Informational Graphs

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Informational graph seems to be one of the most basic underlying structures (circuits [1, 4], frontal lobes functions [10], schemata [15], impressions, etc.) for the concept and possibilities of informing and its understanding. The graph behaves as a regular parallel informational system of formulas (entities) with its own possibilities of informational spontaneity and circularity. By means of informational graph, it is possible to explain the origin of the so-called informational gestalt and, besides, the arising of informational formulas especially concerning the so-called causality in regard to the position of the formula parenthesis pairs. Another view of the graph lies in the moving along the arrows in the graph, that is, a formula construction, when choosing a path and setting parenthesis pairs in the emerging well-formed formula, in a spontaneous and circular way. This approach, together with the arising of the graph itself, can represent one of the keystones of the informational arising of formulas, the vanishing of their parts, and the changing of the structure during the informational moving through the graph. The paper shows how the informational graph can be understood by the phenomenalism of informational gestalts exerting the causal possibilities of formulas with the same length but differently displaced parenthesis pairs. Several examples are formalized.

1 Introduction

Informational graph[1] is a graphical imitation (informational presentation, and circuits [4], frontal lobes functions [10], schemata [15] in the neurological sense) of a serial informational formula system (a system of parallel serial formulas) or also a parallel system of basic (atomic) informational transitions (without any parentheses pairs). Informational graph performs like an imprint along which different formula interpretations are possible. In this sense, an informational graph preserves the sequence (direction) of the occurring informational operands and operators, but does not consider (that is, ignores) the parenthesis pairs of original (initial) formulas. As such, it appears as a schematic pattern of operands and operators, in which the user can set parenthesis pairs spontaneously, getting an arbitrary causal dependence of operands (informational entities) within the graph's pattern[2].

Informational graphs can be comprehended as generalizations of informational formulas (as parallel systems of certain serial formulas) from which various formula reconstructions are possible, the number of which depends on the involved informational operators, that is, on the formula *length.* The number of possible graph interpre-

[1]This paper is a private author's work and no part of it may be used, reproduced or translated in any manner whatsoever without written permission except in the case of brief quotations embodied in critical articles.

[2]Informational phenomenalism joins the terms representing phenomenology, ontology and causation in regard to an informational entity. An informational operator $\models$ exerts an existential (Being-like) as well as causal property of the operand(s), to which the operator belongs (connects them).

tations by formulas grows rapidly by the number of the occurring binary operators in the formula as we shall show in the study which follows. We shall learn also in which way the most rational (unique) formal description of an informational graph is possible and how interpretations of the circular graphs by circular formulas can carry a substantial degree of expressional redundancy.

On the other side we have to determine a set of new concepts concerning graphs and their interpretations especially by *informational gestalts.* It has to be answered rigorously what does an informational graph represent and how can it be used for the generation (emerging) of different formula interpretations. For the sake of the understanding clarity we can introduce special primitive graphical symbols by which graphs of any complexity can be presented in the form of graphical sketches (schemes, circuits). For example, complex circular informational graphs can be studied from the different points of view. On one side, such a graph appears as a relatively clear picture to the user; on the second side it can be described formally in the most rational form by a parallel system of the primitive informational transitions; on the third side, it can be expressed by a parallel system of arbitrary serial and circularly serial formulas, considering only those of them which in a given case represent the reality (rationality) of the problem.

An informational graph represents all possible interpretations which number depends solely on the involved binary operators. Additionally, as interpretations of the graphs, the so-called star gestalts of graphs can be introduced which illustrate the moving through the graph from an initial operand, constructing serial and circularly serial formulas of different lengths, for example from the length $\ell = 1$ (basic or atomic transition) on to an arbitrary length $\ell = n$. Thus, systems of formulas belonging to a circular star gestalt from a circular graph can be constructed (by a parenthesizing) in an arbitrarily lasting way.

Informational graphs are visual (texts, images), acoustic (voices, music, noise), tactile (Braille script), taste (food evaluation), smelling (perfume competition), etc. They are static and dynamic. Some practical examples of static informational graphs are literature texts, artistic pictures, drawings, music notes, etc. Examples of dynamic informational graphs are theatre performance, TV and radio transmissions (mixed visual and acoustic), everyday happenings in characteristic situations (common patterns of behavior and uncommon reactions), etc. For all these graphs it is typical that they are not 'parenthesized'. Understanding of the mentioned phenomena (together with Parenthesizing, causation, interpretation) is left to the observer. It means that the causal structuring of a graph belongs to the domain of the observer and that different observers can causally-differently structure one and the same static or dynamic informational graph.

2 Elements of Informational Graphs

Elements of informational graphs are circles (or ovals, if their informational markers are longer or complex) and arrows (vectors). Parallel and alternative input and output buses contribute only to the compactness of graphs. Circles (operand atoms) are marked by operands which represent informational entities in informational formulas. Arrows (operator atoms) are marked and unmarked. Unmarked arrows represent the most general operator $\models$ and are used also in situations where all of the unmarked arrows belong to one and the same operator, e.g., to the implication operator $\Longrightarrow$ in the global implication axioms of Hilbert [8]. The symbolic atoms of informational graphs are presented in Fig. 1.

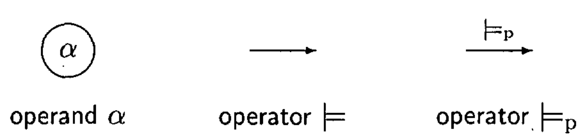


Figure 1: *Graphical symbols for informational operands and operators (atomic elements).*

The symbols in Fig. 1 can be connected in the form of a graph representing a formula or formula system, but without parenthesis pairs. In this way the order of operands and operators remains preserved (exactly in cases of a single formula, and to some extent in cases of formula systems).

In Fig. 2 some elementary graphs for the most basic phenomenal occurrences of an informational entity α are presented. These occurrences are

(1) operand (entity) α *as such,*

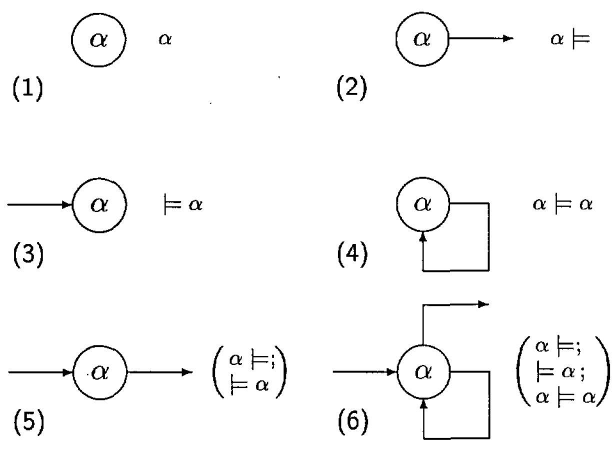


Figure 2: *Informational graphs for the basic (phenomenalistically structured) informational formulas.*

(2) α's *externalism* $\alpha \models$ (informing for others),

(3) α's *internalism* $\models \alpha$ (informing for itself),

(4) α's *metaphysicalism* $\alpha \models \alpha$ (informing in or within itself),

(5) α's *phenomenalism* $(\alpha \models; \models \alpha)$ (informing as such), and

(6) for the sake of clarity, the *entire modus agendi*[3] of an informing entity α, that is, its phenomenalistic and simultaneously metaphysicalistic informing as a system of $(\alpha \models; \models \alpha; \alpha \models \alpha)$.

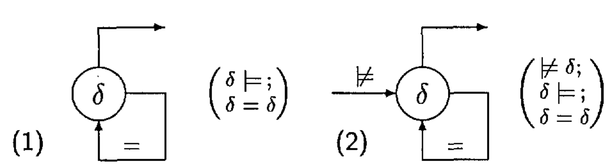


Figure 3: *Informational graphs representing (phenomenalistically) the structure of data δ.*

Data, marked by δ, is a characteristic informational entity which can be graphically presented by a particularized graph being essentially different from the modus agendi belonging to a general informational entity, marked by α. The data graph is sketched in Fig. 3, where the feedback loop is marked by the equality operator '=', realizing the metaphysical situation $\delta = \delta$, belonging to data. In case (2) one can introduce also the explicit operator of non-informedness of data δ, that is $\not\models \delta$. In this case, the non-informedness of δ means the absence or impossibility of any exterior or interior impact on data δ.

In the case of input and/or output parallelism concerning an informational entity α, we introduce, for the sake of graphical transparency, a kind of input and output lines (parallel buses), respectively. Some specific cases are presented in Fig. 4.

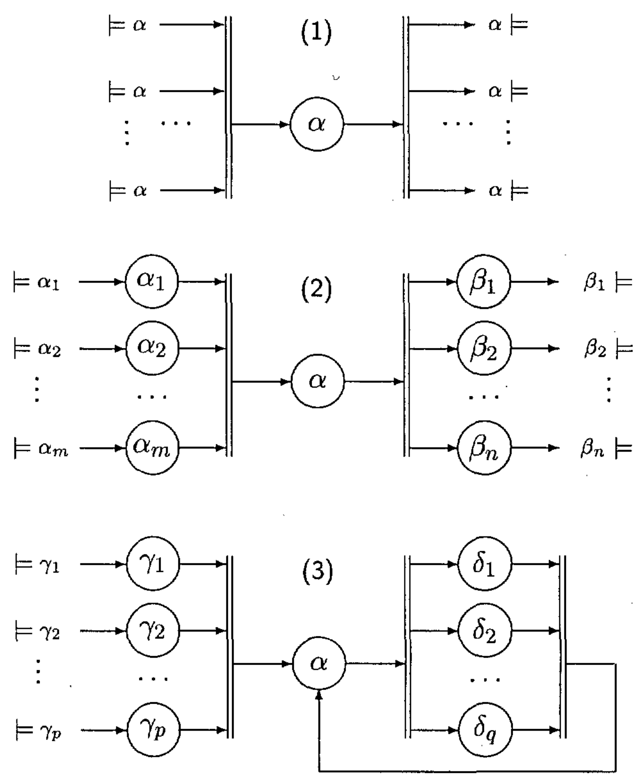


Figure 4: *Informational graphs representing characteristic cases of informational parallelism, where vertical double-bars (||) are parallel input and output collection lines of operand (entity) α.*

The graph in Fig. 4, case (1), shows how the parallel decomposition of operand α might be senseful, that is, in the form of implication

$$\alpha \Longrightarrow \left(\begin{pmatrix} \models \alpha; \\ \models \alpha; \\ \vdots \\ \models \alpha \end{pmatrix}; \begin{pmatrix} \alpha \models; \\ \alpha \models; \\ \vdots \\ \alpha \models \end{pmatrix} \right)$$

[3]Modus agendi of an informational entity, exerting an entity characteristic internalism, externalism, and metaphysicalism, has the potentiality to be compared with the Self behaving self-sensitive and self-active in regard to its environment (exterior) and interior (the subject regarded as the object of its own activity).

which expresses the α's unlimited input (internalistic) and output (externalistic) potentiality. The unique description of the graph is presented by a system of the incomplete basic transitions, that is, $\alpha \rightleftharpoons (\models \alpha; \models \alpha; \cdots; \models \alpha; \alpha \models; \alpha \models; \cdots; \alpha \models)$.

Case (2) in Fig. 4 can be described formally as

$$\left(\left(\begin{matrix}\models \alpha_1;\\ \models \alpha_2;\\ \vdots\\ \models \alpha_m\end{matrix}\right) \models \alpha\right) \models \left(\begin{matrix}\beta_1 \models;\\ \beta_2 \models;\\ \vdots\\ \beta_n \models\end{matrix}\right)$$

But, as we see looking at the graph, there exists still another formula interpretation of the graph, in the form

$$\left(\begin{matrix}\models \alpha_1;\\ \models \alpha_2;\\ \vdots\\ \models \alpha_m\end{matrix}\right) \models \left(\alpha \models \left(\begin{matrix}\beta_1 \models;\\ \beta_2 \models;\\ \vdots\\ \beta_n \models\end{matrix}\right)\right)$$

The unique description of the graph by elementary transitions is in the form of the parallel formula system, which is

$$\left(\begin{matrix}\models \alpha_1; & \models \alpha_2; & \cdots; & \models \alpha_m;\\ \alpha_1 \models \alpha; & \alpha_2 \models \alpha; & \cdots; & \alpha_m \models \alpha;\\ \alpha \models \beta_1; & \alpha \models \beta_2; & \cdots; & \alpha \models \beta_n;\\ \beta_1 \models; & \beta_2 \models; & \cdots; & \beta_n \models\end{matrix}\right)$$

Case (3) in Fig. 4 includes a loop of parallel operands and a possible formal description of this graph is

$$\left(\begin{matrix}\models \gamma_1;\\ \models \gamma_2;\\ \vdots\\ \models \gamma_p\end{matrix}\right) \models \left(\left(\alpha \models \left(\begin{matrix}\delta_1 \models;\\ \delta_2 \models;\\ \vdots\\ \delta_q \models\end{matrix}\right)\right) \models \alpha\right)$$

The reader can guess in which way still four other interpretations of the graph (3) in Fig. 4 are possible. On the other side, the very unique graph description, including all possible graph interpretations, is the parallel formula system

$$\left(\begin{matrix}\models \gamma_1; & \models \gamma_2; & \cdots; & \models \gamma_p;\\ \gamma_1 \models \alpha; & \gamma_2 \models \alpha; & \cdots; & \gamma_p \models \alpha;\\ \alpha \models \delta_1; & \alpha \models \delta_2; & \cdots; & \alpha \models \delta_q;\\ \delta_1 \models \alpha; & \delta_2 \models \alpha; & \cdots; & \delta_q \models \alpha\end{matrix}\right)$$

Let us show two examples which explain the graphical presentation of parallelism.

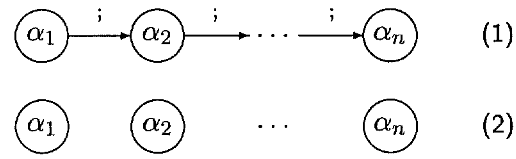


Figure 5: *Graphically, the parallel connection of operands* $\alpha_1, \alpha_2, \cdots, \alpha_n$ (1) *by semicolons (operators of informational parallelism,* $\Vert\!\models$*) is replaced by isolated parallel operands* (2).

Case (1) in Fig. 5 shows the graphical presentation of a strictly, that is operationally, parallel structured formula

$$(\cdots(\alpha_1 \Vert\!\models \alpha_2) \Vert\!\models \cdots \alpha_{n-1}) \Vert\!\models \alpha_n$$

(also, with any other distribution of parenthesis pairs) which is replaced with the common semicolon (symbol of parallelism) formula

$$\alpha_1; \alpha_2; \cdots; \alpha_n$$

Case (2) in Fig. 5 shows this semicolon-simplified formula example graphically.

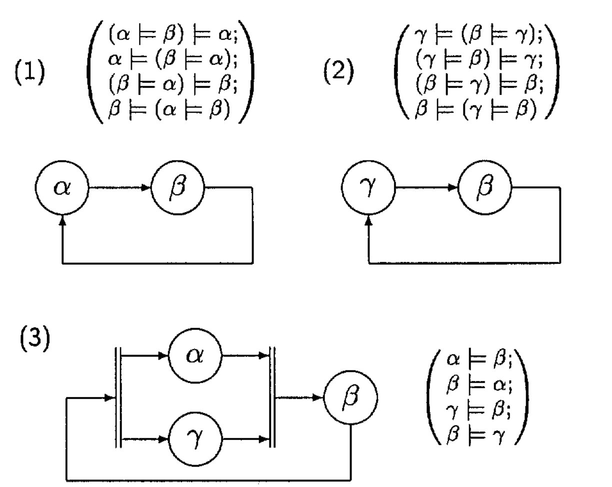


Figure 6: *The joining of two serial graphs given by formula systems* (1) *and* (2) *into a unique serial-parallel graph determined by the adequate formula system* (3).

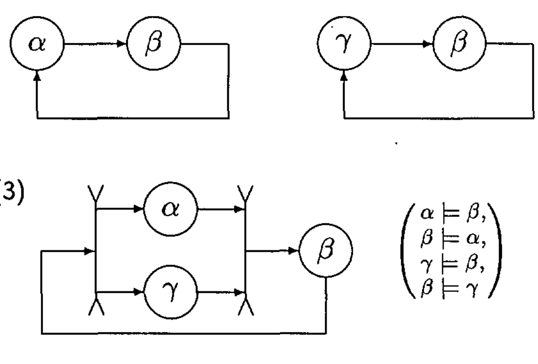
Fig. 6 shows in which way two circular serial graphs (1) and (2) can be joined into the circular serial-parallel graph (3). In this way the graphical transparency of the resulting formula system is essentially improved. The serially circular formula system, being parallelized by joining graphs (1) and (2), means a (graphically) equivalent form

$$\begin{pmatrix} \alpha \models \beta; \\ \beta \models \alpha; \\ \gamma \models \beta; \\ \beta \models \gamma \end{pmatrix} \rightleftharpoons \begin{pmatrix} \left(\begin{pmatrix}\alpha; \\ \gamma\end{pmatrix} \models \beta\right) \models \begin{pmatrix}\alpha; \\ \gamma\end{pmatrix}; \\ \begin{pmatrix}\alpha; \\ \gamma\end{pmatrix} \models \left(\beta \models \begin{pmatrix}\alpha; \\ \gamma\end{pmatrix}\right); \\ \left(\beta \models \begin{pmatrix}\alpha; \\ \gamma\end{pmatrix}\right) \models \beta; \\ \beta \models \left(\begin{pmatrix}\alpha; \\ \gamma\end{pmatrix} \models \beta\right) \end{pmatrix}$$

This formula describes the joined systems (1) and (2) in Fig. 6 (compare to the eight formulas). There exists a sort of meaning equivalence (operator $\rightleftharpoons$) between the transition formula system describing to the graph (3) in Fig. 6 and the serial-parallel formula system on the right side of operator $\rightleftharpoons$.

