepts concerning the informational emerging of entities — operands, operators, formulas, and formula systems — constructing spontaneosly the meanings concerning those entities. To those concepts belong just chosing of subscripts for operands and operators and, in more sphisticated way, the searching of meaning in a web of informatiuonal graphs and, in the similar sense, informational decompositio. Also, rotation of operands in circular formulas and parenthesizing of formula schemes belong to unforeseeavle concrete results of the meaning developing procedures. These procedures are constitutional parts of the design of concscious informational entities, discussed in Sect. 13.

9 Informons and Entropons

9.1 Introduction

9.2 Informonizing an Operand

9.3 Informon

9.4 Entroponizing an Operand

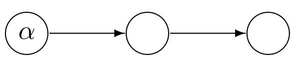
9.5 Entropon

Entropon, $\overline{\boldsymbol{\alpha}}$, as something being subconscious, named α, is a complex counterinformational entity (organization), in the sense of informational irregularity, deficiency of meaning, meaninglessness, schematicalness, informational incompleteness, delusiveness. By $\overline{\boldsymbol{\alpha}} \longrightarrow \underline{\boldsymbol{\alpha}}$, entropon $\overline{\boldsymbol{\alpha}}$ is the background for informon $\underline{\boldsymbol{\alpha}}$ generation in ICS (informational conscious system), where informon $\underline{\boldsymbol{\alpha}}$ as something being conscious is an informational complex, constituting α's meaning, in the sense being informationally regular, meaningful, formula-like, systemic, informationally complete, authentic. The schematic flow of informational genesis in ICS is something like

$$\alpha \longrightarrow \overline{\boldsymbol{\alpha}} \longrightarrow \underline{\boldsymbol{\alpha}}$$

when $\underline{\boldsymbol{\alpha}}$ comes to existence as a first-time event, as an initial occurrence. Then , the informational genesis cycles schematically and graphically, that is,

$\alpha \longrightarrow \overline{\boldsymbol{\alpha}} \longrightarrow \underline{\boldsymbol{\alpha}} \longrightarrow \overline{\boldsymbol{\alpha}}$



9.6 The Philosophy Behind an Informon and Entropon

10 Informational Spaces

10.1 Introduction

The concept of informational space is the key in understanding *conscious* informational system, its complexity, component perplexedness, and organization. Recursive *informonizing* and *entroponizing* informational spaces enables the introduction, existence, informational emerging, and understanding of the so-called subconscious, conscious, and superconscious layes within the conscious informational system.

10.2 A Pair of Informon and Entropon

Informon and entropon implicitly concern the conscious nature of particular — named — entities. A named informational entity (operand) means that it is named in an ethnic, abstract or other language, that it is named sensually or experientially, in an imaginitive (collored and picturesque) way, hearing (accoustical, musical), smelling, tasting, tactile way, or otherwise physically feeling way, etc. By α named informon $\underline{\boldsymbol{\alpha}}$, and to it corresponding entropon $\overline{\boldsymbol{\alpha}}$, concern the complex meaning of name α during the informon $\underline{\boldsymbol{\alpha}}$-emerging out of entropon $\overline{\boldsymbol{\alpha}}$ and other possible conscious and sensual environment. In fact, this to some extemt simplified concept of informon's emerging is replaced with a more objective presumption that an informon arises out of several sub- and superconscious domains within a conscious informational system. This view essentially increases the degree of complexity and informational component perplexedness.

10.3 Basic Informational Space

Basic or a common α-named informational space, $\mathfrak{B}\lceil\alpha\rceil$, as a conscious component, is defined as an α-informon and an α-entropon pair, that is,

$$\mathfrak{B}\lceil\alpha\rceil \rightleftharpoons (\underline{\boldsymbol{\alpha}}; \overline{\boldsymbol{\alpha}})$$

where the semicolon ';' on the right side stands, as usually, between two formula systems, the informonic and the entroponic one.

Different basic informational spaces, named by $\alpha_1, \alpha_2, \ldots, \alpha_n$, connected by common operands, can be meaningfully denoted by

$$\mathfrak{B}\lceil \alpha_1, \alpha_2, \ldots, \alpha_n \rceil \rightleftharpoons \left((\underline{\boldsymbol{\alpha_1}}; \overline{\boldsymbol{\alpha_1}}); (\underline{\boldsymbol{\alpha_2}}; \overline{\boldsymbol{\alpha_2}}); \ldots; (\underline{\boldsymbol{\alpha_n}}; \overline{\boldsymbol{\alpha_n}}) \right)$$

representing a complex formula system of perplexedly connected operands. In fact,

$$\mathfrak{B}\lceil \alpha_1, \alpha_2, \ldots, \alpha_n \rceil \rightleftharpoons (\mathfrak{B}\lceil \alpha_1 \rceil; \mathfrak{B}\lceil \alpha_2 \rceil; \ldots; \mathfrak{B}\lceil \alpha_n \rceil)$$

Although the basic α-named informational space seems to be a straightforward concept, the recursive nature is hidden behind its informonic and entroponic component, that is, within informon $\underline{\boldsymbol{\alpha}}$ and entropon $\overline{\boldsymbol{\alpha}}$, respectively. This kind of recursiveness can be called the first-order informational perplexity.

10.4 Holistic Informational Space

Holistic α-named informational space, $\mathfrak{H}\lceil \alpha \rceil$, is derived recursively out of a basic informational space $(\underline{\boldsymbol{\alpha}}; \overline{\boldsymbol{\alpha}})$ as a complex formula system

$$\mathfrak{H}\lceil \alpha \rceil \rightleftharpoons \left(\begin{array}{l} (\underline{\boldsymbol{\alpha}}; \overline{\boldsymbol{\alpha}}); \\ \left(\underline{(\underline{\boldsymbol{\alpha}}; \overline{\boldsymbol{\alpha}})}; \overline{(\underline{\boldsymbol{\alpha}}; \overline{\boldsymbol{\alpha}})} \right); \\ \left(\underline{\left(\underline{(\underline{\boldsymbol{\alpha}}; \overline{\boldsymbol{\alpha}})}; \overline{(\underline{\boldsymbol{\alpha}}; \overline{\boldsymbol{\alpha}})} \right)}; \overline{\left(\underline{(\underline{\boldsymbol{\alpha}}; \overline{\boldsymbol{\alpha}})}; \overline{(\underline{\boldsymbol{\alpha}}; \overline{\boldsymbol{\alpha}})} \right)} \right); \\ \left(\begin{array}{l} \underline{\underline{\left(\underline{(\underline{\boldsymbol{\alpha}}; \overline{\boldsymbol{\alpha}})}; \overline{(\underline{\boldsymbol{\alpha}}; \overline{\boldsymbol{\alpha}})} \right)}; \overline{\left(\underline{(\underline{\boldsymbol{\alpha}}; \overline{\boldsymbol{\alpha}})}; \overline{(\underline{\boldsymbol{\alpha}}; \overline{\boldsymbol{\alpha}})} \right)}}; \\ \qquad \overline{\underline{\left(\underline{(\underline{\boldsymbol{\alpha}}; \overline{\boldsymbol{\alpha}})}; \overline{(\underline{\boldsymbol{\alpha}}; \overline{\boldsymbol{\alpha}})} \right)}; \overline{\left(\underline{(\underline{\boldsymbol{\alpha}}; \overline{\boldsymbol{\alpha}})}; \overline{(\underline{\boldsymbol{\alpha}}; \overline{\boldsymbol{\alpha}})} \right)}} \end{array} \right); \\ \quad \ldots \end{array} \right)$$