Similar role as the parallel informational operator $\parallel\!\models$, that is semicolon ';', has the alternative informational operator $\models_{\text{alternatively\_to}}$, that is comma ','. In an informational graph we use a specially marked alternative bus (instead of parallel bus) to distinguish the particular case of alternativism. For instance, if in cases of Fig. 6, all semicolons are replaced by commas, the alternative situation is presented in Fig. 7.

(1) $\begin{pmatrix} (\alpha \models \beta) \models \alpha, \\ \alpha \models (\beta \models \alpha), \\ (\beta \models \alpha) \models \beta, \\ \beta \models (\alpha \models \beta) \end{pmatrix}$ (2) $\begin{pmatrix} \gamma \models (\beta \models \gamma), \\ (\gamma \models \beta) \models \gamma, \\ (\beta \models \gamma) \models \beta, \\ \beta \models (\gamma \models \beta) \end{pmatrix}$



$\begin{pmatrix} \alpha \models \beta, \\ \beta \models \alpha, \\ \gamma \models \beta, \\ \beta \models \gamma \end{pmatrix}$

Figure 7: *The joining of two serial graphs given by formula systems* (1) *and* (2) *into a unique serial-alternative graph determined by the adequate formula system* (3).

After the discussion by examples we have to answer the question, what does an informational graph mean at all, what is its informational representing potentiality?

3 Informational Graph as an Informational Entity

After the introductory interpretation concerning the informational graph on one side and the informational formula (also formula system) phenomenalism on the other side we have to construct a precise definition of the informational graph and its meaning, and deduce some consequences of this definition. Further, how can an informational graph arise informationally? To answer this question we must determine which kind of informational entity or even entities (operands, formulas) does the informational graph represent.

DEFINITION 1 (A General Graph Determination) An informational graph is a connection of informational operands (entities) and informational operators (entities' informational properties) not containing the parenthesis pairs of a formula. *Operands* are marked circles or ovals representing arbitrary informational entities. *Operators* are unmarked or marked arrows (vectors) representing adequate informational properties of entities which they connect. An *informational graph* as a structure of connected and unconnected (isolated) graphical elements can represent any possible well-formed informational formulas—serial, parallel, and circular—which can be constructed by a consequent use of the parentheses pairs. □

DEFINITION 2 (A General Primitive Parallel Formula System) A general primitive parallel formula system (GPPFS, for short), marked by $\varphi'_{\parallel}$, is a parallel sequence (system) of the most simple internalistic, externalistic, transitional (serial, serially circular) formulas of length $\ell = 1$ (having a single operator) and unconnected (marker) formulas of length $\ell = 0$, concerning the informationally involved operands. Such primitive formulas are, for example,

$\models \iota;$	[internalistic (input) formula]
$o \models;$	[externalistic (output) formula]
$\tau_1 \models \tau_2;$	[transition formula as a serial or serially circular formula]
$\upsilon;$	[unconnected marker formula]

$$\left.\begin{array}{l}\iota, o,\\ \tau_1, \tau_2,\\ \upsilon\end{array}\right\} \in \mathcal{P} \quad \text{[primitive operands domain]}$$

where set $\mathcal{P}$ represents all possible primitive (the most elementary) operands or operand markers. Thus, for example,

$$\varphi'_{\parallel}(\iota, o, \tau_1, \tau_2, \upsilon) \rightleftharpoons \begin{pmatrix} \models \iota;\ o \models;\\ \iota \models \tau_1;\ \tau_1 \models \tau_2;\\ \tau_2 \models o;\ \upsilon \end{pmatrix}$$

marks a general form of GPPFS. □

According to the last definition we can represent an informational graph graphically, as already done in the previous section in Fig. 2, or also symbolically, that is by formulas or formula systems, using an appropriate and unique (well-formed) informational symbolism. However, there exists only one form for unique graph representation by informational formulas without parenthesis pairs.

THEOREM 1 (A Graph Interpretation by the General Primitive Parallel Formula System) *An arbitrary informational graph (drawing), being formally marked by*

$$\mathfrak{G}(\varphi'_{\parallel}(\gamma_1, \gamma_2, \cdots, \gamma_{n_\gamma}; \upsilon_1, \upsilon_2, \cdots, \upsilon_{n_\upsilon}))$$

concerning the connected operands $\gamma_1, \gamma_2, \cdots, \gamma_{n_\gamma}$ *and the unconnected (informationally isolated) operands* $\upsilon_1, \upsilon_2, \cdots, \upsilon_{n_\upsilon}$*, can uniquely be described by the primitive parallel formula system* $\varphi'_{\parallel}$ *of the form*

$$\varphi'_{\parallel}(\gamma_1, \gamma_2, \cdots, \gamma_{n_\gamma}, \upsilon_1, \upsilon_2, \cdots, \upsilon_{n_\upsilon}) \rightleftharpoons \begin{pmatrix} \models \gamma_i;\ \ \gamma_j \models;\ \ \gamma_p \models \gamma_q;\\ \gamma_i, \gamma_j, \gamma_p, \gamma_q \in \{\gamma_1, \gamma_2, \cdots, \gamma_{n_\gamma}\};\\ \upsilon_1; \upsilon_2; \cdots; \upsilon_{n_\upsilon} \end{pmatrix}$$

Preliminarily unconnected operands $\upsilon_1;\ \upsilon_2;\ \cdots;\ \upsilon_{n_\upsilon}$ *function as entities which could become connected in the course of further decomposition of the system* $\varphi'_{\parallel}$. □

Proof 1 (Graph $\mathfrak{G}$ and Formula System $\varphi'_{\parallel}$) Each graph $\mathfrak{G}$ can completely be described by the adequate formula system $\varphi'_{\parallel}$. The proof of the theorem is the following. For any two by the arrow connected marked circles (or ovals) in the direction from γ_p to γ_q, there is, evidently, $\gamma_p \models \gamma_q$, where the arrow represents the operator $\models$, being marked or unmarked. For each arrow in the graph, there is exactly one basic transitional formula. In this way, all operator connections of the graph can be formalized. In principle, a graph can include also unconnected (isolated) operands which are not connected elsewhere. The input arrows leading to some operand markers are formalized in the form $\models \gamma_i$, while output arrows leading from some operands have the form $\gamma_j \models$. This completes the proof of the theorem. □

The next question we have to solve is what an informational entity, that is, formula or formula system, does an informational graph, formally determined in Theorem 1, imply. We have to prove the informational transformation possibilities of the parallel system in the previous theorem. Evidently, a parallel informational system hides the power of another parallelism of serial and circular structure which has a *causal* origin.

PRESUMPTION 1 (Interpretation Possibilities of the Graph) An informational graph represents a parallel system of serial and serial-circular formulas of different lengths in which operands can be variously interwoven and the parenthesis pairs in the occurring formulas can be arbitrarily displaced. This means that the parallel system of the most basic transition formulas, representing the graph (as in Theorem 1), can be informationally transformed in a causally more transparent and for the human observer more understandable parallel system of serial and/or circular-serial formulas of different lengths. In this way transformed formula system brings to the surface the explicit possibilities of a causal structure of the occurring formulas which, then, can be chosen as the best fitting ones for the description of an informational situation and attitude. □

Serial and circularly serial formulas will be superscribed by the formula length n and $n+1$, respectively, and subscribed by the formula index i in an interval $1, 2, \cdots, N_{\rightarrow}$ and $1, 2, \cdots, N_{\rightarrow}^{\circlearrowleft}$, respectively, where $N_{\rightarrow}$ and $N_{\rightarrow}^{\circlearrowleft}$, respectively, the so-called *numeri causae* (causal numbers), will depend on the length of a serial and circularly serial formula. Usually, subscript 1 will be given to a serial formula

$$ {}^{n}_{1}\varphi_{\rightarrow}(\sigma, \sigma_1, \sigma_2, \cdots, \sigma_{n-1}, \sigma_n) \rightleftharpoons ((\cdots((\sigma \models \sigma_1) \models \sigma_2) \models \cdots \sigma_{n-1}) \models \sigma_n) $$

where $\sigma, \sigma_1, \sigma_2, \cdots, \sigma_{n-1}, \sigma_n$ are serial operands, and to a circular formula

$$ {}^{n+1}_{1}\varphi^{\circlearrowleft}_{\rightarrow}(\omega, \omega_1, \omega_2, \cdots, \omega_{n-1}, \omega_n) \rightleftharpoons (((\cdots((\omega \models \omega_1) \models \omega_2) \models \cdots \omega_{n-1}) \models \omega_n) \models \omega) $$

where $(\omega, \omega_1, \omega_2, \cdots, \omega_{n-1}, \omega_n$ are circular serial operands. The subscribing proceeds consequently (systematically) from 1 to $N^{\rightarrow}_{\rightarrow}$ and 1 to $N^{\circlearrowleft}_{\rightarrow}$, respectively.

DEFINITION 3 (A Serial Formula and Its Gestalt) By a *serial* formula ${}^{n}_{i}\varphi_{\rightarrow}$ let us mark any well-formed arrangement of the operands, operators and parenthesis pairs, for which

$$ {}^{n}_{i}\varphi_{\rightarrow}(\sigma, \sigma_1, \cdots, \sigma_{n-1}, \sigma_n) \in \left\{ \begin{array}{l} {}^{n}_{1}\varphi_{\rightarrow}(\sigma, \sigma_1, \cdots, \sigma_{n-1}, \sigma_n), \\ {}^{n}_{2}\varphi_{\rightarrow}(\sigma, \sigma_1, \cdots, \sigma_{n-1}, \sigma_n), \\ \cdots, \\ {}^{n}_{N_{\rightarrow}}\varphi_{\rightarrow}(\sigma, \sigma_1, \cdots, \sigma_{n-1}, \sigma_n) \end{array} \right\}; $$

$$ i \in \{1, 2, \cdots, N_{\rightarrow}\}; \quad N_{\rightarrow}\} = \tfrac{1}{n+1}\tbinom{2n}{n}; $$

$$ \Gamma\left({}^{n}_{i}\varphi_{\rightarrow}(\sigma, \sigma_1, \cdots, \sigma_{n-1}, \sigma_n)\right) \rightleftharpoons \left(\begin{array}{l} {}^{n}_{1}\varphi_{\rightarrow}(\sigma, \sigma_1, \cdots, \sigma_{n-1}, \sigma_n); \\ {}^{n}_{2}\varphi_{\rightarrow}(\sigma, \sigma_1, \cdots, \sigma_{n-1}, \sigma_n); \\ \vdots \\ {}^{n}_{N_{\rightarrow}}\varphi_{\rightarrow}(\sigma, \sigma_1, \cdots, \sigma_{n-1}, \sigma_n) \end{array} \right) $$

where n is the length of serial formula being equal to the number of binary operators $\models$ in the formula, i is a systematic (causal) numbering of serial formulas of length n, $N_{\rightarrow}$ is the number of all possible serial formulas obtained from a serial formula by the displacements of the parenthesis pairs, and $\Gamma({}^{n}_{i}\varphi_{\rightarrow}(\sigma, \sigma_1, \cdots, \sigma_{n-1}, \sigma_n))$ is the so-called gestalt of the serial formula representing the parallel system of all formulas of length n obtained from the original formula by all possible displacements of the parenthesis pairs in the original formula. As evident, operands and operators remain on the initially fixed positions, according to the original (initial) formula ${}^{n}_{i}\varphi_{\rightarrow}(\sigma, \sigma_1, \cdots, \sigma_{n-1}, \sigma_n)$. □

DEFINITION 4 (A Circularly Serial Formula and Its Gestalt) By a *circularly serial* informational formula ${}^{n+1}_{j}\varphi^{\circlearrowleft}_{\rightarrow}$ let us mark any serially and circularly well-formed arrangement of the operands, operators and parenthesis pairs, for which

$$ {}^{n+1}_{j}\varphi^{\circlearrowleft}_{\rightarrow}(\omega, \omega_1, \cdots, \omega_{n-1}, \omega_n) \in \left\{ \begin{array}{l} {}^{n+1}_{1}\varphi^{\circlearrowleft}_{\rightarrow}(\omega, \omega_1, \cdots, \omega_{n-1}, \omega_n), \\ {}^{n+1}_{2}\varphi^{\circlearrowleft}_{\rightarrow}(\omega, \omega_1, \cdots, \omega_{n-1}, \omega_n), \\ \cdots, \\ {}^{n+1}_{N^{\circlearrowleft}_{\rightarrow}}\varphi^{\circlearrowleft}_{\rightarrow}(\omega, \omega_1, \cdots, \omega_{n-1}, \omega_n) \end{array} \right\}; $$

$$ j \in \{1, 2, \cdots, N^{\circlearrowleft}_{\rightarrow}\}; \quad N^{\circlearrowleft}_{\rightarrow} = \tfrac{1}{n+2}\tbinom{2n+2}{n+1}; $$

$$ \Gamma\left({}^{n+1}_{j}\varphi^{\circlearrowleft}_{\rightarrow}(\omega, \omega_1, \cdots, \omega_{n-1}, \omega_n)\right) \rightleftharpoons \left(\begin{array}{l} {}^{n+1}_{1}\varphi^{\circlearrowleft}_{\rightarrow}(\omega, \omega_1, \cdots, \omega_{n-1}, \omega_n); \\ {}^{n+1}_{2}\varphi^{\circlearrowleft}_{\rightarrow}(\omega, \omega_1, \cdots, \omega_{n-1}, \omega_n); \\ \vdots \\ {}^{n+1}_{N^{\circlearrowleft}_{\rightarrow}}\varphi^{\circlearrowleft}_{\rightarrow}(\omega, \omega_1, \cdots, \omega_{n-1}, \omega_n) \end{array} \right) $$

where circularity concerns the first (main) operand, that is, ω and the parenthesis pairs can be arbitrarily displaced in another way, according to the gestalt of the formula.

The difference between formulas ${}^{n}_{i}\varphi_{\rightarrow}(\sigma, \sigma_1, \sigma_2, \cdots, \sigma_{n-1}, \sigma_n)$ and ${}^{n+1}_{j}\varphi^{\circlearrowleft}_{\rightarrow}(\omega, \omega_1, \omega_2, \cdots, \omega_{n-1}, \omega_n)$ is in their lengths $\ell_{\rightarrow}$ and $\ell^{\circlearrowleft}_{\rightarrow}$, that is, $\ell^{\circlearrowleft}_{\rightarrow} = \ell_{\rightarrow} + 1$. Thus,

- gestalt $\Gamma\left({}^{n}_{i}\varphi_{\rightarrow}(\sigma, \sigma_1, \sigma_2, \cdots, \sigma_{n-1}, \sigma_n)\right)$ includes

$$ \frac{1}{\ell_{\rightarrow} + 1}\binom{2\ell_{\rightarrow}}{\ell_{\rightarrow}} $$

formulas of length $\ell_{\rightarrow}$;

- gestalt $\Gamma\left({}^{n+1}_{j}\varphi^{\circlearrowleft}_{\rightarrow}(\omega, \omega_1, \omega_2, \cdots, \omega_{n-1}, \omega_n)\right)$ of a circular formula includes, analogously to the serial structure of its circularity,

$$ \frac{1}{\ell^{\circlearrowleft}_{\rightarrow} + 1}\binom{2\ell^{\circlearrowleft}_{\rightarrow}}{\ell^{\circlearrowleft}_{\rightarrow}} $$

formulas of length $\ell^{\circlearrowleft}_{\rightarrow}$ formulas of length $\ell^{\circlearrowleft}_{\rightarrow} = \ell_{\rightarrow} + 1$; and

– the so-called circular gestalt of the form $\Gamma^{\circlearrowleft}\left({}^{n+1}_{\ \ j}\varphi^{\circlearrowleft}_{\rightarrow}(\omega,\ \omega_1,\ \omega_2,\ \cdots,\ \omega_{n-1},\ \omega_n)\right)$ includes, considering all operands in the circular structure (loop, cycle),

$$\frac{\ell^{\circlearrowleft}_{\rightarrow}}{\ell^{\circlearrowleft}_{\rightarrow}+1}\binom{2\ell^{\circlearrowleft}_{\rightarrow}}{\ell^{\circlearrowleft}_{\rightarrow}}$$

formulas of length $\ell^{\circlearrowleft}_{\rightarrow} = \ell_{\rightarrow} + 1$.