In this case, recursivness is evident on the level of α-named informational space. Informational spaces of the forms $\left(\underline{(\underline{\boldsymbol{\alpha}}; \overline{\boldsymbol{\alpha}})}; \overline{(\underline{\boldsymbol{\alpha}}; \overline{\boldsymbol{\alpha}})} \right)$, $\left(\underline{\left(\underline{(\underline{\boldsymbol{\alpha}}; \overline{\boldsymbol{\alpha}})}; \overline{(\underline{\boldsymbol{\alpha}}; \overline{\boldsymbol{\alpha}})} \right)}; \overline{\left(\underline{(\underline{\boldsymbol{\alpha}}; \overline{\boldsymbol{\alpha}})}; \overline{(\underline{\boldsymbol{\alpha}}; \overline{\boldsymbol{\alpha}})} \right)} \right), \ldots$, are higher order informational spaces, being characteristic for the so-called subconscious and superconscious layers of the conscious system.

Different holistic informational spaces, named by $\alpha_1, \alpha_2, \ldots, \alpha_n$, connected by common operands, can be meaningfully denoted by

$$\mathfrak{H}\lceil \alpha_1, \alpha_2, \ldots, \alpha_n \rceil \rightleftharpoons (\mathfrak{H}\lceil \alpha_1 \rceil ; \mathfrak{H}\lceil \alpha_2 \rceil ; \ldots ; \mathfrak{H}\lceil \alpha_n \rceil)$$

where, for $i = 1, 2, \ldots, n$,

$$\mathfrak{H}\lceil \alpha_i \rceil \rightleftharpoons \left(\begin{array}{l} \left(\underline{\boldsymbol{\alpha_i}}; \overline{\boldsymbol{\alpha_i}}\right); \\ \left(\underline{\left(\underline{\boldsymbol{\alpha_i}}; \overline{\boldsymbol{\alpha_i}}\right)}; \overline{\left(\underline{\boldsymbol{\alpha_i}}; \overline{\boldsymbol{\alpha_i}}\right)}\right); \\ \left(\underline{\left(\underline{\left(\underline{\boldsymbol{\alpha_i}}; \overline{\boldsymbol{\alpha_i}}\right)}; \overline{\left(\underline{\boldsymbol{\alpha_i}}; \overline{\boldsymbol{\alpha_i}}\right)}\right)}; \overline{\left(\underline{\left(\underline{\boldsymbol{\alpha_i}}; \overline{\boldsymbol{\alpha_i}}\right)}; \overline{\left(\underline{\boldsymbol{\alpha_i}}; \overline{\boldsymbol{\alpha_i}}\right)}\right)}\right); \\ \left(\begin{array}{l} \underline{\underline{\left(\underline{\left(\underline{\boldsymbol{\alpha_i}}; \overline{\boldsymbol{\alpha_i}}\right)}; \overline{\left(\underline{\boldsymbol{\alpha_i}}; \overline{\boldsymbol{\alpha_i}}\right)}\right)}; \overline{\left(\underline{\left(\underline{\boldsymbol{\alpha_i}}; \overline{\boldsymbol{\alpha_i}}\right)}; \overline{\left(\underline{\boldsymbol{\alpha_i}}; \overline{\boldsymbol{\alpha_i}}\right)}\right)}}; \\ \qquad \overline{\overline{\underline{\left(\underline{\left(\underline{\boldsymbol{\alpha_i}}; \overline{\boldsymbol{\alpha_i}}\right)}; \overline{\left(\underline{\boldsymbol{\alpha_i}}; \overline{\boldsymbol{\alpha_i}}\right)}\right)}; \overline{\left(\underline{\left(\underline{\boldsymbol{\alpha_i}}; \overline{\boldsymbol{\alpha_i}}\right)}; \overline{\left(\underline{\boldsymbol{\alpha_i}}; \overline{\boldsymbol{\alpha_i}}\right)}\right)}}} \end{array} \right); \\ \quad \ldots \end{array} \right)$$

10.5 Informational Space — A Consequence

A consequence of informational space introduction is the concept of recognition of subconscious and superconscious layers, as presented formally in Tab. 4. It is to stress that higher derivatives of an α-named informational space, obtained solely by the recursive (self-conscious) use of the concept, suggests an interpretation in the form of subconscious and superconscious layers. In this way, a theoretical formalistic concept suggests the existence or, at least theoretically widened understanding, of subconscious and superconscious layers within the study of live and artificial conscious systems.

The case proves the reasonableness of introducing informational space into the context of formalistic investigation. If, at the first glance, informon seems to be the key element of conscious system and, later on, entropon seems to be it logical supplement, informational space as a unity of named informon and named entropon seems to be a superfluous or pure artificially understood concept. However, the recursive

L.	Subconscious depth (entropons)	Superconscious height (informons)
0	α	$\underline{\alpha}$
1	$\overline{\alpha}$	$\underline{(\underline{\alpha};\overline{\alpha})}$
2	$\overline{(\underline{\alpha};\overline{\alpha})}$	$\underline{\left(\underline{(\underline{\alpha};\overline{\alpha})};\overline{(\underline{\alpha};\overline{\alpha})}\right)}$
3	$\overline{\left(\underline{(\underline{\alpha};\overline{\alpha})};\overline{(\underline{\alpha};\overline{\alpha})}\right)}$	$\underline{\left(\underline{\left(\underline{(\underline{\alpha};\overline{\alpha})};\overline{(\underline{\alpha};\overline{\alpha})}\right)};\overline{\left(\underline{(\underline{\alpha};\overline{\alpha})};\overline{(\underline{\alpha};\overline{\alpha})}\right)}\right)}$
4	$\overline{\left(\underline{\left(\underline{(\underline{\alpha};\overline{\alpha})};\overline{(\underline{\alpha};\overline{\alpha})}\right)};\overline{\left(\underline{(\underline{\alpha};\overline{\alpha})};\overline{(\underline{\alpha};\overline{\alpha})}\right)}\right)}$	$\underline{\left(\underline{\left(\underline{\left(\underline{(\underline{\alpha};\overline{\alpha})};\overline{(\underline{\alpha};\overline{\alpha})}\right)};\overline{\left(\underline{(\underline{\alpha};\overline{\alpha})};\overline{(\underline{\alpha};\overline{\alpha})}\right)}\right)};\overline{\left(\underline{\left(\underline{(\underline{\alpha};\overline{\alpha})};\overline{(\underline{\alpha};\overline{\alpha})}\right)};\overline{\left(\underline{(\underline{\alpha};\overline{\alpha})};\overline{(\underline{\alpha};\overline{\alpha})}\right)}\right)}\right)}$
5	$\overline{\left(\underline{\left(\underline{\left(\underline{(\underline{\alpha};\overline{\alpha})};\overline{(\underline{\alpha};\overline{\alpha})}\right)};\overline{\left(\underline{(\underline{\alpha};\overline{\alpha})};\overline{(\underline{\alpha};\overline{\alpha})}\right)}\right)};\overline{\left(\underline{\left(\underline{(\underline{\alpha};\overline{\alpha})};\overline{(\underline{\alpha};\overline{\alpha})}\right)};\overline{\left(\underline{(\underline{\alpha};\overline{\alpha})};\overline{(\underline{\alpha};\overline{\alpha})}\right)}\right)}\right)}$	$\underline{\left(\underline{\left(\underline{\left(\underline{\left(\underline{(\underline{\alpha};\overline{\alpha})};\overline{(\underline{\alpha};\overline{\alpha})}\right)};\overline{\left(\underline{(\underline{\alpha};\overline{\alpha})};\overline{(\underline{\alpha};\overline{\alpha})}\right)}\right)};\overline{\left(\underline{\left(\underline{(\underline{\alpha};\overline{\alpha})};\overline{(\underline{\alpha};\overline{\alpha})}\right)};\overline{\left(\underline{(\underline{\alpha};\overline{\alpha})};\overline{(\underline{\alpha};\overline{\alpha})}\right)}\right)}\right)};\overline{\left(\underline{\left(\underline{\left(\underline{(\underline{\alpha};\overline{\alpha})};\overline{(\underline{\alpha};\overline{\alpha})}\right)};\overline{\left(\underline{(\underline{\alpha};\overline{\alpha})};\overline{(\underline{\alpha};\overline{\alpha})}\right)}\right)};\overline{\left(\underline{\left(\underline{(\underline{\alpha};\overline{\alpha})};\overline{(\underline{\alpha};\overline{\alpha})}\right)};\overline{\left(\underline{(\underline{\alpha};\overline{\alpha})};\overline{(\underline{\alpha};\overline{\alpha})}\right)}\right)}\right)}\right)}$