In this respect, for the gestalts of a serial and circularly serial formula, and for the circular gestalt of a circularly serial formula, the corresponding numeri causae are the following:

$$N_{\rightarrow} = \frac{1}{\ell_{\rightarrow}+1}\binom{2\ell_{\rightarrow}}{\ell_{\rightarrow}} = \frac{1}{n+1}\binom{2n}{n};$$

$$N^{\circlearrowleft}_{\rightarrow} = \frac{1}{\ell^{\circlearrowleft}_{\rightarrow}+1}\binom{2\ell^{\circlearrowleft}_{\rightarrow}}{\ell^{\circlearrowleft}_{\rightarrow}} = \frac{1}{n+2}\binom{2n+2}{n+1};$$

$${}^{\circlearrowleft}N^{\circlearrowleft}_{\rightarrow} = \frac{\ell^{\circlearrowleft}_{\rightarrow}}{\ell^{\circlearrowleft}_{\rightarrow}+1}\binom{2\ell^{\circlearrowleft}_{\rightarrow}}{\ell^{\circlearrowleft}_{\rightarrow}} = \frac{n+1}{n+2}\binom{2n+2}{n+1}$$

In this way, the so-called *causal difference* between the complex circular and the pure serial case is, expressed by the running subscript n (being equal in all three cases),

$$\frac{n+1}{n+2}\binom{2n+2}{n+1} - \frac{1}{n}\binom{2n}{n}$$

Causal possibilities are essentially different in a pure serial and in a complex circular case. □

THEOREM 2 (Transparency of the Operand Circularity in a Circular Formula) *The circularity of operand ω in a serially circular formula ${}^{n+1}_{\ \ j}\varphi^{\circlearrowleft}_{\rightarrow}(\omega, \omega_1, \omega_2, \cdots, \omega_{n-1}, \omega_n)$ implies the circularity of the remaining operands $\omega_1, \omega_2, \cdots, \omega_n$, that is,*

$${}^{n+1}_{\ \ j}\varphi^{\circlearrowleft}_{\rightarrow}(\omega, \omega_1, \omega_2, \cdots, \omega_{n-1}, \omega_n) \Longrightarrow$$
$$\left(\begin{array}{l} {}^{n+1}_{\ \ j_1}\varphi^{\circlearrowleft}_{\rightarrow}(\omega_1, \omega_2, \cdots, \omega_n, \omega); \\ {}^{n+1}_{\ \ j_2}\varphi^{\circlearrowleft}_{\rightarrow}(\omega_2, \omega_3, \cdots, \omega_n, \omega, \omega_1); \\ \vdots \\ {}^{n+1}_{\ \ j_n}\varphi^{\circlearrowleft}_{\rightarrow}(\omega_n, \omega, \omega_1, \cdots, \omega_{n-2}, \omega_{n-1}) \end{array}\right)$$

In a serially circular formula, the circularity concerns all operands, that is, $\omega, \omega_1, \omega_2, \cdots, \omega_{n-1}, \omega_n$. □

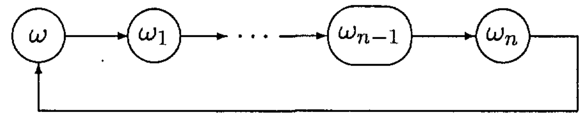


Figure 8: *The serially circular graph representing $\frac{n+1}{n+2}\binom{2n+2}{n+1}$ serially circular formulas of length $\ell = n+1$.*

Proof 2 (Circular Informing of Operands in a Circular Formula) For a serially circular formula

$${}^{n+1}_{\ \ 1}\varphi^{\circlearrowleft}_{\rightarrow}(\omega, \omega_1, \cdots, \omega_{n-1}, \omega_n) \rightleftharpoons$$
$$((\cdots(\omega \models \omega_1) \models \cdots \omega_{n-1}) \models \omega_n)$$

we can construct the circular graph in Fig. 8. In the loop of the graph, for the remaining operands $\omega_1, \cdots, \omega_{n-1}, \omega_n$, the existence of the serially circular formulas (viewed as by the parenthesis-pairs-displaced specific functions of $n+1$ operands)

$$\begin{array}{l} {}^{n+1}_{\ \ j_1}\varphi^{\circlearrowleft}_{\rightarrow}(\omega_1, \omega_2, \cdots, \omega_n, \omega); \\ {}^{n+1}_{\ \ j_2}\varphi^{\circlearrowleft}_{\rightarrow}(\omega_2, \omega_3, \cdots, \omega_n, \omega, \omega_1); \\ \vdots \\ {}^{n+1}_{\ \ j_n}\varphi^{\circlearrowleft}_{\rightarrow}(\omega_n, \omega, \omega_1, \cdots, \omega_{n-2}, \omega_{n-1}) \end{array}$$

is evident. This proves the validity of the theorem. □

THEOREM 3 (A Graph Interpretation by the Circularly Serial Formula System) *An informational graph (drawing in Fig. 9), being formally marked by*

$$\mathfrak{G}\left({}_{\Vert}\Phi^{\circlearrowleft}_{\rightarrow}\left(\begin{array}{l} \iota_0, \iota_1, \iota_2, \cdots, \iota_{n_\iota}; \\ o_0, o_1, o_2, \cdots, o_{n_o}; \\ \sigma_{p0}, \sigma_{p1}, \sigma_{p2}, \cdots, \sigma_{pm_p}; \\ p = 0, 1, \cdots, A; \\ \omega_{q0}, \omega_{q1}, \omega_{q2}, \cdots, \omega_{qn_q}; \\ q = 0, 1, \cdots, B; \\ \upsilon_0, \upsilon_1, \upsilon_2, \cdots, \upsilon_{n_\upsilon} \end{array}\right)\right)$$

concerns the systematically grouped and also overlapping

– input *(internalistic) operands, marked by* $\mathbb{I} = \{\iota_0, \iota_1, \iota_2, \cdots, \iota_{n_\iota}\}$,

– *the* output *(externalistic) operands, symbolized by* $\mathbb{O} = \{o_0, o_1, o_2, \cdots, o_{n_o}\}$,

- *the A groups of* serial *(transitional) formula operands, denoted by* $\mathbb{S} = \{\sigma_{p0}, \sigma_{p1}, \sigma_{p2}, \cdots, \sigma_{pm_p} \mid p = 0, 1, \cdots, A\}$,
- *the B groups of* circularly serial *formula operands, represented by* $\Omega = \{\omega_{q0}, \omega_{q1}, \cdots, \omega_{qn_q} \mid q = 0, 1, \cdots, B\}$, *and*
- *the* unconnected *(informationally isolated) operands,* $\mathbb{U} = \{\upsilon_0, \upsilon_1, \upsilon_2, \cdots, \upsilon_{n_\upsilon}\}$.

The unconnected operands do not overlap with other operands and are foreseen as those which could become informationally involved. The integral gestalt, being composed of the respective partial gestalts, is a formula

$$\Gamma\left({}_{\|}\Phi^{\circlearrowleft}_{\rightarrow}\left(\begin{array}{l} \iota_0, \iota_1, \iota_2, \cdots, \iota_{n_\iota}; \\ o_0, o_1, o_2, \cdots, o_{n_o}; \\ \sigma_{p0}, \sigma_{p1}, \sigma_{p2}, \cdots, \sigma_{pm_p}; \\ p = 0, 1, \cdots, A; \\ \omega_{q0}, \omega_{q1}, \omega_{q2}, \cdots, \omega_{qn_\upsilon}; \\ q = 0, 1, \cdots, B; \\ \upsilon_0, \upsilon_1, \upsilon_2, \cdots, \upsilon_{n_\upsilon} \end{array}\right)\right) \rightleftharpoons$$

$$\left(\begin{array}{l} \Gamma(\models \iota_0; \models \iota_1; \models \iota_2; \cdots; \models \iota_{n_\iota}); \\ \Gamma(o_0 \models; o_1 \models; o_2 \models; \cdots; o_{n_o} \models); \\ \Gamma\left({}^{m_p}_{i_p}\varphi_{\rightarrow}(\sigma_{p0}, \sigma_{p1}, \cdots, \sigma_{pm_p})\right); \\ p = 0, 1, \cdots, A; \\ \Gamma\left({}^{n_q+1}_{j_{q0}}\varphi^{\circlearrowleft}_{\rightarrow}(\omega_{q0}, \omega_{q1}, \omega_{q2}, \cdots, \omega_{qn_q})\right); \\ \Gamma\left({}^{n_q+1}_{j_{q1}}\varphi^{\circlearrowleft}_{\rightarrow}(\omega_{q1}, \omega_{q2}, \cdots, \omega_{qn_q}, \omega_{q0})\right); \\ \cdots; \\ \Gamma\left({}^{n_q+1}_{j_{qn_q}}\varphi^{\circlearrowleft}_{\rightarrow}(\omega_{qn_q}, \omega_{q0}, \omega_{q1}, \cdots, \omega_{qn_{\upsilon-1}})\right); \\ q = 0, 1, \cdots, B; \\ \Gamma(\upsilon_0; \upsilon_1; \upsilon_2; \cdots; \upsilon_{n_\upsilon}) \end{array}\right)$$

where

$$1 \le i_p \le \tfrac{1}{m_p+1}\binom{2m_p}{m_p};$$
$$1 \le j_{qk} \le \tfrac{1}{n_q+2}\binom{2n_q+2}{n_q+1};$$
$$k = 0, 1, \cdots, n_q$$

If the elements of the connected operands are represented by the union set $\mathbb{C} = \mathbb{I} \cup \mathbb{O} \cup \mathbb{S} \cup \Omega$, *then* $\mathbb{C} \cap \mathbb{U} = \emptyset$. *Evidently, the different sorts of graphs corresponding to the input, output, serial, and serially circular gestalts can mutually (spontaneously, arbitrarily) overlap.* □

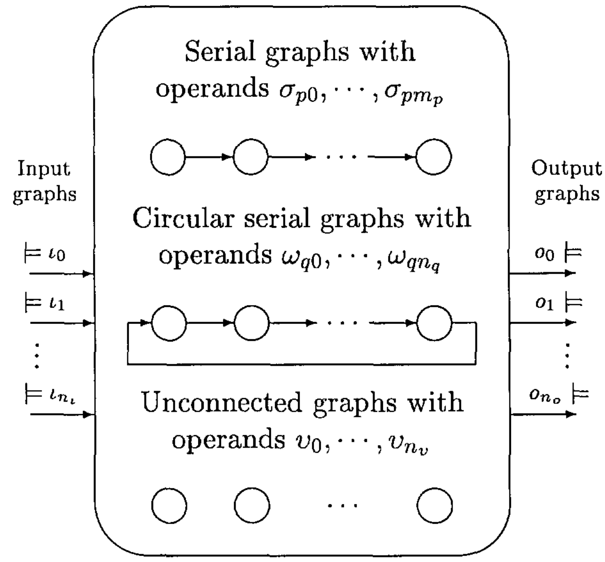


Figure 9: *A complex (circularly parallel-serially structured) graph concerning input (internalistic operands), output (externalistic operands), serial (transitional), serially circular, and isolated operands, corresponding to the gestalt in* Theorem 3.

Proof 3 (Covering the Graph by Serial and Circular Formulas) It is to stress that any operand of the system formula $\varphi^{\circlearrowleft}_{\|,\rightarrow}$ appears in the graph one time only. This situation leads to the overlapping of input, output, serial, and serially circular graphs. Overlapping means the occurrence of one and the same operand in several formulas concerning the input, output, serial, and serially circular arrangement of operands and operators.

The proof of the theorem can be realized by the inspection of the graph. In this situation, serial and circular formulas can be constructed, concerning different paths and loops, respectively, with the aim, to cover the entire graph by this formula description technique. In this process, any form of the formula, irrespective of the setting of the parenthesis pairs within it, can be chosen. Certainly, for each chosen path or loop of the graph, a formula and to it corresponding gestalt can be determined. Evidently, by such a technique, the graph with all its circles, ovals, and arrows can be covered, that is described by formulas in whole. It is evident that for, the isolated operands and for internalistic and externalistic formulas, there is

$$(\upsilon_1; \upsilon_2; \cdots; \upsilon_{n_\upsilon}) \rightleftharpoons \Gamma(\upsilon_1; \upsilon_2; \cdots; \upsilon_{n_\upsilon}) \text{ and}$$
$$(\models \iota_i) \rightleftharpoons \Gamma(\models \iota_i);\ (o_j \models) \rightleftharpoons \Gamma(o_j \models)$$

respectively. Thus, the number of causal variations of system ${}_{\|}\Phi_{\rightarrow}^{\circlearrowleft}$ is

$$\sum_{p=0}^{A} \frac{1}{m_p+1}\binom{2m_p}{m_p} + \sum_{q=0}^{B} \frac{1}{n_q+2}\binom{2n_q+2}{n_q+1}$$

This completes the proof of the theorem. □

DEFINITION 5 (Graphical Equivalence of Formulas and Formula Systems) Two formula systems (or formulas), marked by Φ_1 and Φ_2, are said to be graphically equivalent, if they describe (cover, have, possess) exactly (completely) one and the same informational graph $\mathfrak{G}$. In this case, we introduce

$$\Phi_1 \equiv_{\mathfrak{G}} \Phi_2$$

where $\equiv_{\mathfrak{G}}$ marks the operator of the informational graphical equivalence. The meaning of this graphical equivalence can be expressed by the formula

$$(\Phi_1 \equiv_{\mathfrak{G}} \Phi_2) \rightleftharpoons (\mathfrak{G}(\Phi_1) \equiv \mathfrak{G}(\Phi_2))$$

in which the general informational equivalence (operator $\equiv$) can be used. For a formula system (or formula) Φ_1 and its graph, and a formula system (or formula) Φ_2 and its graph, the following is alternatively (the comma) informationally implied:

$$(\mathfrak{G}(\Phi_1) \equiv \mathfrak{G}(\Phi_2)) \Longrightarrow \begin{pmatrix} \Phi_1 \equiv_{\mathfrak{G}} \mathfrak{G}(\Phi_2), \\ \mathfrak{G}(\Phi_1) \equiv_{\mathfrak{G}} \Phi_2, \\ \mathfrak{G}(\Phi_1) \equiv_{\mathfrak{G}} \mathfrak{G}(\Phi_2) \end{pmatrix}$$

Thus the use of the general equivalence operator $\equiv$ and the graphical equivalence operator $\equiv_{\mathfrak{G}}$ is uniquely determined. □

THEOREM 4 (An Equivalence of the Possible Graph Descriptions by Different Formula Systems) *There exists always the one and only one graph $\mathfrak{G}$ being described simultaneously by the circular primitive parallel formula system*

$$\psi_{\|}^{\circlearrowleft\prime} \begin{pmatrix} \iota_0, \iota_1, \iota_2, \cdots, \iota_{n_\iota}; \\ o_0, o_1, o_2, \cdots, o_{n_o}; \\ \sigma_{p0}, \sigma_{p1}, \sigma_{p2}, \cdots, \sigma_{pm_p}; \\ p = 0, 1, \cdots, A; \\ \omega_{q0}, \omega_{q1}, \omega_{q2}, \cdots, \omega_{qn_q}; \\ q = 0, 1, \cdots, B; \\ v_0, v_1, v_2, \cdots, v_{n_v} \end{pmatrix}$$

(Theorem 1), *consisting of input operands ι_{i_ι}, output operands o_{i_o}, serial (elementary transitional) operands σ_{i_σ}, circular (elementary transitional) operands ω_{i_ω} and isolated operands v_{i_v}, which can (with exception of the isolated operands) arbitrarily overlap one another, on the one side, and the graphically equivalent parallel circular serial formula system ${}_{\|}\Phi_{\rightarrow}^{\circlearrowleft}$, on the other side. In this system, there exist circular serial formulas (of length 2 and greater), which can be derived from the graph. There is*

$${}_{\|}\Phi_{\rightarrow}^{\circlearrowleft} \equiv_{\mathfrak{G}} \psi_{\|}^{\circlearrowleft\prime}$$

Moreover, $\psi_{\|}^{\circlearrowleft\prime}$ means nothing else than the primitive parallelization of ${}_{\|}\Phi_{\rightarrow}^{\circlearrowleft}$, by which serial and circular serial formulas of ${}_{\|}\Phi_{\rightarrow}^{\circlearrowleft}$ are decomposed into primitive (basic) transitions. In this way,

$$\Pi'\left({}_{\|}\Phi_{\rightarrow}^{\circlearrowleft}\right) \rightleftharpoons \psi_{\|}^{\circlearrowleft\prime}$$

where

$$\psi_{\|}^{\circlearrowleft\prime} \begin{pmatrix} \iota_0, \iota_1, \iota_2, \cdots, \iota_{n_\iota}; \\ o_0, o_1, o_2, \cdots, o_{n_o}; \\ \sigma_{p0}, \sigma_{p1}, \sigma_{p2}, \cdots, \sigma_{pm_p}; \\ p = 0, 1, \cdots, A; \\ \omega_{q0}, \omega_{q1}, \omega_{q2}, \cdots, \omega_{qn_q}; \\ q = 0, 1, \cdots, B; \\ v_0, v_1, v_2, \cdots, v_{n_v} \end{pmatrix} \rightleftharpoons$$

$$\begin{pmatrix} \models \iota_r;\ r = 0, 1, \cdots, n_\iota; \\ o_s \models;\ s = 0, 1, \cdots, n_o; \\ \sigma_{pi} \models \sigma_{p,i+1}; \\ \quad p = 0, 1, \cdots, A; \\ \quad i = 0, 1, \cdots, m_p - 1; \\ \omega_{qj} \models \omega_{q,j+1};\ \omega_{qn_q} \models \omega_{q0}; \\ \quad q = 0, 1, \cdots, B; \\ \quad j = 0, 1, \cdots, n_q - 1; \\ v_u;\ u = 1, 2, \cdots, n_v \end{pmatrix}$$

The obtained serial and circular serial basic transitions are seen in the lower formula array. □

Proof 4 The proof of the last theorem is evident and proceeds from the previous definitions and theorems. For a graph $\mathfrak{G}$, there is evidently,

$$\mathfrak{G}\left(\psi_{\|}^{\mathcal{O}'}\left(\begin{array}{l}\iota_0, \iota_1, \iota_2, \cdots, \iota_{n_\iota};\\ o_0, o_1, o_2, \cdots, o_{n_o};\\ \sigma_{p0}, \sigma_{p1}, \sigma_{p2}, \cdots, \sigma_{pm_p};\\ p = 0, 1, \cdots, A;\\ \omega_{q0}, \omega_{q1}, \omega_{q2}, \cdots, \omega_{qn_q};\\ q = 0, 1, \cdots, B;\\ \upsilon_0, \upsilon_1, \upsilon_2, \cdots, \upsilon_{n_\upsilon}\end{array}\right)\right) \equiv$$

$$\mathfrak{G}\left({}_{\|}\Phi_{\rightarrow}^{\mathcal{O}}\left(\begin{array}{l}\iota_0, \iota_1, \iota_2, \cdots, \iota_{n_\iota};\\ o_0, o_1, o_2, \cdots, o_{n_o};\\ \sigma_{p0}, \sigma_{p1}, \sigma_{p2}, \cdots, \sigma_{pm_p};\\ p = 0, 1, \cdots, A;\\ \omega_{q0}, \omega_{q1}, \omega_{q2}, \cdots, \omega_{qn_v};\\ q = 0, 1, \cdots, B;\\ \upsilon_0, \upsilon_1, \upsilon_2, \cdots, \upsilon_{n_\upsilon}\end{array}\right)\right)$$

Both parallel formula systems, $\psi_{\|}^{\mathcal{O}'}$ and ${}_{\|}\Phi_{\rightarrow}^{\mathcal{O}}$ describe exactly one and the same graph $\mathfrak{G}$. This proves the theorem. □

Theorem 4 says that there exist at least two formal and to the graph completely corresponding interpretations of an informational graph: that in the form of the primitive parallel formula system (PPFS) and the other in the form of the parallel circular serial formula system (PCSFS). Other forms can certainly be circularly mixed parallel-serial systems, including explicit expressions of various main operands of complexly mashed informational systems.

4 Serial and Circular Informational Graphs Hiding a Parallel Informational Structure

4.1 Introduction

In general, an informational graph represents a complex (gestalt-like) informational structure, which under certain circumstances, can simultaneously represent parallel, serial and circular informing of the involved (mutually informing) operands (entities). An informational graph, as an optical or formalistic scheme, does not say anything of that what concretely, in a true situation, comes actually in the foreground. It can be only a simple, very particular serial or circularly serial scheme of informing. On the other side, such a graph, obtained from the pure serial or circularly serial situation, comes to the foreground simultaneously as a pure, that is, extremely parallel informingly structured organization, and through this view, covers not only one particular case but all possible other particular cases of particular causalisms, as a consequence of the parenthesis pairs displacements in particular formulas in respect to the original (initial) particular formula(s).

On the other hand, we have learned so far, how informational parallelism can cause the phenomenon of informational serialism and informational circular serialism (as an implicit property of elementary informational transitions). Within informational serialism of any kind, the so-called causalism can come into existence. The causalism is nothing other than a different serial interpretation of an initial formula, in which parenthesis pairs are not once for all determined or are simply left out. This happens with sentences of a natural language where a formal syntax analysis cannot be performed unambiguously. Also in a speech act, the speaker or hearer cannot follow an abstract and depth-structured syntax analysis (synthesis), but more or less a spontaneous linguistic informing. Also, a living linguistic performer, by his/her consciousness, cannot inform in the discussed primitive parallel way, when long and circularly structured sentences (with hundreds or thousands causal possibilities) appear in the discourse. A consequent primitive informing would be possible solely by an informational machine[4] [22].

Causalism appears as nothing other than a specific informational organization (structure) of informational serialism. There does not exist a causalism of this sort in a pure parallel (simultaneous) case. It seems that causalism is "timely" (serially) conditioned, where serially could mean time-consequently.

4.2 A Serial Formula and Its Graph

The pure serial informational graphs (without informational circles) correspond to the pure serial informational formulas in which there are only bi-

[4]An informational machine is a multiprocessing (multiprocessor) device possessing the property of an informational entity (spontaneity, circularity, parallelism, serial and circular causality).

nary informational operators between operand entities (parenthesized or single) in a formula. To this pure serial structure one can (must) add possibilities of the input and output informing of the serial structure. The input informing is internalistic when a serial operand component σ is being openly informed from the environment by $\models \sigma_i$. The output informing is externalistic when an operand of the serial structure informs openly to the environment by $\sigma_i \models$. Such a structure is realistic from the viewpoint that entities (operands) of a serial structure (formula) can be informed from exterior operands and can inform to exterior operands.

DEFINITION 6 (A Pure Serial Formula)A *pure serial* formula, ${}^{n}_{i}\varphi_{\rightarrow}$, is determined in the following manner:

$$
{}^{n}_{i}\varphi_{\rightarrow}(\sigma_0, \sigma_1, \cdots, \sigma_n) \rightleftharpoons
\left(\begin{array}{l}
\models \sigma_\iota;\ \sigma_o \models;\\
(\sigma_\iota, \sigma_o \in \{\sigma_0, \sigma_1, \cdots, \sigma_n\});\\
(\cdots(\sigma_0 \models \sigma_1) \models \cdots \sigma_{n-1}) \models \sigma_n
\end{array}\right)
$$

where the serial formula of the form $(\cdots(\sigma_0 \models \sigma_1) \models \cdots \sigma_{n-1}) \models \sigma_n$ can be substituted by any other serial formula with displaced parenthesis pairs, that is by a formula which is graphically equivalent to the original formula (Definition 5). The formula subscript i systematically varies in the interval $1 \leq i \leq \frac{1}{n+1}\binom{2n}{n}$. □

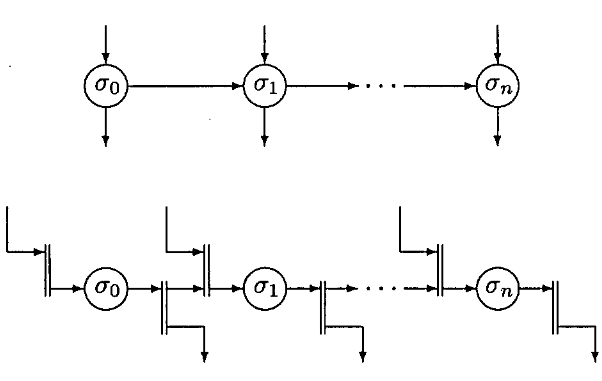


Figure 10: *Two graphical interpretations corresponding to the pure serial formula system in* Definition 6. *The equivalent bottom graph explicates the parallel character of the serial formula.*

4.3 Primitive Serial Parallelism and Serial Formula Gestalt

A primitive serial parallelism denotes the existence of the primitive transitions which are serially connected, e.g., in the form of a small paragon system $\alpha \models \beta; \beta \models \gamma; \gamma \models \delta$. A serial formula gestalt is the system of all the possible serial formulas which parallelization delivers the primitive parallel system. For the paragon system, these gestalt formulas have the form $((\alpha \models \beta) \models \gamma) \models \delta$, with all possible replacement of the parenthesis pairs.

DEFINITION 7 (Primitive Parallelism of a Pure Serial Formula) The graph corresponding to Definition 6 is presented in Fig. 10. The parallel collection lines $\parallel$ in the bottom graph of the figure show the potentiality of further parallel inputs and outputs of the serially coupled entities. According to Theorem 4, the graph in Fig. 10 can be equivalently described by the primitive parallel formula system

$$
{}^{n}\varphi'_{\parallel}(\sigma_0, \sigma_1, \cdots, \sigma_n) \rightleftharpoons
\left(\begin{array}{l}
\models \sigma_\iota;\ \sigma_o \models;\ (\sigma_\iota, \sigma_o \in \{\sigma_0, \sigma_1, \cdots, \sigma_n\});\\
\sigma_0 \models \sigma_1;\ \sigma_1 \models \sigma_2;\ \cdots;\ \sigma_{n-1} \models \sigma_n
\end{array}\right)
$$

For this formula it is characteristic that it determines the gestalt Γ of formula ${}^{n}_{i}\varphi_{\rightarrow}(\sigma_1, \sigma_2, \cdots, \sigma_n)$ in Definition 6. □

THEOREM 5 (Graphical Equivalence of a Serial Formula Gestalt and a Pure Serial, Primitive Parallel Formula System) *The graphical equivalence of the form*

$$
\Gamma\left({}^{n}_{i}\varphi_{\rightarrow}(\sigma_0, \sigma_1, \cdots, \sigma_n)\right) \equiv_{\mathfrak{G}} {}^{n}\varphi'_{\parallel}(\sigma_0, \sigma_1, \cdots, \sigma_n)
$$

determines one and the same graph for the gestalt of a serial formula of length n and the corresponding primitive parallel formula. This equivalence shows the power of the basic transition *formulas (of the length 1, and informing in parallel) compared to the* long serial *formulas of length n, and belonging to the gestalt* $\Gamma\left({}^{n}_{i}\varphi_{\rightarrow}(\sigma_0, \sigma_1, \cdots, \sigma_n)\right)$. □

Proof 5 We have to prove the graphical equivalence of the two parallel formula systems in the theorem. Gestalt $\Gamma\left({}^{n}_{i}\varphi_{\rightarrow}(\sigma_0, \sigma_1, \cdots, \sigma_n)\right)$ is a parallel system of serial formulas of the form ${}^{n}_{i}\varphi_{\rightarrow}(\sigma_0, \sigma_1, \cdots, \sigma_n)$ which length is n. In a pure serial formula of length n there are exactly n binary operators and $n+1$ serial operands. As described, parenthesis pairs can be displaced in a spontaneous manner, giving to the formulas different causal meanings (the corresponding causal subscript i of formula ${}^{n}_{i}\varphi_{\rightarrow}$. Thus, the formulas can be systematically numbered (subscribed), where, for example,

$$\begin{array}{l} {}^{n}_{1}\varphi_{\rightarrow}(\sigma_0, \sigma_1, \cdots, \sigma_n) \rightleftharpoons \\ \quad ((\cdots(\sigma_0 \models \sigma_1) \models \cdots \sigma_{n-1}) \models \sigma_n); \\ {}^{n}_{2}\varphi_{\rightarrow}(\sigma_0, \sigma_1, \cdots, \sigma_n) \rightleftharpoons \\ \quad ((\cdots(\sigma_0 \models \sigma_1) \models \cdots \sigma_{n-1} \models \sigma_n)); \\ \vdots \\ {}^{\quad\quad\;\, n}_{\frac{1}{n+1}\binom{2n}{n}}\varphi_{\rightarrow}(\sigma_0, \sigma_2, \cdots, \sigma_n) \rightleftharpoons \\ \quad (\sigma_0 \models (\sigma_1 \models \cdots (\sigma_{n-1} \models \sigma_n) \cdots)) \end{array}$$

Thus, the gestalt of any of these formulas is a parallel system of $N_{\rightarrow} = \frac{1}{n+1}\binom{2n}{n}$ serial formulas, that is, in a shortened symbolic form,

$$\Gamma({}^{n}_{i}\varphi_{\rightarrow}) \rightleftharpoons \left({}^{n}_{1}\varphi_{\rightarrow}; {}^{n}_{2}\varphi_{\rightarrow}; \cdots; {}^{\quad\quad\;\, n}_{\frac{1}{n+1}\binom{2n}{n}}\varphi_{\rightarrow}\right)$$

for $1 \leq i \leq N_{\rightarrow}$. Each of these formulas determines one and the same graph $\mathfrak{G}$.

On the other hand, a graph $\mathfrak{G}$, corresponding to a formula ${}^{n}_{i}\varphi_{\rightarrow}$ can be described, according to Theorem 1, by formula ${}^{n}\varphi'_{\parallel}$. This proves the theorem. □

4.4 A Circular Serial Formula and Its Graph

DEFINITION 8 (A Pure Serially Circular Formula) A *pure serially circular* formula, ${}^{n+1}_{j_1}\varphi^{\circlearrowleft}_{\rightarrow}$, is determined in the following manner:

$$\begin{array}{l} {}^{n+1}_{j_1}\varphi^{\circlearrowleft}_{\rightarrow}(\omega_0, \omega_1, \cdots, \omega_n) \rightleftharpoons \\ \left(\begin{array}{l} \models \omega_\iota;\ \omega_o \models;\ (\omega_\iota, \omega_o \in \{\omega_0, \omega_1, \cdots, \omega_n\}); \\ ((\cdots(\omega_0 \models \omega_1) \models \cdots \omega_{n-1}) \models \omega_n) \models \omega_0 \end{array}\right) \end{array}$$

where the serially circular formula of the form $((\cdots(\omega_0 \models \omega_1) \models \cdots \omega_{n-1}) \models \omega_n) \models \omega_0$ can be substituted by any other serial formula with displaced parenthesis pairs, that is by a formula which is graphically equivalent to the original formula (Definition 5). Formula subscript j systematically varies in the interval $1 \leq j_1 \leq \frac{1}{n+2}\binom{2n+2}{n+1}$. □

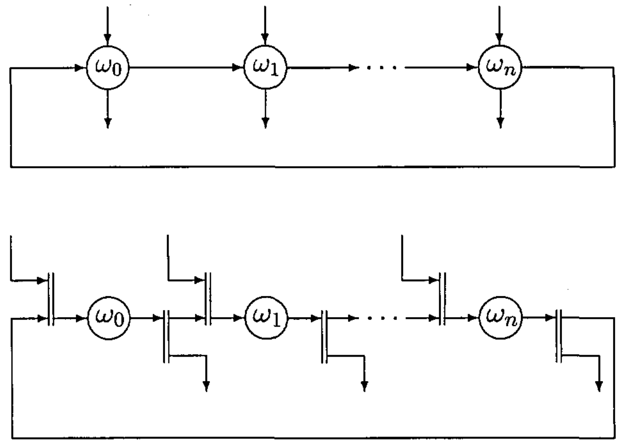


Figure 11: *Two graphical interpretations corresponding to formula system in* Definition 8. *The equivalent bottom graph explicates the parallel character of the serially circular formula.*

4.5 Primitive Circular Serial Parallelism, and Gestalt of Circular Serial Formula

For the circular serial parallelism, one of the basic transition formulas must informationally connect the 'last' operand with the 'first' one, that is, $\alpha_{\text{last}} \models \alpha_{\text{first}}$.

THEOREM 6 (Graphical Equivalence of a Circular Serial Formula Gestalt and a Pure Circular Serial, Primitive Parallel Formula System) *The graphical equivalence of the form*

$$\Gamma\left({}^{n+1}_{j}\varphi^{\circlearrowleft}_{\rightarrow}(\omega_0, \omega_1, \cdots, \omega_n)\right) \equiv_{\mathfrak{G}} {}^{n+1}\varphi'^{\circlearrowleft}_{\parallel}(\omega_0, \omega_1, \cdots, \omega_n)$$

determines one and the same graph for the gestalt of a circular serial formula of length $n+1$ and the corresponding primitive circular parallel formula system. This equivalence shows the power of the basic transition formulas (of the length 1, and informing in parallel) compared to long circular serial formulas of the length $n+1$, belonging to the gestalt $\Gamma\left({}^{n+1}_{j}\varphi^{\circlearrowleft}_{\rightarrow}(\omega_0, \omega_1, \cdots, \omega_n)\right)$. □

Proof 6 We have to prove the graphical equivalence of the both circularly structured parallel formula systems in the theorem. Gestalt $\Gamma\left({}^{n+1}_{j}\varphi^{\circlearrowleft}_{\rightarrow}(\omega_0, \omega_1, \cdots, \omega_n)\right)$ is a parallel system of the serial formulas of the form

${}^{n+1}_{\;\;j}\varphi^{\circlearrowleft}_{\rightarrow}(\omega_0, \omega_1, \cdots, \omega_n)$ which length is $n+1$. In a pure circular serial formula of the length $n+1$ there are exactly $n+1$ binary operators and the $n+1$ serial operands (one of them appears twice, that is, the title operand of the circular formula, at the beginning and at the end of the formula. As described, parenthesis pairs can be displaced in a spontaneous manner, giving to the formulas different causal meanings (the corresponding causal subscript i of formula ${}^{n+1}_{\;\;j}\varphi^{\circlearrowleft}_{\rightarrow}(\omega_0, \omega_1, \cdots, \omega_n)$. Thus, the formulas can be systematically numbered (subscribed), where, for example,

$$\begin{array}{l} {}^{n+1}_{\;\;1}\varphi^{\circlearrowleft}_{\rightarrow}(\omega_0, \omega_1, \cdots, \omega_n) \rightleftharpoons \\ \qquad (((\cdots(\omega_0 \models \omega_1) \models \cdots \omega_{n-1}) \models \omega_n) \models \omega_0); \\ {}^{n+1}_{\;\;2}\varphi^{\circlearrowleft}_{\rightarrow}(\omega_0, \omega_1, \cdots, \omega_n) \rightleftharpoons \\ \qquad ((\cdots(\omega_0 \models \omega_1) \models \cdots \omega_{n-1}) \models (\omega_n \models \omega_0)); \\ \vdots \\ {}^{\qquad\quad n+1}_{\frac{1}{n+2}\binom{2n+2}{n+1}}\varphi^{\circlearrowleft}_{\rightarrow}(\omega_0, \omega_2, \cdots, \omega_n) \rightleftharpoons \\ \qquad (\omega_0 \models (\omega_1 \models \cdots (\omega_{n-1} \models (\omega_n \models \omega_0)) \cdots)) \end{array}$$

Thus, the gestalt of any of these formulas is a parallel system of $N^{\circlearrowleft}_{\rightarrow} = \frac{1}{n+2}\binom{2n+2}{n+1}$ circular serial formulas, that is, in a shortened notation,

$$\begin{array}{l} \Gamma\left({}^{n+1}_{\;\;j}\varphi^{\circlearrowleft}_{\rightarrow}\right) \rightleftharpoons \\ \qquad \left({}^{n+1}_{\;\;1}\varphi^{\circlearrowleft}_{\rightarrow};\; {}^{n+1}_{\;\;2}\varphi^{\circlearrowleft}_{\rightarrow};\; \cdots;\; {}^{\qquad\quad n+1}_{\frac{1}{n+2}\binom{2n+2}{n+1}}\varphi^{\circlearrowleft}_{\rightarrow}\right) \end{array}$$

for $1 \leq j \leq N^{\circlearrowleft}_{\rightarrow}$. Each of these circular formulas determines one and the same graph $\mathfrak{G}$.