Table 4: The super-subconscious hierarchy where layers (L.) penetrate into the superconscious height and subconscious depth of named entity α.

informonic-entroponic use of named informational space opens a new perspective into the deepness of subconsciousness and into the highness of superconscious, both functioning as recursive metaconcepts to each other and to themselves. In this way, informational complexity becomes put wide into the realm of subconscious deepness and superconscious highness of emerging conscious systems.

In Tab. 4, α is the named entity emerging from the basic subconscious Layer 0 (as an initial idea), and $\underline{\boldsymbol{\alpha}}$, the informon, is its conscious interpretation. Informon can be grasped also as an entity of Layer 0 superconscious presentation. However, entropon $\overline{\boldsymbol{\alpha}}$ is already a proper subconscious conglomerat of informational lumps and regularities concerning α in the subconscious Layer 1.

From now on, both informon $\underline{\boldsymbol{\alpha}}$ and entropon $\overline{\boldsymbol{\alpha}}$ begin to play the common role as informational space constituted as a formula system $(\underline{\boldsymbol{\alpha}};\overline{\boldsymbol{\alpha}})$. Informons and entropons of informational spaces come into the game of the conscious surface. On the superconscious Level 1, the informon of informonic-entroponic union, $\underline{\boldsymbol{(}\underline{\boldsymbol{\alpha}}\boldsymbol{;}\overline{\boldsymbol{\alpha}}\boldsymbol{)}}$, appears and, simultaneously, the subconscious Level 2 as $\overline{\boldsymbol{(}\underline{\boldsymbol{\alpha}}\boldsymbol{;}\overline{\boldsymbol{\alpha}}\boldsymbol{)}}$ can come into existence.

In Tab. 4, it is evident how further superconscious and subconscious layers of the α-named informonic and entroponic entities, extending to higher layers, come into existence. The recursive emerging of entities can extend as subconsciously deep and as superconsciously high as situations and attitudes (actual intentions) manage the emerging informational situations.

10.6 Informational Space Implication

Recursively, in a conscious system, a named informational space is the generator of higher order named informational spaces, in the sense,

$$
\begin{array}{l}
\alpha \Longrightarrow \underline{\boldsymbol{\alpha}}; \\
\underline{\boldsymbol{\alpha}} \Longrightarrow (\underline{\boldsymbol{\alpha}};\overline{\boldsymbol{\alpha}}); \\
(\underline{\boldsymbol{\alpha}};\overline{\boldsymbol{\alpha}}) \Longrightarrow \Big(\underline{\boldsymbol{(}\underline{\boldsymbol{\alpha}}\boldsymbol{;}\overline{\boldsymbol{\alpha}}\boldsymbol{)}};\overline{\boldsymbol{(}\underline{\boldsymbol{\alpha}}\boldsymbol{;}\overline{\boldsymbol{\alpha}}\boldsymbol{)}}\Big); \\
\Big(\underline{\boldsymbol{(}\underline{\boldsymbol{\alpha}}\boldsymbol{;}\overline{\boldsymbol{\alpha}}\boldsymbol{)}};\overline{\boldsymbol{(}\underline{\boldsymbol{\alpha}}\boldsymbol{;}\overline{\boldsymbol{\alpha}}\boldsymbol{)}}\Big) \Longrightarrow \bigg(\underline{\Big(\underline{\boldsymbol{(}\underline{\boldsymbol{\alpha}}\boldsymbol{;}\overline{\boldsymbol{\alpha}}\boldsymbol{)}}\boldsymbol{;}\overline{\boldsymbol{(}\underline{\boldsymbol{\alpha}}\boldsymbol{;}\overline{\boldsymbol{\alpha}}\boldsymbol{)}}\Big)};\overline{\Big(\underline{\boldsymbol{(}\underline{\boldsymbol{\alpha}}\boldsymbol{;}\overline{\boldsymbol{\alpha}}\boldsymbol{)}}\boldsymbol{;}\overline{\boldsymbol{(}\underline{\boldsymbol{\alpha}}\boldsymbol{;}\overline{\boldsymbol{\alpha}}\boldsymbol{)}}\Big)}\bigg); \\
\ldots
\end{array}
$$

11 Phenomenal and Sensory Informational Spaces

11.1 Introduction to Qualia

In philosophy of mind, some sorts of informational spaces are understood as *qualia*. Qualia is *experience* which cannot be adequately, in fact, directly communicated to other conscious entities (individuals). E.g., the redness[2], the experience of the red, cannot be communicated as an individual feeling (cognition, emotion, physicalism) directly to other conscious entities, it can be only individually experienced. What an individual in fact sees as the red in his mind remains the experiencing of himself and cannot be characterized. In this sense, the mind colorism as qualia can be extended to sensory-phenomenal events, however, also to the meaning of an emerging ethnic language in a conscious state. It seems that qualia is a general principle of an individual mind when something is being emerged as individual experience to the conscious surface.

Certainly, various and to some extent similar definitions can be discussed concerning qualia. Qualia are most simply defined as the properties of sensory experiences by virtue of which there is something it is like to have them. These properties are, by definition, epistemically unknowable in the absence of direct experience of them and, in this way, they are incommunicable. In this view, an ethnic-language experience concerning meaning of words and sentences, can be understood as language qualia. Similar concerns the perception of pictures and melodies where the direct experience of it remains incommunicable. For instance, α, α, and α is experienced as ethnic-language-like, pictorial, and sound-like object named α, respectively. Such an example is the object called Mona Lisa. Entity $\mathfrak{m}_{\mathrm{Mona\_Lisa}}$ is a description in ethnic language of the face and painting of Mona Lisa. Operand $\mathfrak{m}_{\mathrm{Mona\_Lisa}}$ is the painting of Mona Lisa made by Leonardo da Vinci and operand $\mathfrak{m}_{\mathrm{Mona\_Lisa}}$ is a song and melody named Mona Lisa. The summary of these phenomenal objects can be denoted as a system by (abstract) informational notation $\mathfrak{m}_{\mathrm{Mona\_Lisa}} \rightleftharpoons \Big(\mathfrak{m}_{\mathrm{Mona\_Lisa}};\ \mathfrak{m}_{\mathrm{Mona\_Lisa}};$

[2]How to communicate to the blind the experience of the red or any other color?