On the other hand, graph $\mathfrak{G}$, corresponding to a formula ${}^{n+1}_{\;\;j}\varphi^{\circlearrowleft}_{\rightarrow}$ can be described, according to Theorem 1, by formula ${}^{n+1}\varphi^{\circlearrowleft\prime}_{\parallel}$. This proves the theorem. □

4.6 Circular Gestalt

The circular gestalt of a circular formula concerns the parity of the formula operands. Within the cycle of the formula graph, each operand can be rotated to the title (initial, leftmost) position, and in this situation, it can function also as the leftmost and simultaneously as the rightmost operand in the circular formula.

THEOREM 7 (Graphical Equivalence of Primitive Circular Parallel Formula Systems) *If the expression* ${}^{n+1}\varphi^{\circlearrowleft\prime}_{\parallel}(\omega_0, \omega_1, \cdots, \omega_n)$ *represents a primitive circular parallel formula system (of basic $n+1$ transitions), then*

$$\begin{array}{l} {}^{n+1}\varphi^{\circlearrowleft\prime}_{\parallel}(\omega_0, \omega_1, \cdots, \omega_n) \equiv_{\mathfrak{G}} \\ \qquad {}^{n+1}\varphi^{\circlearrowleft\prime}_{\parallel}(\omega_i, \omega_{i+1}, \cdots, \omega_n, \omega_0, \omega_1, \cdots, \omega_{i-1}) \end{array}$$

for $i = 1, 2, \cdots, n$. Each primitive circular formula system

$${}^{n+1}\varphi^{\circlearrowleft\prime}_{\parallel}(\omega_i, \omega_{i+1}, \cdots, \omega_n, \omega_0, \omega_1, \cdots, \omega_{i-1})$$

corresponds to a gestalt Γ of the circular serial formula

$${}^{n+1}_{\;\;j_i}\varphi^{\circlearrowleft}_{\rightarrow}(\omega_i, \omega_{i+1}, \cdots, \omega_n, \omega_0, \omega_1, \cdots, \omega_{i-1})$$

The parallel system of such gestalts is called the the circular gestalt $\Gamma^{\circlearrowleft}$ of a circular serial function ${}^{n+1}_{\;\;j_0}\varphi^{\circlearrowleft}_{\rightarrow}(\omega_0, \omega_1, \cdots, \omega_n)$. There is

$$\begin{array}{l} \Gamma^{\circlearrowleft}\left({}^{n+1}_{\;\;j_i}\varphi^{\circlearrowleft}_{\rightarrow}(\omega_i, \omega_{i+1}, \cdots, \omega_n, \omega_0, \omega_1, \cdots, \omega_{i-1})\right) \rightleftharpoons \\ \left(\begin{array}{l} \Gamma\left({}^{n+1}_{\;\;j_0}\varphi^{\circlearrowleft}_{\rightarrow}(\omega_0, \omega_1, \cdots, \omega_n)\right); \\ \Gamma\left({}^{n+1}_{\;\;j_1}\varphi^{\circlearrowleft}_{\rightarrow}(\omega_1, \omega_2, \cdots, \omega_n, \omega_0)\right); \\ \vdots \\ \Gamma\left({}^{n+1}_{\;\;j_i}\varphi^{\circlearrowleft}_{\rightarrow}(\omega_i, \omega_{i+1}, \cdots, \omega_n, \omega_0, \omega_1, \cdots, \right. \\ \qquad\qquad \left. \omega_{i-1})\right); \\ \vdots \\ \Gamma\left({}^{n+1}_{\;\;j_n}\varphi^{\circlearrowleft}_{\rightarrow}(\omega_n, \omega_0, \omega_1, \cdots, \omega_{n-1})\right) \end{array}\right) \end{array}$$

□

Proof 7 In a parallel formula system, formulas can occur in an arbitrary sequence. The formula ordering does not influence the informing of the system. Therefore, instead of $(\alpha \models \beta) \parallel\!\models (\gamma \models \delta)$, simply the semicolon system $(\alpha \models \beta; \gamma \models \delta)$ can be used (taking a semicolon instead of $\parallel\!\models$), where semicolon performs as an associative operator of parallel occurrences of formulas in an informational system.

The proof of the first part of the theorem consists of the graphical equivalence of informational systems of the form

$$\begin{pmatrix} \omega_0 \models \omega_1; \\ \omega_1 \models \omega_2; \\ \vdots \\ \omega_{i-1} \models \omega_i; \\ \omega_i \models \omega_{i+1}; \\ \omega_{i+1} \models \omega_{i+2}; \\ \vdots \\ \omega_{n-1} \models \omega_n; \\ \omega_n \models \omega_0 \end{pmatrix} \equiv_{\mathfrak{G}} \begin{pmatrix} \omega_i \models \omega_{i+1}; \\ \omega_{i+1} \models \omega_{i+2}; \\ \vdots \\ \omega_{n-1} \models \omega_n; \\ \omega_n \models \omega_0; \\ \omega_0 \models \omega_1; \\ \vdots \\ \omega_{i-2} \models \omega_{i-1}; \\ \omega_{i-1} \models \omega_i \end{pmatrix}$$

for $i = 0, 1, 2, \cdots, n$. The right formula system is nothing else than the parallel reordered left formula system. So,

$$\begin{gathered} {}^{n+1}\varphi_{\|}^{\circlearrowleft\prime}(\omega_0, \omega_1, \cdots, \omega_n) \equiv_{\mathfrak{G}} \\ {}^{n+1}\varphi_{\|}^{\circlearrowleft\prime}(\omega_i, \omega_{i+1}, \cdots, \omega_n, \omega_0, \omega_1, \cdots, \omega_{i-1}) \end{gathered}$$

is proved. But, evidently, in this particular case, instead of the operator of the graphical equivalence $\equiv_{\mathfrak{G}}$, the operator of the general informational equivalence $\equiv$ could be used.

In the second part of the theorem we must prove

$$\begin{gathered} \Gamma^{\circlearrowleft}\Big({}^{n+1}_{\;j_i}\varphi_{\rightarrow}^{\circlearrowleft}(\omega_i, \omega_{i+1}, \cdots, \omega_n, \omega_0, \omega_1, \cdots, \omega_{i-1})\Big) \\ \equiv_{\mathfrak{G}} {}^{n+1}\varphi_{\|}^{\circlearrowleft\prime}(\omega_0, \omega_1, \cdots, \omega_n) \end{gathered}$$

There also is, evidently,

$$\begin{gathered} \Gamma\Big({}^{n+1}_{\;j_i}\varphi_{\rightarrow}^{\circlearrowleft}(\omega_i, \omega_{i+1}, \cdots, \omega_n, \omega_0, \omega_1, \cdots, \omega_{i-1})\Big) \\ \equiv_{\mathfrak{G}} {}^{n+1}\varphi_{\|}^{\circlearrowleft\prime}(\omega_0, \omega_1, \cdots, \omega_n) \end{gathered}$$

However, there are $n+1$ different gestalts $\Gamma\Big({}^{n+1}_{\;j_i}\varphi_{\rightarrow}^{\circlearrowleft}(\omega_i, \omega_{i+1}, \cdots, \omega_n, \omega_0, \omega_1, \cdots, \omega_{i-1})\Big)$ for a circular formula, and so, ${}^{\circlearrowleft}\mathcal{N}_{\rightarrow}^{\circlearrowleft} = \frac{n+1}{n+2}\binom{2n+2}{n+1}$ possibilities of the circular formula interpretation through all circular operands, where each of the operands can occupy the title position in the corresponding circular formula. This proves the second part of the theorem. □

To remind, graphical equivalence means one and the same informational graph for two differently structured informational formulas or formula systems. As we have seen, the following graphical equivalences hold:

$$\begin{gathered} {}^{n+1}\varphi_{\|}^{\circlearrowleft\prime} \equiv_{\mathfrak{G}} \Gamma\Big({}^{n+1}_{\;j_i}\varphi_{\rightarrow}^{\circlearrowleft}\Big) \equiv_{\mathfrak{G}} \Gamma^{\circlearrowleft}\Big({}^{n+1}_{\;j_i}\varphi_{\rightarrow}^{\circlearrowleft}\Big) \equiv_{\mathfrak{G}} \\ \mathfrak{G}\Big({}^{n+1}_{\;j_i}\varphi_{\rightarrow}^{\circlearrowleft}\Big) \equiv_{\mathfrak{G}} \mathfrak{G}\Big({}^{n+1}_{\;j_k}\varphi_{\rightarrow}^{\circlearrowleft}\Big) \end{gathered}$$

where $i, k = 0, 1, 2, \cdots, n$. We see how operator $\equiv_{\mathfrak{G}}$, in fact, has the property of the graphical projection of an informational formula onto its informational graph.

4.7 Star Gestalt $\Gamma^{\star}$

The star gestalt of a formula or a (complex) formula system is obtained by moving through the graph from an arbitrary operand by an arbitrary chosen path (in the direction of operator arrows). In this way, two formulas, obtained by such a moving, can have one and the same graph. The moving can run along an infinite path when formula or formula system is circularly structured. In this sense, a star gestalt concerning a circular system, can consist of an unbounded number of formulas (the infiniteness of recursiveness).

The reader can imagine how formulas of a star gestalt can be arbitrarily not only cycled, but also re-cycled, that is, certain parts of the paths can be passed again and again. Such a circulating does not cause an additional part of the graph, but it can have complex causal, especially, self-referencing and self-constructing consequences, reaching to arbitrary causal (self-informing, hermeneutic, historical, memorizing, consciousness) depths. The phenomena using the attribute of the self can have a circular organization of an arbitrary depth. For instance, phenomena of self-observation, self-reference, self-replication, self-consciousness, etc. can be conceptually and notionally captured (grasped, understood) by sufficiently complex circular informational formalism, possessing means of spontaneous informational arising (emerging, coming into existence, to the surface, etc.). The reader can perform such experiments by means of presented circular informational graphs in this paper.

For a simple (pure) circular formula of the form ${}^{n+1}_{\;j_i}\varphi_{\rightarrow}^{\circlearrowleft}(\omega_i, \omega_{i+1}, \cdots, \omega_n, \omega_0, \omega_1, \cdots, \omega_{i-1})$, the cycle can be repeated several times, and can begin at an arbitrary operand and end by an another (arbitrary) operand. Such a case is not particularly interesting in the sense of a star

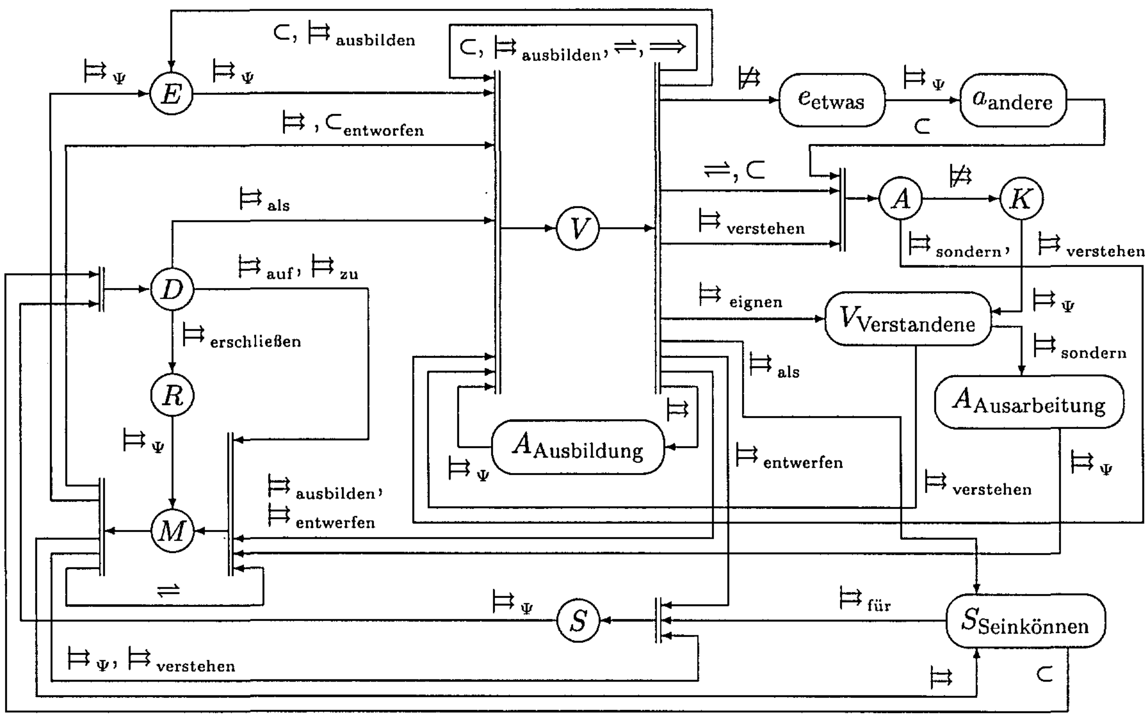


Figure 12: *The beginning informational graph of the Heideggerian understanding and interpretation for the original German text (taken from the first paragraph, Section 32, p. 148* [1]*). The vertical parallel lines* (||) *denote the input and output buses of entities (circled markers).*

gestalt, although it can carry a particular causal sense. Much more significant and senseful are complexly and completely circularly structured informational graphs, where moving through the graph can run through different loops (only touching them or more actively influence operands of different paths) and in variously repeated ways. The reader can grasp how the degree of causality changes (arises, emerges) and how this degree can represent a complicated "historically structured" event through several steps of circularly consequent informing. In this respect, it is possible to set up informational systems of any imaginable circular causal complexity. The reader can grasp the significance of a star gestalt and its formulas on the basis of an instructive example. A complex circularly parallel serial informational system (Definition 3) was denoted by ${}_{\|}\Phi^{\circlearrowleft}_{\rightarrow}$. Let us have the case of Heideggerian understanding (Verstehen) and interpretation (Auslegung) system ${}_{\|}V^{\circlearrowleft}_{\rightarrow}$ (the first eight sentences of the first paragraph on page 148 in [7]) with the graph in Fig. 12 (original text in German), with the following meaning (in German and English) of operands and operators:

a_{andere}	(der, die, das) andere [different]
$A_{\text{Ausarbeitung}}$	Ausarbeitung [working-out]
$A_{\text{Ausbildung}}$	Ausbildung [development]
A	Auslegung [interpretation]
D	Dasein [Dasein]
E	Entwerfen [projecting]
e_{etwas}	etwas [something]
K	Kenntnisnahme [acquiring of information]
M	Möglichkeit, Möglichkeiten [possibility, possibilities]
R	Rückschlag [counter-thrust]
S	Sein [Being]
$S_{\text{Seinkönnen}}$	Seinkönnen [potentiality]
$V_{\text{Verstandene}}$	Verstandene [the understood]
V	Verstehen [understanding]
W	Weg [way]
$S(D)$	Sein des Daseins, $S \models_{\Psi} D$ [Dasein's Being]
$\models_{\text{als}}$	ist als (als) [is as (as)]
$\models_{\text{auf}}$	ist auf (auf) [is upon (upon)]
$\models_{\text{ausbilden}}$	ausbilden [develop]
$\models_{\text{eignen}}$	eignen [appropriate]
$\models_{\text{enthüllen}}$	enthüllen [exert]
$\models_{\text{entwerfen}}$	entwirft [projects]

$\subset_{\text{entworfen}}$	(ist) entworfen in [(is) projected in]
$\models_{\text{erschließen}}$	erschließen [disclose]
$\models_{\text{für}}$	ist für (für) [is for (for)]
$\models$	sein (bin, bist, ist, sind) [to be (am, are, is)]
$\not\models$	nicht sein (ist nicht, wird nicht) [not to be (is not, does not become)]
$\Longrightarrow$	impliziert [implies]
$\models_{\text{sondern}}$	sondern (ist) [but (is)]
$\models_{\text{verstehen}}$	verstehen [understand(s)]
$\models_{\text{zu}}$	ist zu (zu, gegen) [is towards (towards)]
$\models_{\Psi}$	ist eine Funktion von [is a function of]
$\subset$	hat, einschließt, besitzt [has, include(s), possess(es)]
$\circ$	und (Operatorkomposition) [and (operator composition)]
;	Formelparallelismus [parallelism (of formulas)]
','	Formelalternativität [alternativeness (of formulas)]
$\rightleftharpoons$	bedeutet, bedeuten [mean(s)]

Evidently, according to Fig. 12, each operand in in some way circularly connected with other operands occurring in the graph. The graph is a mesh of feedback loops for each occurring operand, a kind of creative loops[5] interacting in the informational mesh. It means also, that Heidegger was probably well aware that a proper philosophical system for understanding and interpretation has to be structured circularly in the sense of interconnected loops (informational circles), if possible, also in the presented initial philosophical text detail.