$\mathfrak{m}_{\text{Mona\_Lisa}}\big)$.

In a musical where song and music are harmonically (emotionally) perplexed, the song named $\mathfrak{m}_{\text{Mona\_Lisa}}$ can be individually comprehended as a language-musical operand $\mathfrak{m}_{\text{Mona\_Lisa}}$ or as a music-language-like $\mathfrak{m}_{\text{Mona\_Lisa}}$. To somebody, the melody is dominant, to somebody else the text of the song is preferred. Also, the first association could be distinctively pictorial, e.i., $\mathfrak{m}_{\text{Mona\_Lisa}}$ or $\mathfrak{m}_{\text{Mona\_Lisa}}$. Other possible cases of perception are, for instance, melody-language-pictorial $\mathfrak{m}_{\text{Mona\_Lisa}}$, melody-pictorial-language-like $\mathfrak{m}_{\text{Mona\_Lisa}}$, etc. These cases of mixed sensory and phenomenal (ethnic-language-like) possibilities show the perplexed informational organization happening in a conscious system.

In a foreign language, the adequate perception of meaning (language in use) remains unexperienced to the foriegn speaker. The foreign mind behaves as a stranger in the province of minds which home is the foreign language. For it, the foreign language remains partly as qualia and partly understood in the reference of its own ethnic language. Already the meaning of words does not coincede in two different ethnic languages, neither the languages' idioms.

11.2 Symbolism for Informational, Ethnic-language, Picture, and Sound Presentation

In *informational phenomenalism* four kinds of formalism can be clearly distinguished. The first formalism is the so-called *informational* where formal expressions appear in the black script on the white background, e.g., α. This formalism represents the most abstract level uniting other kinds of possible formalisms as, for instance, the formalisms of ethnic-language, picture, and sound phenomena presentation. Certainly, other kinds of formalisms for newly recognized phenomenal-sensory experience can be added. In Table 5 examples of the four kinds of symbolisms are presented.

The table introduces four sorts of comparative formal languages

(3)-, $\mathfrak{L}$-, $\mathfrak{V}$-, $\mathfrak{S}$-language	**Explanation for informational (3), ethnic-language $\mathfrak{L}$, visual $\mathfrak{V}$, sound $\mathfrak{S}$ expression**
$\alpha, (), \models$	Informational operand, parenthesis pair, and operator
α, $\square$, $\models$	Ethnic-language operand, parenthesis pair, and operator
α, $\square$, $\models$	Visual operand, parenthesis pair, and operator
α, $\square$, $\models$	Sound operand, parenthesis pair, and operator
$\lfloor\,\rfloor$, $\lfloor\,\rfloor$, $\lfloor\,\rfloor$, $\lfloor\,\rfloor$	Informational, ethnic-language, visual, and sound *floor* parenthesis pair
$\lceil\,\rceil$, $\lceil\,\rceil$, $\lceil\,\rceil$, $\lceil\,\rceil$	Informational, ethnic-language, visual, and sound *ceil* parenthesis pair
$(\underline{\alpha};\overline{\alpha})$	Informational space, named α
$\underline{\alpha};\overline{\alpha}$	Ethnic-language informational space, named α
$\underline{\alpha};\overline{\alpha}$	Visual informational space, named α
$\underline{\alpha};\overline{\alpha}$	Sound informational space, named α
$\underline{\mathfrak{z}}\lceil(\underline{\alpha};\overline{\alpha})\rceil$	Informational consciousness $\mathfrak{z}$ concerning α
$\underline{\mathfrak{z}}\lceil \underline{\alpha};\overline{\alpha} \rceil$	Ethnic-language informational consciousness $\mathfrak{z}$ concerning α, where $\underline{\mathfrak{z}} \rightleftharpoons \underline{\mathfrak{c}\text{consciousness}}$
$\underline{\mathfrak{z}}\lceil \underline{\alpha};\overline{\alpha} \rceil$	Visual informational consciousness $\mathfrak{z}$ concerning α, where $\underline{\mathfrak{z}} \rightleftharpoons \underline{\mathfrak{c}\text{consciousness}}$
$\underline{\mathfrak{z}}\lceil \underline{\alpha};\overline{\alpha} \rceil$	Sound informational consciousness $\mathfrak{z}$ concerning α, where $\underline{\mathfrak{z}} \rightleftharpoons \underline{\mathfrak{c}\text{consciousness}}$

Table 5: Meaning of symbols representing basic and complex organization of informational, ethnic-language, visual and sound entities and, through these, the formal meaning complexity originating in recursively constituted symbolism.

concerning the informational, ethnic-language, visual, and sound phenomenalism, as $(\mathfrak{Z})$, $\boxed{\mathfrak{L}}$, $\boxed{\mathfrak{V}}$, $\boxed{\mathfrak{S}}$, respectively.

Some of the most relevant areas of human thought and communication are the phenomenal-sensory kinds of informational formalization concerning ethnic-language, visual and sound structure and organization, using the brown-, red- and orchid-colored background, e.g., $\boxed{\alpha}$, $\boxed{\alpha}$ and $\boxed{\alpha}$, respectively, for the α-named operand. Introduction of corresponding colored parenthesis pairs $\boxed{\ }$, $\boxed{\ }$ and $\boxed{\ }$, floor parenthesis pairs $\boxed{\lfloor\ \rfloor}$, $\boxed{\lfloor\ \rfloor}$ and $\boxed{\lfloor\ \rfloor}$, and ceil parenthesis pairs $\boxed{\lceil\ \rceil}$, $\boxed{\lceil\ \rceil}$ and $\boxed{\lceil\ \rceil}$,

The next example in Table 5 is the α-named informational space, as $(\underline{\boldsymbol{\alpha}};\overline{\boldsymbol{\alpha}})$, $\boxed{\underline{\boldsymbol{\alpha}};\overline{\boldsymbol{\alpha}}}$, $\boxed{\underline{\alpha};\overline{\alpha}}$ and $\boxed{\underline{\alpha};\overline{\alpha}}$, respectively. These spaces are named systems with distinguished conscioous $\left(\underline{\boldsymbol{\alpha}}, \boxed{\underline{\boldsymbol{\alpha}}}, \boxed{\underline{\alpha}}, \boxed{\underline{\alpha}}\right)$ and subconscious $\left(\overline{\boldsymbol{\alpha}}, \boxed{\overline{\boldsymbol{\alpha}}}, \boxed{\overline{\alpha}}, \boxed{\overline{\alpha}}\right)$ components.