This complete circular system can be formally described by the primitive circular parallel understanding system ${}_{\|}V_{\rightarrow}^{\circlearrowleft\prime}$, consisting of elementary transitions, that is (alphabetically ordered by the left operands of elementary transitions),

$$
{}_{\|}V_{\rightarrow}^{\circlearrowleft\prime} \rightleftharpoons
\left(\begin{array}{ll}
a_{\text{andere}} \subset A; & \left(\begin{array}{c} A_{\text{Ausarbeitung}} \\ \models_{\Psi} M \end{array}\right); \\
A_{\text{Ausbildung}} \models_{\Psi} V; & A \models_{\text{sondern}} V; \\
A \models_{\text{verstehen}} V; & A \not\models K; \\
D \models_{\text{als}} V; & D \models_{\text{auf}} M; \\
D \models_{\text{zu}} M; & D \models_{\text{erschließen}} R; \\
E \models_{\Psi} V; & e_{\text{etwas}} \models_{\Psi} a_{\text{andere}}; \\
K \models_{\Psi} V_{\text{Verstandene}}; & M \rightleftharpoons M; \\
M \models_{\Psi} S; & M \models_{\text{verstehen}} S; \\
M \models S_{\text{Seinkönnen}}; & M \models V; \\
M \models_{\Psi} E; & M \subset_{\text{entworfen}} V; \\
R \models_{\Psi} M; & S \models_{\Psi} D; \\
S_{\text{Seinkönnen}} \models_{\text{für}} S; & S_{\text{Seinkönnen}} \subset D; \\
\left(\begin{array}{c} V_{\text{Verstandene}} \\ \models_{\text{verstehen}} V \end{array}\right); & \left(\begin{array}{c} V_{\text{Verstandene}} \\ \models_{\text{sondern}} \\ A_{\text{Ausarbeitung}} \end{array}\right); \\
V \models_{\text{entwerfen}} S; & V \models_{\text{als}} S_{\text{Seinkönnen}}; \\
V \subset V; & V \subset E; \\
V \models_{\text{ausbilden}} M; & V \models_{\text{ausbilden}} E; \\
V \models_{\text{ausbilden}} V; & V \rightleftharpoons A; \\
V \rightleftharpoons V; & V \models A_{\text{Ausbildung}}; \\
V \models_{\text{eignen}} V_{\text{Verstandene}}; & V \subset A; \\
V \not\models e_{\text{etwas}}; & V \models_{\text{verstehen}} A; \\
V \Longrightarrow V; & V \models_{\text{entwerfen}} M
\end{array}\right)
$$

Understanding ${}_{\|}V_{\rightarrow}^{\circlearrowleft\prime}$ of something α requires the additional transition

$$\alpha \models V$$

to the system ${}_{\|}V_{\rightarrow}^{\circlearrowleft\prime}$, causing ${}_{\|}V_{\rightarrow}^{\circlearrowleft\prime}(\alpha)$, and thus all operands of system ${}_{\|}V_{\rightarrow}^{\circlearrowleft\prime}$ become functions of α, that is, take the general functional form $\varphi(\alpha)$ [20].

5 Complexly Interweaved Circular Informational Graphs

Real informational systems are complexly circularly interweaved. This is a condition sine qua non, for only circular systems have the potentiality of emerging from that what already *is*, to that what unforeseeably could arise. In the most normal situation, each occurring operand (representing an informational entity) is circularly connected in one or more loops (circular graphs), and

[5] See, for instance, E. Harth: *The Creative Loop, How the Brain Makes a Mind.* Penguin, Harmondsworth (1996); or the book review in *Journal of Consciousness Studies* **3** (1996) No. 2, pp. 186–187, by G. Sommerhoff.

each loop is in some way connected to all other loops in the system. For such a system we say that it is *completely circularly connected* or informationally closed. In some way, each operand of such a system informs (indirectly via other operands) all other operands and vice versa: each operand is indirectly (or, in particular cases, directly) informed by all other operands. This means that a singular operand impacts the system entirely and is entirely impacted by the system in which it occurs.

This type of informational closeness does not mean that system operands cannot be impacted from the exterior and that they cannot impact the exterior operands (entities). According to informational axioms [21], this property of informational openness or independence of operands is given, in general, to any informational entity. Only in clearly explicated cases, it can be determined in which case an entity does not inform an another entity.

Besides, there can exist operands which do not appear in a loop, for instance, merely in linearly serially structured formulas, where the last (end) operands of such formulas function like final destinations, informing for the sake of its own purpose, as a kind of final receptors. In some cases, such final informational destinations can be foreseen for a later looping into the system, when their informing will begin to impact the other entities of the system.

In the described complexly interweaved circular informational system, presented by the corresponding graph, the only senseful and significant function of each operand is to be circularly connected to the system, that is, to play a developmental role of the system by its arising and diminishing[6]. Otherwise, the existence of an unconnected or partly connected informational item is not within an informationally senseful and significant function of system development, emergence, and function.

In the same sense, parallel informational graphs can exist, but, in a senseful situation, they must be in some way connected. Isolated graphs are presentations of possible informational informing and as such, that is mutually isolated, they perform as a kind of informational reductionism. This especially holds in the cases when informing of system entities is studied, grasped, and finally presented under essentially limited circumstances. Sooner or later, the need for informational complexity in the form of a serial, parallel, and circular phenomenalism comes to consciousness. Both in the living and artificial systems, as well, the facts of this informational complexity can be considered.

[6]For instance, in the sense of an estimate of the precision or certainty or definiteness according to [11].

6 A Classification of Informational Graphs

6.1 Isolated Graphs

Isolated graphs perform as informationally isolated entities. It simply means that they are not connected to and from the other graphs or entities. They usually emerge as a consequence of the so-called reductionistic reasoning, where each graph, as such, represents a reductionistic situation of a particularly isolated view or interest.

Isolated graphs as informational entities are in no way senseless since they can become, through the emergence of conceptual and informing systems, parts of systems, also with essential informational modification, further decomposition, connectivity, and the like. As such, they can become suitable for the so-called bottom-up composition. In this sense, isolated informational graphs hide the potentiality for their future involvement into a linearly (serially), parallel (simultaneously), and circularly (cyclically, with regard to a loop structure and organization) connected informational realm.

By definition, isolated informational graphs do not loose the axiomatically given property of the input (internalistic) and output (externalistic) possibility of operands, that is, their connection to and from the potential environment. Considering this situation for isolated graphs, the following definition becomes meaningful.

DEFINITION 9 (Isolated Graph) An *isolated informational graph* is an arbitrary organized graph of operand circles and/or ovals and them connecting operator arrows in a serial (linear), parallel, and circular way, but *not* connected to or from other informational graphs. Operands of the graph retain their potentiality for undetermined internalistic and externalistic informing, from and to the virtual graph environment. Isolated graphs and operands are graphically presented as circles and ovals without arrows. □

As a consequence, each finite informational graph is isolated, that is obtained on the basis of a reductionistic approach. However, it hides the possibility for its further decomposition of operands and operators [26]. Graphs can contain isolated operands and isolated subgraphs.

6.2 Primitive Transition Graph

A primitive transition of the form $\alpha \models \beta$, and its decomposition, [26] is the key form of any informational system, particularly of the primitive serial and serially circular parallel systems of basic transitions $\left({}^{n}\varphi'_{\parallel} \text{ and } {}^{n+1}\varphi^{\circlearrowleft\prime}_{\parallel}\right)$. Its operand and operator decomposition possibilities were exhaustively treated and discussed in [26].

Definition 10 (Transition Graph) A *transition informational graph* consists of two operand circles or ovals, connected by a single operand arrow. This arrangement of both operands and an arrow is treated as an informational unity, that is, as a transition from the first operand to the second one. □

6.3 Pure Serial Graph

Pure serial graph is a graphical presentation of the formula ${}^{n}_{i}\varphi_{\rightarrow}$ with $n+1$ operands and n binary operators. Pure serial graph represents a system of different formulas ${}^{n}_{i}\varphi_{\rightarrow}$ of length n, where $1 \leq i \leq \frac{1}{n+1}\binom{2n}{n}$.

6.4 Pure Circular Serial Graph

A pure circular serial graph is a graphical presentation of formula ${}^{n+1}_{j}\varphi^{\circlearrowleft}_{\rightarrow}$ with $n+1$ operands and $n+1$ binary operators. A pure circular serial graph represents a system of different formulas ${}^{n+1}_{j}\varphi^{\circlearrowleft}_{\rightarrow}$ of length $n+1$, where $1 \leq j \leq \frac{1}{n+2}\binom{2n+2}{n+1}$.

6.5 Parallelism of Graphs

The reader can see that informational graphs are by arrows connected circles and/or ovals. Both circles/ovals and arrows are marked: circles/ovals by operands and arrows by operators. An unmarked arrow represents the operator $\models$ (an operational joker). At the first glance, such connected circles/ovals in the graph give the impression that the system of operands is informing in a serial (also circularly serial) manner. To exceed this surface impression, the reader should stay aware that any basic informational transition, $\alpha \models \beta$, with its left part α and its right part β, simultaneously means the detachment [23], in the form

$$\frac{\alpha \models \beta}{\alpha; \beta}$$

This detachment says, that α and β inform independently and *in parallel* to the transition $\alpha \models \beta$. This detachment must be understood recursively, irrespective of the complexity of both α an β, which can represent arbitrary formulas or systems of formulas.

Each graph represents parallel informing of all operands and all possible subformulas and formulas which proceed from the graph in the sense of their informational well-formedness, that is as serial formulas ${}^{n}_{i}\varphi_{\rightarrow}$ and ${}^{n+1}_{j}\varphi^{\circlearrowleft}_{\rightarrow}$, primitive formula systems ${}^{n}\varphi'_{\parallel}$ and ${}^{n+1}\varphi^{\circlearrowleft\prime}_{\parallel}$ and all the possible formulas and formula systems of these formulas and formula systems.

Using the last rule of the parallel detachment of subformulas recursively, one can determine how many parallel processors are needed for a simulation of formulas ${}^{n}_{i}\varphi_{\rightarrow}$ and ${}^{n+1}_{j}\varphi^{\circlearrowleft}_{\rightarrow}$ in an informational machine [22]. For serial formula ${}^{n}_{1}\varphi_{\rightarrow}$, the detachment

$$\frac{(\cdots((\alpha_0 \models \alpha_1) \models \alpha_2) \ldots \models \alpha_{n-1}) \models \alpha_n}{\begin{array}{c} \alpha_0; \alpha_1; \alpha_2; \ldots; \alpha_{n-1}; \alpha_n; \\ \alpha_0 \models \alpha_1; \\ (\alpha_0 \models \alpha_1) \models \alpha_2; \\ \cdots \\ ((\alpha_0 \models \alpha_1) \models \alpha_2) \ldots \models \alpha_{n-1}; \\ {}^{n}_{1}\varphi_{\rightarrow} \end{array}}$$

delivers $2n+1$ separate parallel operands (entities), that is, $2n+1$ parallel informing processors of the machine.

For the circular serial formula ${}^{n+1}_{1}\varphi^{\circlearrowleft}_{\rightarrow}$ the number of processors increases to $2n+2$.

Through this discussion, the reader can (should) become aware, that a complex graph represents much more of parallelism as it may be needed in a concrete situation, because it hides also the various possibilities of circularism, by which a graph can be covered, e.g., by the parallelization of a concrete system of formulas.

6.6 Incompletely Structured Graphs

A definition concerning incompletely structured graphs can be useful.

DEFINITION 11 (Incompletely Structured Graph) An *incompletely structured graph* is characterized by several properties when α, β, and γ are operands of the graph:

1. it includes at least one isolated operand α for which neither $\alpha \models \beta$ nor $\gamma \models \alpha$ holds;
2. it includes at least one operand α for which $\alpha \models \beta$ holds (externalistic connectivity) but $\gamma \models \alpha$ does not hold; or
3. it includes at least one operand α for which $\beta \models \alpha$ holds (internalistic connectivity) but $\alpha \models \gamma$ does not hold.

□

6.7 Completely (Circularly) Structured Graphs

Within an informational system, it is senseful to insist, that all graph operands are externalistically as well as and internalistically (mutually) connected.

DEFINITION 12 (Completely Structured Graph) A *completely structured graph* does not include an operand which is externalistically and/or internalistically isolated and there does not exist a loop isolated from other loops of the graph. □

THEOREM 8 (Completely Circularly Structured Graphs) *In a completely structured graph, each graph operand is circularly connected, and each operand is transitionally (through informational operators and other operands) connected with all the other (remaining) operands of the graph.* □

Proof 8 (Circularity of Operands in a Completely Structured Graph) In a completely structured graph all the operands are externalistically and internalistically connected to at least one other operand of the graph. Let the graph operands be marked by $\alpha_0, \alpha_1, \cdots, \alpha_n$. The worst case condition is, for example, that α_i is connected to α_{i+1}, this one to α_{i+2}, and so on, to α_n. Now, let α_n be connected to α_1, this one to α_2, and so on, to α_{i-1}. In this way we have exhausted all the available operands of the graph, however, α_{i-1} does not have the connection externalistic to another operand yet. Let it be connected to α_i. In this case, all the operands of the graph are in the longest possible loop of the graph.

Besides the longest loop also any shorter loop is possible and some loops can cover (include) common operands. The common loop operands mean the informational connection of involved loops. The interloop connection must be realized in such a manner that every operand of the graph is indirectly (informationally) connected with the all remaining operands of the graph.

Let graph $\mathfrak{G}$ possess k distinguishable loops λ_ℓ of the set $\Lambda = \{\lambda_1, \lambda_2, \cdots, \lambda_k\}$, in which $n+1$ operands (all operands appearing in graph $\mathfrak{G}$) of the set $A = \{\alpha_0, \alpha_1, \cdots, \alpha_n\}$ occur. Let any two loops, for example $\lambda_{\ell_1}, \lambda_{\ell_2} \in \Lambda$, include some common operands $\alpha_{i_1}, \alpha_{i_2}, \cdots, \alpha_{i_q} \in A$, where $q \geq 1$. Let this hold for any two loops and let all the occurring loops cover all the operands of graph $\mathfrak{G}$. Evidently, under these circumstances, each operand is transitionally connected with the remaining operands of the graph. This means not only that an operand circularly transitionally informs the remaining operands, but also that it is circularly transitionally informed by the remaining operands. □

Evidently, according to the proof, a loop can be arbitrarily structured, from the shortest one, consisting of two operands to the longer ones.

The next request is, that all loops of the graph must be mutually connected, and no loop group must be isolated. For loops of the graph the same holds as for the graph operands. This leads to the conclusion that every operand is in some way circularly connected within the graph.

A completely (circularly) structured graph guarantees an equal informational treatment of any occurring operand and its possibility to become, in some particular context, the title operand of the system, when it observes and is observed as a significant entity, magnifying its phenomenalism within the system presented by the graph.

7 What Would Mean to Understand an Informational Graph and to Program Its Possibilities?

An informational graph is the most powerful presentation of an instantaneous informational system since it contains all the possibilities of the instantaneous informational system in respect to its (integral) gestalt (gestalts of the possible loops with already occurring graph operands and operators).

To program all such possibilities of an instantaneous graph means simply to process in parallel not only all the operands in parallel, but also to have separate processors for any subformula of the system and, at last, for the system as an entirety. We have seen how a primitive parallel (transition) formula system does not represent (e.g., simulate) only the concrete system of formulas, but also all the other possibilities which the formula system with its operands and operators could represent. This situation is not always an adequate one, although its simulates the all possible situations of the instantaneous system.

The next problem of an informational graph, representing a system, is its emerging, being conditioned by the informational arising of the system it represents. Informational arising is a consequence of different decompositional processes concerning operands (informational entities) together with their operands. It means that a graph changes its graphical structure during the informing of the system. An informational graph is nothing other than a particular (representational) informational entity, which underlies the principles of informational externalism, internalism, and metaphysicalism.

One can imagine a decomposition of a graph in a similar manner as the decomposition of an operand or operator [24, 26]. Between two operands of the graph, connected by an operator arrow, the decomposition means, that instead of a single arrow, a new subgraph arises, being adequately inserted into the graph.

Let $\alpha \models \beta$ be a transition and $\Delta(\alpha \models \beta)$ its decomposition in the form

$$((\cdots((\alpha \models \gamma_1) \models \gamma_2) \models \cdots \gamma_{n-1}) \models \gamma_n) \models \beta$$

This decomposition of $\alpha \models \beta$ can be grasped in the following way:

1. operand α-decomposition is framed as

$$\boxed{((\cdots((\alpha \models \gamma_1) \models \gamma_2) \models \cdots \gamma_{n-1}) \models \gamma_n)} \models \beta$$

2. operand β-decomposition is framed as

$$\boxed{((\cdots((} \; \alpha \models \boxed{\gamma_1) \models \gamma_2) \models \cdots \gamma_{n-1}) \models \gamma_n) \models \beta}$$

and, finally,

3. operands α-β-decomposition or the original operator $\models$-decomposition is framed as

$$\boxed{((\cdots((} \; \alpha \; \boxed{\models \gamma_1) \models \gamma_2) \models \cdots \gamma_{n-1}) \models \gamma_n) \models} \; \beta$$

8 Informational Graphs for Informational Being-in and Informational Being-of

What are informational graphs for informational Being-in and informational Being-of and how could they be reasonably interpreted? In concern to these relatively simple informational cases we can discuss the meaning of the occurring gestalts, circular gestalts, and star gestalts.

8.1 Informational Being-in

In [19], the informational Being-in or informational inclusion (operator $\subset$) was defined in the following way.

DEFINITION 13 (Informational Includedness) Let the entity α inform within the entity β, that is, $\alpha \subset \beta$. This expression reads: α *informs within (is an informational component or constituent of)* β. Let the following parallel system of includedness (Being-in) be defined recursively:

$$(\alpha \subset \beta) \rightleftharpoons_{\mathrm{Def}} \begin{pmatrix} \beta \models \alpha; \\ \alpha \models \beta; \\ \Xi(\alpha \subset \beta) \end{pmatrix}$$

where for the extensional part $\Xi(\alpha \subset \beta)$ of the includedness $\alpha \subset \beta$, there is,

$$\Xi(\alpha \subset \beta) \in \mathcal{P}\left(\left\{\begin{array}{l}(\beta \models \alpha) \subset \beta,\\ (\alpha \models \beta) \subset \beta,\\ (\beta \models \alpha) \subset \alpha,\\ (\alpha \models \beta) \subset \alpha\end{array}\right\}\right)$$

The most complex element of this power set is denoted by

$$\Xi^{\beta,\alpha}_{\beta,\alpha}(\alpha \subset \beta) \rightleftharpoons \begin{pmatrix}(\beta \models \alpha) \subset \beta, \alpha;\\ (\alpha \models \beta) \subset \beta, \alpha\end{pmatrix}$$

Cases, where $\Xi(\alpha \subset \beta) \rightleftharpoons \emptyset$ and $\emptyset$ denotes an empty entity (informational nothing), are exceptional (reductionistic). □

If one looks into this definition, irrespective of the complexity and recursiveness of the definition, (s)he can observe the informational interplay solely between two entities, that is, α and β. Informational includedness means that both α and β are under mutual informing and observing. Within this interplay two informational operators appear: $\models$ and $\subset$.

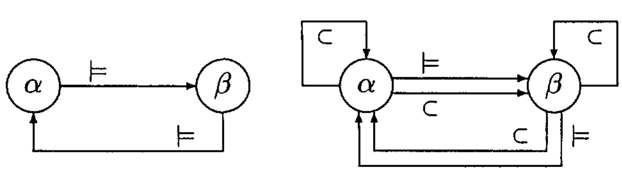
Let us perform the primitive parallelization Π' of the definition, that is,

$$\Pi'\begin{pmatrix}\beta \models \alpha;\\ \alpha \models \beta;\\ \Xi^{\beta,\alpha}_{\beta,\alpha}(\alpha \subset \beta)\end{pmatrix} \rightleftharpoons \begin{pmatrix}\beta \models \alpha; & \alpha \models \beta;\\ \Xi^{\beta,\alpha}_{\beta,\alpha} \models_{\Psi} \alpha; & \alpha \subset \beta\end{pmatrix}$$

and

$$\Pi'\left(\Xi^{\beta,\alpha}_{\beta,\alpha}(\alpha \subset \beta\right) \rightleftharpoons \begin{pmatrix}\beta \models \alpha; & \alpha \subset \beta\\ \alpha \subset \alpha; & \alpha \models \beta;\\ \beta \subset \beta; & \beta \subset \alpha\end{pmatrix}$$

This parallelization delivers according to the definition of the informational includedness 16 different graphs, where the minimal and the maximal configuration is presented in Fig. 13.



$\Xi(\alpha \subset \beta) = \emptyset$ $\Xi^{\beta,\alpha}_{\beta,\alpha}(\alpha \subset \beta)$

Figure 13: *Informational graphs for the simplest and the most complex case of informational includedness.*

For the so-called zero or minimal option ($\Xi(\alpha \subset \beta) = \emptyset$), there is,

$$(\alpha \subset \beta) \rightleftharpoons (\beta \models \alpha;\ \alpha \models \beta)$$

The remaining Ξ-parts are:

$$\Xi_{\alpha},\ \Xi_{\beta},\ \Xi_{\beta,\alpha},\ \Xi^{\alpha},\ \Xi^{\alpha}_{\alpha},\ \Xi^{\alpha}_{\beta},\ \Xi^{\alpha}_{\beta,\alpha},$$
$$\Xi^{\beta},\ \Xi^{\beta}_{\alpha},\ \Xi^{\beta}_{\beta},\ \Xi^{\beta}_{\beta,\alpha},\ \Xi^{\beta,\alpha},\ \Xi^{\beta,\alpha}_{\alpha},\ \Xi^{\beta,\alpha}_{\beta}$$

The minimal graph configuration must be included in all the Ξ-parts.

8.2 Informational Being-of

In [20], the informational Being-of or informational function (expressed as $\varphi(\alpha)$) was defined in the following way.

DEFINITION 14 **[Informational Function]** Let entity φ be an informational function of the entity α, that is, $\varphi(\alpha)$. This expression reads: *φ is a function of α.* Let the following parallel system of the informational function (Being-of) be defined recursively:

$$\varphi(\alpha) \rightleftharpoons \begin{pmatrix}\varphi \models_{\text{of}} \alpha;\\ \alpha \models \varphi;\\ (\varphi \models_{\text{of}} \alpha) \subset \varphi;\\ (\alpha \models \varphi) \subset_{\text{of}} \varphi\end{pmatrix}$$

where, for the first informational includedness of the formula, according to [19], there is

$$((\varphi \models_{\text{of}} \alpha) \subset \varphi) \rightleftharpoons \begin{pmatrix}\varphi \models (\varphi \models_{\text{of}} \alpha);\\ (\varphi \models_{\text{of}} \alpha) \models \varphi;\\ (\varphi \models (\varphi \models_{\text{of}} \alpha)) \subset \varphi;\\ ((\varphi \models_{\text{of}} \alpha) \models \varphi) \subset \varphi\end{pmatrix}$$

and, for the second informational includedness, according to [19],

$$((\alpha \models \varphi) \subset_{\text{of}} \varphi) \rightleftharpoons \begin{pmatrix}\varphi \models_{\text{of}} (\alpha \models \varphi);\\ (\alpha \models \varphi) \models_{\text{of}} \varphi;\\ (\varphi \models_{\text{of}} (\alpha \models \varphi)) \subset_{\text{of}} \varphi;\\ ((\alpha \models \varphi) \models_{\text{of}} \varphi) \subset_{\text{of}} \varphi\end{pmatrix}$$

□

This definition recursively determines the parallel informational mechanisms of the informational Being-of, irrespective of the functional-nesting depth. For the complex (recursive) functional def-

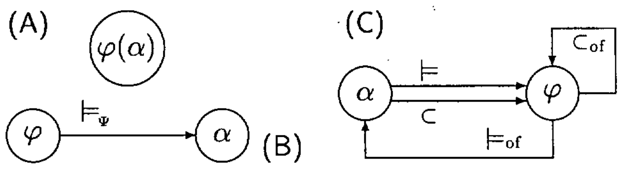


Figure 14: *Informational graph for the case of informational function:* (A) *for* $\varphi(\alpha)$, (B) *for the functional transition* $\varphi \models_\Psi \alpha$, *and* (C) *for the definition of informational function* $\varphi(\alpha)$.

inition $\varphi(\alpha)$, the standardized informational transition of the form $\varphi \models_\Psi \alpha$ is introduced, with the meaning

$$\varphi(\alpha) \rightleftharpoons \left(\varphi \models_\Psi \alpha\right)$$

The definition of $\varphi(\alpha)$ is graphically presented in Fig. 14. Questions which follow are the following: How can α and φ be expressed explicitly in a parallel circular form? Which is the primitive parallel system for the informational function? How complex is the circular gestalt and what is the star gestalt for $\varphi(\alpha)$?

From the graph in Fig. 14, the informational system concerning α is, evidently,

$$\alpha \rightleftharpoons \begin{pmatrix} (\alpha \models \varphi) \models_{\text{of}} \alpha; & (\alpha \models \varphi) \subset_{\text{of}} \varphi; \\ (\alpha \subset \varphi) \models_{\text{of}} \alpha; & (\alpha \subset \varphi) \subset_{\text{of}} \varphi \end{pmatrix}$$

Similarly, from the system, represented by the graph, functional component φ can be expressed. There is

$$\varphi \rightleftharpoons \begin{pmatrix} (\varphi \models_{\text{of}} \alpha) \models \varphi; & (\varphi \subset_{\text{of}} \varphi) \models_{\text{of}} \alpha; \\ (\varphi \models_{\text{of}} \alpha) \models_{\text{of}} \varphi & \end{pmatrix}$$

Now, one can see, how $\varphi(\alpha)$ can be expressed by substitution of φ and α, where the complex operand α (a parallel system of cyclically serially structured formulas) becomes the argument of the similarly complex operand φ (as a parallel system of circularly serially structured formulas). Such a substitution could be quite senseful in case of a particular causal situation.

According to the definition of $\varphi(\alpha)$, there exists a unique parallel primitive system (of basic transitions), marked consequently by $(\varphi(\alpha))'_{\parallel}$, that is,

$$(\varphi(\alpha))'_{\parallel} \rightleftharpoons \begin{pmatrix} \alpha \models \varphi; & \alpha \subset \varphi; \\ \varphi \models_{\text{of}} \alpha; & \varphi \subset_{\text{of}} \varphi \end{pmatrix}$$

The circular gestalt must cover the entire graph in Fig. 14 by circularly serial formulas. Thus,

$$\Gamma^{\circlearrowleft}(\varphi(\alpha)) \rightleftharpoons$$
$$\begin{pmatrix} (\alpha \models \varphi) \models_{\text{of}} \alpha; & (\varphi \models_{\text{of}} \alpha) \models \varphi; \\ \alpha \models (\varphi \models_{\text{of}} \alpha); & \varphi \models_{\text{of}} (\alpha \models \varphi); \\ (\alpha \subset \varphi) \models_{\text{of}} \alpha; & (\varphi \models_{\text{of}} \alpha) \subset \varphi; \\ \alpha \subset (\varphi \models_{\text{of}} \alpha); & \varphi \models_{\text{of}} (\alpha) \subset \varphi); \\ \varphi \subset_{\text{of}} \varphi & \end{pmatrix}$$

9 Graphs for Informational Concluding

9.1 Introduction

Informational concluding (modi informationis) was classified, critically discussed, and informationally formalized for the first time in [18]. In this framework, the following modi can be presented systematically and in the form of informational graphs, gestalts, and circular particularities:

1. informational modus agendi (an entity's externalism, internalism, and metaphysicalism);
2. informational implication as a complex structure;
3. informational modus ponens (linear concluding);
4. informational modus tollens (circular concluding);
5. informational modus rectus (detachment of an entity's intention);
6. informational modus obliquus;
7. informational modus procedendi;
8. informational modus operandi (detachment of an entity's informing);
9. informational modus vivendi;
10. informational modus possibilitatis; and
11. informational modus necessitatis.

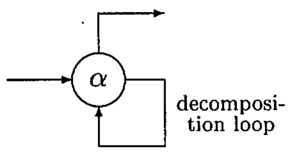


Figure 15: *Informational graphs for informational modus agendi with input and output path, and the loop for inner decomposition.*

9.2 Graph Investigation for Informational Modus Agendi

The graph for informational modus agendi in Fig. 15 demonstrates the most general phenomenalism of informing of entity α. This entity is open to its exterior and interior and it can be innerly decomposed by the informing of its components. There always exists an α-decomposition $\Delta(\alpha)$, which, in general, is a system of formulas (or a simple circular serial formula) in which inner components appears together with α.

Modus agendi of an operand is its possibility to be informed from its exterior by other entities, to inform the exterior components, and to be circularly organized (e.g., metaphysically or otherwise). In an informational graph, the circle or oval represents, in general (in principle) an informational operand (entity) with the presented three categories of arrows (informational operators). Implicitly, the rule of modus agendi, ρ_{MA}, can be formalized as

$$\rho_{\mathrm{MA}}(\alpha) \rightleftharpoons \begin{pmatrix} \models \alpha; \\ \alpha \models; \\ \Delta(\alpha \models \alpha) \end{pmatrix}$$

This scheme of the operand α presentation is essential for the understanding of the informational operand and informational formulas or formula systems, which are nothing other than forms of operands (informing entities). The parallel formula system $(\models \alpha; \alpha \models; \Delta(\alpha \models \alpha))$ is a form of primitive parallelization of α, that is, $\Pi'(\alpha)$, being equivalent to the graph in Fig. 15.

9.3 Graph Investigation for Informational Modus Ponens

The modus ponens is the most obvious and fully legal rule of inference in mathematics. Its structure realizes logically a conjunction (operator of informational parallelism ';'), an implication (operator $\Longrightarrow$), and the main implication, called the informational detachment (operator in the form of a fraction line, denoted by $\frac{\cdots}{\cdots}$ in an informational graph). Formally, the rule of informational modus ponens, ρ_{MP}, is a formula of the form

$$\rho_{\mathrm{MP}}(\alpha, \beta) \rightleftharpoons \frac{\alpha; \alpha \Longrightarrow \beta}{\beta}$$

with the graph in Fig. 16, corresponding to the primitive rule parallelization, that is,

$$\Pi'\left(\frac{\alpha; \alpha \Longrightarrow \beta}{\beta}\right) \rightleftharpoons \begin{pmatrix} \alpha \parallel\!\models \alpha; \\ \alpha \Longrightarrow \beta; \\ \dfrac{\beta}{\beta} \end{pmatrix}$$

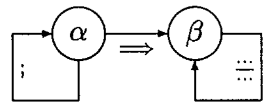


Figure 16: *Informational graph for informational modus ponens.*

In this primitive parallelization scheme, the semicolon in the premise was replaced by operator of parallelism $\parallel\!\models$, to make the primitive formula system more transparent (semicolons are used as separators between elementary transition formulas). By the rule of modus ponens, operand β is detached from the rule premise, that is, follows as a conclusion.

What is characteristic for this rule of inference is its linear serial structure in concern to α, but circular structure in concern to β, being evident from the graph in Fig. 16. It will be presented how other rules of inference are much more informationally circularly structured and, that informational circularity pervades the entire living and artificial (also mathematical) informational realm. Thus, modus ponens, as one of the firmest inference rules in mathematics, is pseudolinear (linear *con*sequential) and, in fact, violates itself (in a hidden form) the mathematical principle of straightforwardness. Namely, the detached operand β is, according to the modus agendi of an informational entity, circularly decomposed in the most consequent form $\frac{\beta}{\beta}$ (or $\beta \Longrightarrow \beta$).

What could bring a real surprise into the philosophy of modus ponens is a mathematically and informationally legal rearrangement of the rule premise. The semicolon represents a conjuctive connective in mathematics and a parallel connective in informational theory: both underlie the so-called associative law. This means, that operands on the left and the right of semicolon can be exchanged. This sort of legal conclusion causes a rule of modus ponens in the form

$$\rho^1_{\text{MP}}(\alpha, \beta) \rightleftharpoons \frac{\alpha \Longrightarrow \beta; \alpha}{\beta}$$

If this rule with exchanged premise parts is mathematically unacceptable, it just means that behind the philosophy of modus ponens something remains unexplained (hidden, unrevealed), and that the semicolon, also in mathematics, occupies an loosely determined logical connective (separator), being formally excluded from the valid (transparent) field of legal intelligibility. It should mean that parallelism does not enter into the regular mathematical discourse, although it functions as the most normal phenomenon in logical concluding.

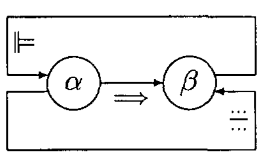


Figure 17: *Informational graph for another formal interpretation of informational modus ponens.*

This disputable rule of modus ponens delivers the graph in Fig. 17 or the primitive parallelization scheme

$$\Pi'\left(\frac{\alpha \Longrightarrow \beta; \alpha}{\beta}\right) \rightleftharpoons \begin{pmatrix} \alpha \Longrightarrow \beta; \\ \beta \models\!\!\!\models \alpha; \\ \dfrac{\alpha}{\beta} \end{pmatrix}$$

As the reader can see, the local (inner) loops for operands α and β disappeared, and instead of them two other loops including both operands α and β appear. Precisely the graphs for the first and the second formal presentation of modus ponens explicate the essential difference of them and bring up the dispute of the ultimate and everlasting validity of this type of concluding.

A radically different concept of modus ponens concerns the decomposition of both operands α and β. As well α as β hide a decompositional nature Δ_α and Δ_β, which decide about the necessary informational (modus ponens) adequateness between α and β. Thus, the new inference rule $\rho^2_{\text{MP}}(\alpha, \beta, \Delta_\alpha, \Delta_\beta)$ must be understood as

$$\rho^2_{\text{MP}}(\alpha, \beta, \Delta_\alpha, \Delta_\beta) \rightleftharpoons \frac{\alpha;\ \Delta_\alpha(\alpha) \Longrightarrow \Delta_\beta(\beta)}{\beta}$$

The graph for this rule of modus ponens is presented in Fig. 18.

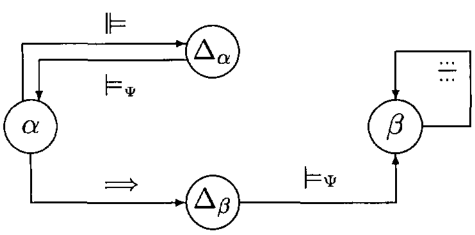


Figure 18: *Informational graph for decompositional formal interpretation of informational modus ponens.*

9.4 Graph Investigation for Informational Modus Tollens

The informational modus tollens already arises from a more informationally slippery ground, with interweaved informational loops which sometimes might perform explicitly tautologically. Two possible graphs for modus tollens are presented in Fig. 19

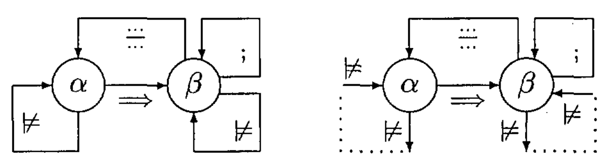


Figure 19: *Informational graphs for informational modus tollens.*

9.5 Graph for Informational Modus Rectus

The aim of informational modus rectus ρ_{MR} is detaching intention $\iota_{\text{intention}}$ of an informational entity α within a transitional intentional informing of α to an entity β. E.g., an exterior observer, say β, of α who observes the α's intentional informing of β, comes to the conclusion that there exists an α's intention in the informing by which it informationally impacts β. The result of this intentional informing is observed (seeable, comprehensible, intelligible) in β as an informational Being-in [19]. Intention of entity α appears as a general circular decomposition, e.g. as $\Delta^{\circlearrowleft}_{\rightarrow}(\iota_{\mathrm{intention}}(\alpha))$ or as a metaphysicalistic decomposition $\mathsf{M}^{\circlearrowleft}_{\rightarrow}(\iota_{\mathrm{intention}}(\alpha))$.