The last example deals with systems of consciousnes, in the forms $\underline{\mathfrak{z}}$, $\boxed{\underline{\mathfrak{z}}}$, $\boxed{\underline{\mathfrak{z}}}$, $\boxed{\underline{\mathfrak{z}}}$, denoted as $\underline{\mathfrak{z}}\lceil(\underline{\boldsymbol{\alpha}};\overline{\boldsymbol{\alpha}})\rceil$, $\boxed{\underline{\mathfrak{z}}\left\lceil\boxed{\underline{\boldsymbol{\alpha}};\overline{\boldsymbol{\alpha}}}\right\rceil}$, $\boxed{\underline{\mathfrak{z}}\left\lceil\boxed{\underline{\alpha};\overline{\alpha}}\right\rceil}$, and $\boxed{\underline{\mathfrak{z}}\left\lceil\boxed{\underline{\alpha};\overline{\alpha}}\right\rceil}$, each of them concerning the specific α-informational space, where ceil parenthesis pairs of different sorts (colors) are used. These examples are of straightforward form, and the mixed examples, e.g., $\boxed{\underline{\mathfrak{z}}\left\lceil\boxed{\underline{\alpha};\overline{\alpha}}\right\rceil}$, $\boxed{\underline{\mathfrak{z}}\left\lceil\boxed{\underline{\alpha};\overline{\alpha}}\right\rceil}$, or even $\boxed{\underline{\mathfrak{z}}\left\lceil\boxed{\underline{\alpha};\boxed{\overline{\alpha}}}\right\rceil}$, are not discussed. The reader can now imagine other possible types of mixed informational phenomenalism.

11.3 Informational Formulas of Qualia

Informational formula is used for a precise expression of meaning in any sort of phenomenalism. The formula is nothing else than a precise, unambiguos meaning of something. The meaning is understood as the use of any particular language in a conscious environment. In this sense, the meaningful information is a matter of conscious systems, is the means of perplexed communication emerging within their informational interaction. In a general informational implicit form, the eight types of formulas are

$$\begin{array}{ll} \varphi_{\rightarrow}\lfloor\alpha_1,\ldots,\alpha_{n_{\rightarrow}}\rfloor, & \varphi_{\leftarrow}\lfloor\alpha_1,\ldots,\alpha_{n_{\leftarrow}}\rfloor, \\ \varphi_{\rightleftarrows}\lfloor\alpha_1,\ldots,\alpha_{n_{\rightleftarrows}}\rfloor, & \varphi_{\rightarrow,\leftarrow}\lfloor\alpha_1,\ldots,\alpha_{n_{\rightarrow,\leftarrow}}\rfloor, \\ \varphi^{\circlearrowleft}_{\rightarrow}\lfloor\alpha_1,\ldots,\alpha_{n^{\circlearrowleft}_{\rightarrow}}\rfloor, & \varphi^{\circlearrowleft}_{\leftarrow}\lfloor\alpha_1,\ldots,\alpha_{n^{\circlearrowleft}_{\leftarrow}}\rfloor, \\ \varphi^{\circlearrowleft}_{\rightleftarrows}\lfloor\alpha_1,\ldots,\alpha_{n^{\circlearrowleft}_{\rightleftarrows}}\rfloor, & \varphi^{\circlearrowleft}_{\rightarrow,\leftarrow}\lfloor\alpha_1,\ldots,\alpha_{n^{\circlearrowleft}_{\rightarrow,\leftarrow}}\rfloor, \end{array}$$

representing serial. reverse serial, biserial, split biserial, circular serial. circular reverse serial, circular biserial, and circular split biserial formula, respectively. Thus, for instance,

$$\begin{array}{llll} (1) & \boxed{\varphi_{\rightarrow}\lfloor\alpha_1,\ldots,\alpha_{n_{\rightarrow}}\rfloor}, & (2) & \boxed{\varphi_{\leftarrow}\boxed{\lfloor\alpha_1,\ldots,\alpha_{n_{\leftarrow}}\rfloor}}, \\ (3) & \boxed{\varphi_{\rightleftarrows}\left\lfloor\boxed{\alpha_1},\ldots,\boxed{\alpha_{n_{\rightleftarrows}}}\right\rfloor}, & (4) & \boxed{\varphi_{\rightarrow,\leftarrow}\boxed{\left\lfloor\boxed{\alpha_1,\ldots,\alpha_{n_{\rightarrow,\leftarrow}}}\right\rfloor}}, \\ (5) & \boxed{\varphi^{\circlearrowleft}_{\rightarrow}\boxed{\left\lfloor\boxed{\alpha_1,\ldots,\boxed{\alpha_{n^{\circlearrowleft}_{\rightarrow}}}}\right\rfloor}}, & (6) & \boxed{\varphi^{\circlearrowleft}_{\leftarrow}\lfloor\alpha_1,\ldots,\alpha_{n^{\circlearrowleft}_{\leftarrow}}\rfloor}, \\ (7) & \boxed{\varphi^{\circlearrowleft}_{\rightleftarrows}\lfloor\alpha_1,\ldots,\alpha_{n^{\circlearrowleft}_{\rightleftarrows}}\rfloor}, & (8) & \varphi^{\circlearrowleft}_{\rightarrow,\leftarrow}\left\lfloor\boxed{\alpha_1},\boxed{\ldots},\boxed{\alpha_{n^{\circlearrowleft}_{\rightarrow,\leftarrow}}}\right\rfloor \end{array}$$

These qualia-uniform and qualia-mixed formulas can now be commented into more details. Formulas (1), (6) and (7) are paragons of uniform etnic-language, picture and sound formulas, respectively. Formulas (2), (3), (4), and (5) are qualitatively mixed (differently colored), as seen from the upper array. Formula (8) has its abstact (uncolored) part and colored segments.

As one can see, the relation of informational formula floor-parenthesizing $(\lfloor, \rfloor)$ can be put in a qualitative environment in essentially various ways. In the so-called uniformly colored formulas (1), (6) and (7), there is no dilemma. In (2), the symbolic formula pictorial operand segment $\boxed{\lfloor\alpha_1,\ldots,\alpha_{n_{\leftarrow}}\rfloor}$ appears in the etnic-language formula environment $\boxed{\varphi_{\leftarrow}}$. This means, explicitly, for instance, taking into account the setting of pictorial perenthesis pairs $\boxed{}$,

$$
{}_{1}\varphi_{\leftarrow}\, \lfloor \alpha_1, \ldots, \alpha_{n_\leftarrow} \rfloor \rightleftharpoons
$$

$$
\left(\boxed{\boxed{\boxed{\ldots \boxed{\boxed{\alpha_1 \Dashv \alpha_2} \Dashv \alpha_3} \ldots \Dashv \alpha_{p-2}} \Dashv \alpha_{p-1}} \Dashv \alpha_p} \right)
$$

where $p = n_\leftarrow$. The last case of possible parenthesizing is

$$
{}_{\frac{1}{n_\leftarrow}\binom{2n_\leftarrow - 2}{n_\leftarrow - 1}}\varphi_{\leftarrow}\, \lfloor \alpha_1, \ldots, \alpha_{n_\leftarrow} \rfloor \rightleftharpoons
$$

$$
\left(\boxed{\alpha_1 \Dashv \boxed{\alpha_2 \Dashv \boxed{\alpha_3 \ldots \Dashv \boxed{\alpha_{p-2} \Dashv \boxed{\alpha_{p-1} \Dashv \alpha_p}} \ldots}}} \right)
$$

where $\frac{1}{n_\leftarrow}\binom{2n_\leftarrow - 2}{n_\leftarrow - 1} = \mathbb{N}_\leftarrow$ (see $\mathbb{N}_\leftarrow$ in Table 3, p. 51). Here, $\rightleftharpoons$ and the parenthesis pair (,) on the right side of operator $\rightleftharpoons$ function as informational symbols (a kind of metasymbols in the qualitative or qualia environment). As something new, the ethnic-language formula background appears in the form ${}_{1}\varphi_{\leftarrow}$ and ${}_{\frac{1}{n_\leftarrow}\binom{2n_\leftarrow - 2}{n_\leftarrow - 1}}\varphi_{\leftarrow}$. In this case, something pictorial, $\boxed{}$, is recognized within an ethnic language directly (language-likely), comparable with the name ${}_{1}\varphi_{\leftarrow}$ or the name ${}_{\frac{1}{n_\leftarrow}\binom{2n_\leftarrow - 2}{n_\leftarrow - 1}}\varphi_{\leftarrow}$ of the something. On the other hand, by ${}_{1}\varphi_{\leftarrow}$ and ${}_{\frac{1}{n_\leftarrow}\binom{2n_\leftarrow - 2}{n_\leftarrow - 1}}\varphi_{\leftarrow}$, two different meanings of the pictorial are presented, rooting in different settings of pictorial parenthesis pairs $\boxed{}$. And, correctly, the right sides of both formulas appear within the ethnic-language background . The scheme for both formulas is unique, that is,

$$\alpha_1 \Dashv \alpha_2 \Dashv \alpha_3 \ldots \Dashv \alpha_{n_\leftarrow - 2} \Dashv \alpha_{n_\leftarrow - 1} \Dashv \alpha_{n_\leftarrow}$$

and out of this scheme, $\frac{1}{n_\leftarrow}\binom{2n_\leftarrow - 2}{n_\leftarrow - 1}$ different formulas can be visually parenthesized and, through that, interpreted in an ethnic-language schematically (superficially) — — or, meaningly rigorously (strictly parenthesized) — — .

12 Conscious Informational Systems

12.1 Introducing Informational Conscious Environment

To make a machine or tool conscious (spiritual, [4], complex, [1]) is a dream of then man has developed its own constructive consciousness. Nowadays, by informational technology, this dream becomes a reality and question of time laying before human mind as the very next challenge.

In an informational conscious system (ICS) all its operands are connected through common operands occurring in their informational formulas or schemes determining the meaning of operands explixitly or implicitly. The *explicit meaning* or definition of an operand is meant when the operand stands on the very first place of a formula or formula scheme. Otherwise, the meaning of the operand is defined *implicitly*, in the context with other operands. This kind of expressions exist within the system components belonging to conscious, subconscious, and superconscious domains. For these operands of the system we say that they are conscious entities, which meaning is determined by formulas, schemes, formula systems, and formula scheme systems.

A new informational operand, α, being not conscious yet, enters in a conscious domain of the system or becomes conscious within it, $(\underline{\boldsymbol{\alpha}};\overline{\boldsymbol{\alpha}})$, when it becomes expressed as a formula- or scheme-like form of common (already existing) conscious operands. Through informing of α-space $(\underline{\boldsymbol{\alpha}};\overline{\boldsymbol{\alpha}})$, conscious, subconscious (subsubconscious), and superconscious (supersuperconscious) spaces come to existence $(\longrightarrow)$. This informational phenomenon can be schematized by

$$\alpha \longrightarrow (\underline{\boldsymbol{\alpha}};\overline{\boldsymbol{\alpha}}) \longrightarrow \left(\underline{(\underline{\boldsymbol{\alpha}};\overline{\boldsymbol{\alpha}})};\overline{(\underline{\boldsymbol{\alpha}};\overline{\boldsymbol{\alpha}})}\right) \longrightarrow$$
$$\left(\underline{\left(\underline{(\underline{\boldsymbol{\alpha}};\overline{\boldsymbol{\alpha}})};\overline{(\underline{\boldsymbol{\alpha}};\overline{\boldsymbol{\alpha}})}\right)};\overline{\left(\underline{(\underline{\boldsymbol{\alpha}};\overline{\boldsymbol{\alpha}})};\overline{(\underline{\boldsymbol{\alpha}};\overline{\boldsymbol{\alpha}})}\right)}\right) \longrightarrow \ldots$$

Operator of conscious, subconscious, and superconsciousc emergence, $\longrightarrow$, reads 'generate(s)'. Thus, $\alpha \longrightarrow (\underline{\boldsymbol{\alpha}};\overline{\boldsymbol{\alpha}})$ reads α generates conscious (informonic) and subconscious (entroponic) informational space $(\underline{\boldsymbol{\alpha}};\overline{\boldsymbol{\alpha}})$ (by naming of α, and so forth. The informonic and entroponic deepness depends on circumstances of α-s actuality in the occurring informational situation of conscious perception.

Operator $\longrightarrow$ plays an important role in the emerging of complex ICS, reaching beyond of currently arising pure (actual) conscious phenomenon. It symbolizes the transconscious informing in constituting the domains of deeper subconscious and higher superconscious levels of ICS. This situation of operator $\longrightarrow$ complex functionality can be sketched by schematic organization of ICS in Fig. 2.

Consequently, for deeper and higher levels (layers, ranks) in ICS, additional rules for subconscious and superconscious operands can be formalized, showing the way on which they become componente of ICS. For instance,

$$\left(\underline{\boldsymbol{\alpha}} \in \Phi\left\lceil\left(\underline{\mathfrak{z}};\overline{\mathfrak{z}}\right)\right\rceil\right) \Longrightarrow \left((\underline{\boldsymbol{\alpha}};\overline{\boldsymbol{\alpha}}) \in \Phi\left\lceil\left(\underline{\mathfrak{z}};\overline{\mathfrak{z}}\right)\right\rceil\right) \quad \text{or} \quad \alpha \longrightarrow (\underline{\boldsymbol{\alpha}};\overline{\boldsymbol{\alpha}})$$

If by space $\left(\underline{\mathfrak{z}};\overline{\mathfrak{z}}\right)$ conscious space is formalized, where $\overline{\mathfrak{z}}$ represents the subconscious component of rank -1, the superconscious component of rank 1 is formalized as space $\left(\underline{\left(\underline{\mathfrak{z}};\overline{\mathfrak{z}}\right)};\overline{\left(\underline{\mathfrak{z}};\overline{\mathfrak{z}}\right)}\right)$. Here, $\overline{\left(\underline{\mathfrak{z}};\overline{\mathfrak{z}}\right)}$ is the subconscious component of rank -2, Thus, the superconscious part $\underline{\left(\underline{\mathfrak{z}};\overline{\mathfrak{z}}\right)}$ has its direct subconsciously corresponding counterpart (its communication counter-correspondent) $\overline{\left(\underline{\mathfrak{z}};\overline{\mathfrak{z}}\right)}$ of subconscious rank -2. In this way, deeper and higher levels of ICS are deeply and highly connected through common operands and throughout subconscious (depth) and superconscious (superficial) layers of ICS. This means that sub- and superlayers are informationally perplexed (e.g., schematically, graphically) and cannot be distinctly separated from one layer to another.

In general, superconsciousness requires depth subconsciousness, that is, conscious superficiality requires conscious depthness. This principle of conscious communication through deeper and higher layers of ICS is recursively constituted. For instance, a higher level intuition is supported by deeper level counterintuition, informing like a form of intuition, not quite clearly known or presented on the basic level of (pure) consciousness space $\left(\underline{\mathfrak{z}};\overline{\mathfrak{z}}\right)$ (rank 0), its state of cognitice-emotional and other domains. Conscious system $\Phi\left\lceil\left(\underline{\mathfrak{z}};\overline{\mathfrak{z}}\right)\right\rceil$ is, recursively, a mixture of all the sub- and superconscious compo-

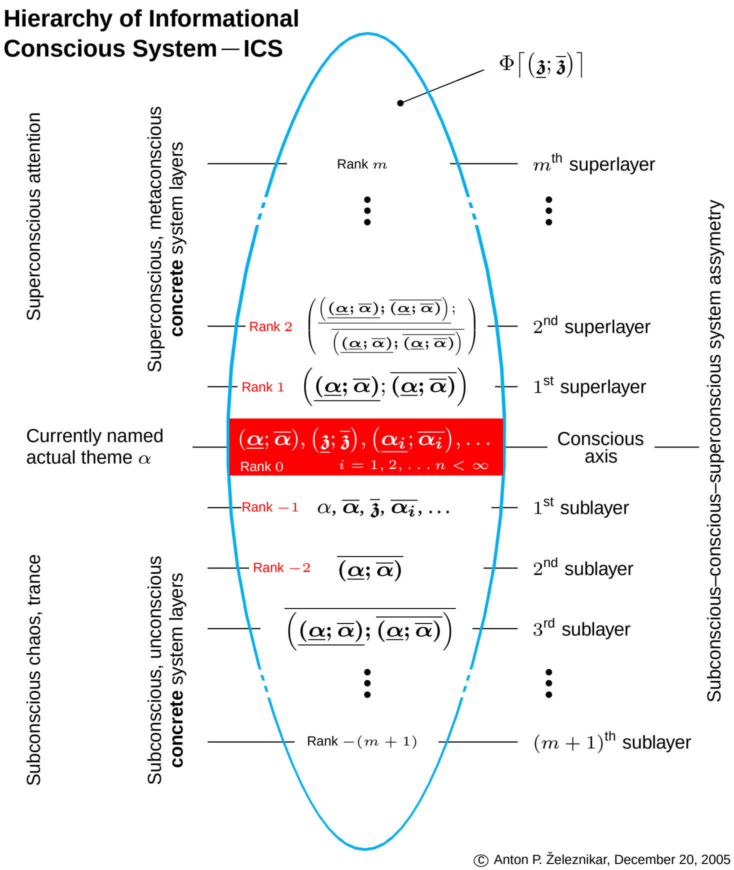


Figure 2: Transconscious informing of operator $\longrightarrow$ generates deeper subconscious and higher superconscious levels (layers, ranks) of ICS.

nents, of deeper and higher levels, positive and negative ranks, where the circular organization, for each operand named α, in the form

$$(\underline{\alpha};\overline{\alpha}) \in \Phi\lceil(\underline{\mathfrak{z}};\overline{\mathfrak{z}})\rceil \quad \text{and} \quad (\underline{\mathfrak{z}};\overline{\mathfrak{z}}) \in \Phi\lceil(\underline{\alpha};\overline{\alpha})\rceil$$

is a consequence of general connectivity of operands in ICS. In this case, $\Phi\lceil(\underline{\mathfrak{z}};\overline{\mathfrak{z}})\rceil$ and $\Phi\lceil(\underline{\alpha};\overline{\alpha})\rceil$ are representatives of one and the same

ICS. The entering in an existing ICS is possible through any of its informational operands. The operand connectivety of ICS is complete in the sense that each operand is connected directly or transitively with each other operand and itself.

Rank 0 — the conscious state — is an exeptional state of ICS in the sense that it cannot be informationally foreseen because of its emerging nature, depending on phenomenal and sensory circumstances of ICS. It does not exist in advance, is transitional and ever changing and, as such, not memorized absolutely. It can leave a trace in the experience if it was sufficiently relevant as event for the future or, for instance, for creative or exiting work.

This introductory philosophy of ICS represents the base for the design and implementation of artificial consciousness. The transition from unconscious to conscious system happens through the rise of complexity in number and circular perplexedness of informational components like cognition, emotions, attention, arousal, motivation, homeostasis, behavior, experience, etc.

The philosophy concerning the sketch of consciousness heirarchy in Fig. 2 can be explained further for the sake of ICS implementation possibilities. For instance, as a flash of wit, α rises from the subconscious level (Rank -1) to consciousness (Rank 0). Two essential possibilities can occur: if α belong to an experience, its meaning $\underline{\boldsymbol{\alpha}}$ can arise out of entropon $\overline{\boldsymbol{\alpha}}$, thus, the typical transition $\alpha \longrightarrow \overline{\boldsymbol{\alpha}} \longrightarrow \underline{\boldsymbol{\alpha}}$ is taking place, constituting α-space $(\underline{\boldsymbol{\alpha}}; \overline{\boldsymbol{\alpha}})$ of Rank 0; if there is being no experience for α yet, the meaning 'no experience exists' is generated and, in this case, α is being rejected as a consciously actual object.

The subconscious layer of Rank -1 is consequently entroponic and, in this way, informationally chaotic and not structured in the way of informational spaces. This is the domain of entropons $\overline{\boldsymbol{\alpha}}$, $\overline{\boldsymbol{\mathfrak{z}}}$, $\overline{\boldsymbol{\alpha}_i}$, and so on. Out of entropon $\overline{\boldsymbol{\alpha}}$, the name α penetrates initially in the conscious domain, so the emergence of conscious informational space $(\underline{\boldsymbol{\alpha}}; \overline{\boldsymbol{\alpha}})$ can be initiated.

The superconscious layer of Rank 1 is the domain of superconscious space, arising from conscious, subconscious,and subsubconscious domain, schematically, in detail, as,

$$\alpha \longrightarrow \overline{\boldsymbol{\alpha}} \longrightarrow \underline{\boldsymbol{\alpha}} \longrightarrow (\underline{\boldsymbol{\alpha}};\overline{\boldsymbol{\alpha}}) \longrightarrow \overline{(\underline{\boldsymbol{\alpha}};\overline{\boldsymbol{\alpha}})} \longrightarrow \underline{(\underline{\boldsymbol{\alpha}};\overline{\boldsymbol{\alpha}})} \longrightarrow \\ \left(\underline{(\underline{\boldsymbol{\alpha}};\overline{\boldsymbol{\alpha}})};\overline{(\underline{\boldsymbol{\alpha}};\overline{\boldsymbol{\alpha}})}\right)$$

Conscious and superconscious layers are not only informationally regular, formally ordered in the way of meaning, but also informationally complete in overview of conscious situation in regard to subconscious layers. These layers are used as a kind of pools of informational lumps, partly ordered and disordered, serving as a kind of association in the process of becoming conscious.

Fig. 2 has to be understood in the following way. Each form of informon generates the corresponding form of entropon, and vice versa. Thus, the superconscious layers are certainly informational space structures too. For instance, within Rank 1,

$$\left(\underline{\left(\underline{(\underline{\boldsymbol{\alpha}};\overline{\boldsymbol{\alpha}})};\overline{(\underline{\boldsymbol{\alpha}};\overline{\boldsymbol{\alpha}})}\right)} \longrightarrow \overline{\left(\underline{(\underline{\boldsymbol{\alpha}};\overline{\boldsymbol{\alpha}})};\overline{(\underline{\boldsymbol{\alpha}};\overline{\boldsymbol{\alpha}})}\right)}\right) \longrightarrow \\ \left(\underline{\left(\underline{(\underline{\boldsymbol{\alpha}};\overline{\boldsymbol{\alpha}})};\overline{(\underline{\boldsymbol{\alpha}};\overline{\boldsymbol{\alpha}})}\right)};\overline{\left(\underline{(\underline{\boldsymbol{\alpha}};\overline{\boldsymbol{\alpha}})};\overline{(\underline{\boldsymbol{\alpha}};\overline{\boldsymbol{\alpha}})}\right)}\right)$$

and so on, for the higher ranks of superconscious domain. In the subconscious domain, the entroponic informational chaos must stay preserved. Subconscious layers are characterized by entroponic spaces, being generated by the corresponding regular conscious and superconscious informational spaces.

12.2 Components of Informational Conscious System

Some fundamental components of ICS have to be discussed from the view of difference existing between natural and artificial consciousness systems. The nature of these components is known from the psychological, biological and clinical research concerning live individual conscious systems of human [2, 5]. The so-called cognitive-emotional paradigm dominates together with other consciousness-specific components within ICS like attention, motivation, homeostasis, behavior and, last but not least, the *experience*, being one of the most significant results of conscious informing.

Experience in ICS is understood as an informationally complex consequence of a conscious event, based on feeling and memorizing. However, in such a case, by feeling a broad spectrum of consciousness-relevant phenomena (specific properties) is meant, resulting, for instance, in knowing, skill, seeing, understanding, apprehending, observing, perceiving, and the like. These synonyms and related words meaning experience in ICS are tied to memorizing of conscious events and, simultaneously, together with the phenomenal enrichment like understanding and interpretation of events build up the complexity of experience. In this view, experience is throughout a memorized complexity of events, enriched by the most essential, consciously organized informational components.

Cognition seems to be the rational part of ICS, being in a vive informational interplay with *emotions*. Both, cognition and emotions are consciously determined by the use of ethnic languages, that is, as evidently existing and named informational operands. For instance, the number of different emotions and their meaning strongly depends on the use of an ethnic language. One could say that cognition and emotions—as certain abstract concepts—come to the consciousness solely through the use of language, depending on the informational developent of a concrete ethnic language. It is, for instance, hardly imaginable how to express an abstract informational entity by a painting or melodic phantasy to be comprehended by the ethnic community as a distinct and clearly understandable abstract entity of the cognitive-emotional character.

Table 6 (in two parts) shows some explicit and implicit cognitive-emotional components of conscious system. One can see how in English the components are named and, consequently, the meaning of them strongly depends on the use in common and professional language. It may happen that in other ethnic languages the meaning of cognitive-emotional components can substantially differ from that in English.

12.3 Informational Conscious System

Adaptation as problem
  solver
Adaptedness, evolutionary,
  environment
Anger
  concept of,
  formal objects of,
  responses to,
  versus rage
  versus sadness
Anger–disgust–contempt
  triad
Anxiety
  controversial states
  versus fear
Apperception
Arousal
Attention
Avoidance

Behavior
  planning of,
  affect infusion in,
  problem solving
Behaviorism
Belief systems

Civilization
  emotional expression
    and,
Closure, law of,
Cognition
  as base of emotions
  emotion and,
  versus emotions
  nature of,
Cognitive construction
Cognitive processes
  elicitors
  emergence of,
  emotion classification
    and,
  emotional experiences
    and,
Cognitive scenarios
Communication
Concepts, cognitive,
  emotional
Constructs, cognitive
Curiosity, cognitive

Decision making
Desire, cognition and,
Discourse, cognition as,

Embarrassment,
  cognitive-attributional
Emotion
  adaptation
  awareness of,
  cognitive aspects
  communicative function
  observable criteria
  versus reason
  topology of,
  understanding

Facial expressions
Fear, formal object of,

Gedanken experiments
Goal appraisal
  blocking
  orientation

Identity
Inference
Intentionality
Interpretation
Irrationality

Joy–sadness pattern

Language
  emotion and cognition in,
  ethnic
Learning, mood and,
Lexical models

Masking, backward,
Meaning, acts of,
  situational, law of,
Memory, biased of,
  content of,
  narrative,
  thinking and,
Meta-emotions
Metaphor
  emotion and cognition as,
  emotional effect of,
Moods: effects of,
  versus emotions
  learning and,
  recall dependent on,
Moral sentiments
Motivation
  emotional events and,
  emotions in,
  subconscious
  superconscious
Narrative memory
Negotiation
  positive effect and,

Panic
  expectations in control of,
  stimuli for,
Passion
Perception
  emotional intelligence and,
  emotions in organiz. of,
Planning, role of imagery
  and emotion in,
Play/joy system
Positive affect
  cognitive,
  conclusions
  decision making and,
  memory and,
  motivation and,
Powerlessness
  depression and,
Problem solving

Rage
  hierarchical control of,
Rage–anger system
Rationality
  emotional,
  cognitive,
  global and local,
Reason versus emotion
Recall
  associative,
  mood-congruent,
  mood-dependent,
Reflexivity
Relationships, emotional
  knowledge about,
Religion, love as ideal of,
Revenge, universality of,
Reverse design
  metaphysicalistic,
Risk, positive effect and,
Ritual chains, interaction
Rumination
  definition and function

Sadness
  aggression and,
  depression and,
  versus anger

Table 6: Part I. A short ad-hoc catalog of the perplexed cognition and emotion concerning components (more in [7], Subsubsect. 27.4.1, Tab. 17) in a conscious system.

versus guilt
Sadness–joy pattern
Self
Self-awareness
development of,
Self-conscious emotions
cognitive,
conclusive,
elicitation of,
neglect of,
role of self in,
Self-constructs
Self-esteem
Self-evaluation
Semantic differential
Sentiments versus emotions
Shame–anger spiral
Significance evaluation
Situational meaning
Social behavior
empathy and,
Social/cognitive
construction
Social competence
Social construction
conclusions
cognitive evaluations
culture in,
Social constructivism
Social context
emotional,
historical,
significance of,
versus temperament
Social groups
emotion decoding and,
emotion encoding and,
emotion expression in,
Social identity
emotion discourse and,
Social judgment/reasoning
affect infusion in,
mood and,
Socialization
cognitive, emotional,
Speech
cognitive, emotional,
Standards, rules, goals
Stress response
Subjective well-being
Surprise, emergence of,
Symbolic interaction
Sympathy
as derivation process
versus empathy
negative moral outcomes
and,

Tabula rasa concepts
Temperament
concepts of,
emotional construct of,
conclusion, empathy and,
Thinking
cognitive and emotional,
Thoughts
memories, and feelings
Threat
detection of,
discovering of,
perceived,
Trauma
cognitively identified,
fear, anxiety and,
linguistic expression of,

Unconscious
Freudian,
in anxiety and fear
Understanding
cognitive,
emotional,
Universality
of cognition and emotion
versus cultural specificity

Verstehen, philosophy of,
Vulnerability
concept of,
depression and,

Well-being, subjective
We-self versus I-self

Table 6: Part II. A short ad-hoc catalog of the perplexed cognition and emotion concerning components (more in [7], Subsubsect. 27.4.1, Tab. 17) in a conscious system.

13 Design of Conscious Informational Entities

xx

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Index of Symbols, Subjects, and Authors

Symbols

A

B

C

D

E

O

S

T

U

Z

[7], 77