The rule of informational modus rectus has the form

$$\rho_{\mathrm{MR}}(\alpha, \beta, \iota_{\mathrm{intention}}, \Delta^{\circlearrowleft}_{\rightarrow}) \rightleftharpoons \frac{\alpha; ((\alpha \models_{\mathrm{intend}} \beta) \Longrightarrow \iota_{\mathrm{intention}}(\alpha))}{\Delta^{\circlearrowleft}_{\rightarrow}(\iota_{\mathrm{intention}}(\alpha)) \subset \beta}$$

The graph for this rule is presented in Fig. 20. Primitive parallelization

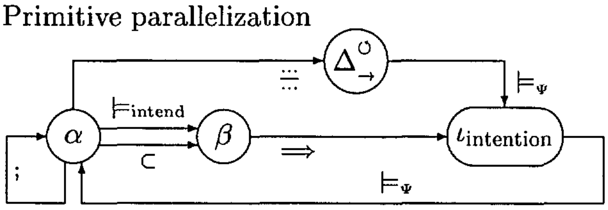


Figure 20: *Informational graph for informational modus rectus.*

$$\Pi'\left(\rho_{\mathrm{MR}}(\alpha, \beta, \iota_{\mathrm{intention}}, \Delta^{\circlearrowleft}_{\rightarrow})\right) \rightleftharpoons \begin{pmatrix} \alpha \models \alpha; & \alpha \models_{\mathrm{intend}} \beta; \\ \beta \Longrightarrow \iota_{\mathrm{intention}}; & \iota_{\mathrm{intention}} \models_\Psi \alpha; \\ \dfrac{\alpha}{\Delta^{\circlearrowleft}_{\rightarrow}}; & \Delta^{\circlearrowleft}_{\rightarrow} \models_\Psi \iota_{\mathrm{intention}}; \\ \iota_{\mathrm{intention}} \models_\Psi \alpha; & \alpha \subset \beta \end{pmatrix}$$

is an exact description of the graph in Fig. 20. One can see how modus rectus emerges through a particular moving along the graph paths (arrows). This formula can be understood as the one of the possibilities of belonging to the infinite star gestalt formula system, which arises through all the possible moving along the graph paths.

Many other rules for detaching (extracting) the intentional informing of an entity could be constructed considering various views and beliefs of intentionality as an informational phenomenalism.

9.6 Graph for Informational Modus Obliquus

An *informational modus obliquus* [18, 23] is a broad informational concept for concluding and inference which has its roots in the Latin conversation practice (e.g., slanting, sideways, oblique, *indirect,* covert, envious discourse). The modus obliquus (MO) concerns indirect adjustment of an absurdly experienced, individually motivated, felt, emotional, interested, etc. consciousness informing. MO as informational detachment of an informational item out of an absurd, disapproved, distrust informational situation uses the inference and concluding forms and processes, even in its conscious realm of informing, in the realm of unawareness, illiteracy, doubt, and falsity. This is the absurd attitude of the MO itself with the aim to surpass the absurdness of a complex informational situation.

The reader will agree that setting an informational graph for various possibilities of MO would require a separate and exhaustive study. But some simplified concepts of MO can be presented by informational graphs and the corresponding formula systems.

As a form of the rule using indirect informational content and meaning, MO obviously deviates from a direct or intentional line (e.g., the line with modus rectus) of discourse, performing roundabout or not going straight to the point. In this respect it performs within a speech game in which behind-the-scenes intentions, views, and purposes remain hidden and must not be disclosed (e.g., in political, ideological, clan-like, deceptional public discourse). As an indirect form of inference, it involves concluding with "commonly noninforming" (secretly, unconsciously informing) entities. But on the other side, right in this manner, MO can reveal information being not openly shown to the participants of a complex, yet not essentially disclosed discourse.

Let a mark a complex controversial and unexamined informational entity. The controversy of a means that a clear absurd informational item $\mathsf{b}_{\mathrm{absurd}}$ in a can be identified. In this situation, $\mathsf{b}_{\mathrm{absurd}}$ has to be informationally decomposed (analyzed, synthesized, interpreted, transformed) in the circular form $\Delta^{\circlearrowleft}_{\rightarrow}(\mathsf{b}_{\mathrm{absurd}}(\mathsf{a}))$ with the aim to deliver the conclusion $\mathsf{c}_{\mathrm{conclusion}}$ in such a way that absurd is informationally included in the conclusion. In this way, the possible scheme for $\mathsf{c}_{\mathrm{conclusion}}$ detachment from the controversial origin entity a is

$$\rho_{\mathrm{MO}}\left(\mathsf{a}, \mathsf{b}_{\mathrm{absurd}}, \mathsf{c}_{\mathrm{conclusion}}, \Delta^{\circlearrowleft}_{\rightarrow}, \mathsf{N}^{\circlearrowleft}_{\rightarrow}\right) \rightleftharpoons$$

$$\frac{(\mathsf{a} \models_{\mathrm{absurdly}} \mathsf{b}_{\mathrm{absurd}}(\mathsf{a})) \subset \mathsf{a};\quad \Delta^{\circlearrowleft}_{\rightarrow}(\mathsf{b}_{\mathrm{absurd}}(\mathsf{a})) \Longrightarrow \mathsf{c}_{\mathrm{conclusion}}}{\mathsf{N}^{\circlearrowleft}_{\rightarrow}(\mathsf{b}_{\mathrm{absurd}}(\mathsf{a})) \subset \mathsf{c}_{\mathrm{conclusion}}}$$

In this rule, N marks the so-called negated circular serial decomposition of the absurd informational entity $\mathsf{b}_{\mathrm{absurd}}(\mathsf{c})$. This circular decomposition is something like

$$(\cdots((\mathsf{b}_{\mathrm{absurd}}(\mathsf{a}) \not\models \alpha_1(\mathsf{a})) \not\models \alpha_2(\mathsf{a}))\cdots \not\models \alpha_n(\mathsf{a})) \not\models \mathsf{b}_{\mathrm{absurd}}(\mathsf{a})$$

where some derivatives $\alpha_i(\mathsf{a})$ informationally counterinform (informationally oppose) in respect to $\mathsf{b}_{\mathrm{absurd}}(\mathsf{a})$. It means that this decomposition is a circular serial function of the form denoted by

$$\overline{{}^{n+1}_{j_0}\varphi^{\circlearrowleft}_{\rightarrow}}(\mathsf{b}_{\mathrm{absurd}}(\mathsf{a}),\ \alpha_1(\mathsf{a}),\ \alpha_2(\mathsf{a}), \cdots, \alpha_n(\mathsf{a}))$$

with $1 \le j_0 \le \frac{1}{n+2}\binom{2n+2}{n+1}$. Now the reader can grasp the importance of the other such functions resulting as a consequence of an operand rotation to the title place. Some of these operands can represent a direct answer (in fact, counter-answer) in regard to the absurd situation $\mathsf{b}_{\mathrm{absurd}}(\mathsf{a})$. Thus,

$$\overline{{}^{n+1}_{j_i}\varphi^{\circlearrowleft}_{\rightarrow}}(\alpha_i(\mathsf{a}),\ \alpha_{i+1}(\mathsf{a}), \cdots, \alpha_n(\mathsf{a}),\ \mathsf{b}_{\mathrm{absurd}}(\mathsf{a}),\ \alpha_1(\mathsf{a}),\ \alpha_2(\mathsf{a}), \cdots, \alpha_{i-1}(\mathsf{a}))$$

The primitive circular parallel system

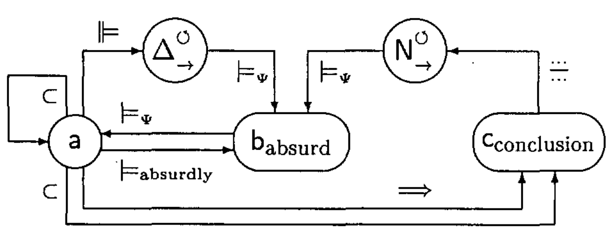


Figure 21: *An informational graph for possible informational modus obliquus.*

$$\Pi'\left(\rho_{\mathrm{MO}}\left(\mathsf{a}, \mathsf{b}_{\mathrm{absurd}}, \mathsf{c}_{\mathrm{conclusion}}, \Delta^{\circlearrowleft}_{\rightarrow}, \mathsf{N}^{\circlearrowleft}_{\rightarrow}\right)\right) \rightleftharpoons$$

$$\left(\begin{array}{ll}
\mathsf{a} \models_{\mathrm{absurdly}} \mathsf{b}_{\mathrm{absurd}}; & \mathsf{b}_{\mathrm{absurd}} \models_{\Psi} \mathsf{a}; \\
\mathsf{a} \subset \mathsf{a}; & \mathsf{a} \Vdash \Delta^{\circlearrowleft}_{\rightarrow}; \\
\Delta^{\circlearrowleft}_{\rightarrow} \models_{\Psi} \mathsf{b}_{\mathrm{absurd}}; & \mathsf{b}_{\mathrm{absurd}} \models_{\Psi} \mathsf{a};^{(*)} \\
\mathsf{a} \Longrightarrow \mathsf{c}_{\mathrm{conclusion}}; & \dfrac{\mathsf{c}_{\mathrm{conclusion}}}{\mathsf{N}^{\circlearrowleft}_{\rightarrow}}; \\
\mathsf{N}^{\circlearrowleft}_{\rightarrow} \models_{\Psi} \mathsf{b}_{\mathrm{absurd}}; & \mathsf{b}_{\mathrm{absurd}} \models_{\Psi} \mathsf{a};^{(**)} \\
\mathsf{a} \subset \mathsf{c}_{\mathrm{conclusion}} &
\end{array}\right)$$

is the exact description of the informational graph in Fig. 21. Formulas marked by $^{(*)}$ and $^{(**)}$ in the primitive system are superfluous and are used solely for seeing the circular continuity of the system.

9.7 Graph for Informational Modus Procedendi

A goal or aim of informing of an entity, as something essentially different in regard to informational intention, can become the subject of the detachment, for instance, in a strategic environment. The question is what could a system of goals within a strategy be at all? The Latin *procedo* has the meaning of *to go forth or before, advance, make progress; to continue, remain;* and *to go on.*

Let an informational strategy entity s include a hidden goal system $\mathsf{g}_{\mathrm{goal}}$. Strategy s causes a system of consequences c (s), elsewhere, such that c (s) can be transparently observed. The goal system $\mathsf{g}_{\mathrm{goal}}$ performs as a cause of c (s), that is, as a system of the form

$$\mathsf{c}(\mathsf{s}) \subset \mathsf{s};\ \mathsf{c}(\mathsf{s}) \models_{\mathrm{cause}} \mathsf{g}_{\mathrm{goal}}$$

The $\models_{\mathrm{cause}}$ operator has to be particularized to operator $\Longrightarrow_{\mathrm{cause}}$ with the meaning *implicatively causes.*

Detachment of $\mathsf{g}_{\mathrm{goal}}$ must remain within a careful (goal-consequent) decomposition $\mathsf{G}^{\circlearrowleft}_{\rightarrow}$ of consequences c, (s,), that is, as $\mathsf{G}^{\circlearrowleft}_{\rightarrow}(\mathsf{c}(\mathsf{s}))$.

Modus procedendi is a rule (ρ_{MPr}) for the detachment of goal-directed organization $\mathsf{g}_{\mathrm{goal}}$ of the strategy informing entity s , through the observing of c (s). Thus,

$$\rho_{\text{MPr}}\left(s, g_{\text{goal}}, c, G^{\circlearrowleft}_{\rightarrow}\right) \rightleftharpoons \frac{g_{\text{goal}} \subset s;\ g_{\text{goal}} \Longrightarrow_{\text{cause}} G^{\circlearrowleft}_{\rightarrow}(c(s))}{g_{\text{goal}}}$$

The graph for this inference rule is presented in Fig. 22. Primitive parallelization of the rule gives

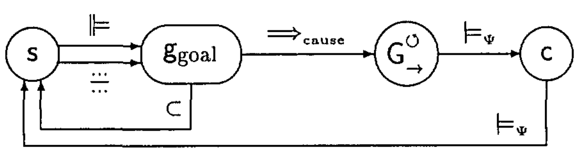


Figure 22: *Informational graph for informational modus procedendi.*

$$\Pi'\left(\rho_{\text{MPr}}\left(s, g_{\text{goal}}, c, G^{\circlearrowleft}_{\rightarrow}\right)\right) \rightleftharpoons \begin{pmatrix} g_{\text{goal}} \subset s; & s \Vdash g_{\text{goal}}; \\ g_{\text{goal}} \Longrightarrow_{\text{cause}} G^{\circlearrowleft}_{\rightarrow}; & G^{\circlearrowleft}_{\rightarrow} \models_{\Psi} c; \\ c \models_{\Psi} s; & \dfrac{s}{g_{\text{goal}}} \end{pmatrix}$$

A more firm and direct inference rule would be that of modus ponens, e.g.,

$$\rho_{\text{MP}}(s, g_{\text{goal}}) \rightleftharpoons \frac{s;\ s \Longrightarrow g_{\text{goal}}}{g_{\text{goal}}}$$

from which c and $G^{\circlearrowleft}_{\rightarrow}$ are excluded. But with modus rectus the preceding informational components can be considered in a slightly different way (see Fig. 23, for instance, in the form

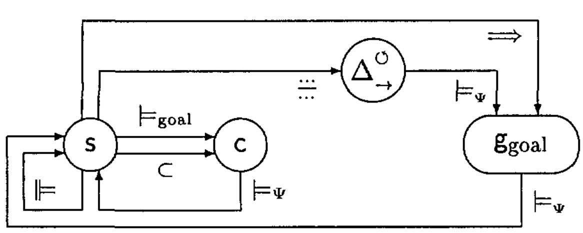


Figure 23: *Informational graph for the case when modus procedendi is replaced by slightly modified modus rectus.*

$$\rho_{\text{MR}}\left(s, c, g_{\text{goal}}, \Delta^{\circlearrowleft}_{\rightarrow}\right) \rightleftharpoons \frac{s;\ ((s \models_{\text{goal}} c(s)) \Longrightarrow g_{\text{goal}}(s))}{\Delta^{\circlearrowleft}_{\rightarrow}(g_{\text{goal}}(s)) \subset c(s)}$$

Here, decomposition $\Delta^{\circlearrowleft}_{\rightarrow}$ is a circular serial decomposition concerning the goal as a function of the strategy, that is, as $g_{\text{goal}}(s)$. Parallelization of the presented rule for modus rectus is

$$\Pi'\left(\rho_{\text{MR}}\left(s, c, g_{\text{goal}}, \Delta^{\circlearrowleft}_{\rightarrow}\right)\right) \rightleftharpoons \begin{pmatrix} s \Vdash s; & s \models_{\text{goal}} c; \\ c \models_{\Psi} s; & s \Longrightarrow g_{\text{goal}}; \\ g_{\text{goal}} \models_{\Psi} s; & \dfrac{s}{\Delta^{\circlearrowleft}_{\rightarrow}}; \\ \Delta^{\circlearrowleft}_{\rightarrow} \models_{\Psi} g_{\text{goal}}; & g_{\text{goal}} \models_{\Psi} s; \\ s \subset c; & c \models_{\Psi} s \end{pmatrix}$$

9.8 Graph for Informational Modus Operandi

An *informational modus operandi* detaches the (inner, own) operational capabilities of an entity α in the form of an informational function of the entity in the general form $\varphi(\alpha)$ (e.g., informational Being-of in [20]). This function is usually called the entity informing and marked by $\mathfrak{I}_\alpha$. But informing $\mathfrak{I}_\alpha$, as an operational property of the entity α, performs by itself as an informational entity within α, as an α's includedness, $\mathfrak{I}_\alpha \subset \alpha$ (e.g., informational Being-in in [19]).

A modus operandi concerns the decomposition of an entity in respect of its interior informing. Informing $\mathfrak{I}_\alpha$ is only the initial step in the decomposition process when circular informing of the form $(\alpha \models \mathfrak{I}_\alpha) \models \alpha$ and/or $\alpha \models (\mathfrak{I}_\alpha \models \alpha)$ comes to the surface. The deeper operational detachment of further inner components of α can deliver not only the other inner components but also the informational structure (formula) of them. One of the possible forms of the operational detachment concerning an entity is the so-called rule $\rho^{\mu_j}_{\text{MOp}}(\alpha, \mathfrak{I}_\alpha, \mathfrak{i}_\alpha, \mathfrak{C}_\alpha, \mathfrak{c}_\alpha, \mathfrak{E}_\alpha, \mathfrak{e}_\alpha)$ of metaphysicalistic modus operandi (metaphysicalistic decomposition $\mathsf{M}^{\circlearrowleft}_{\rightarrow}$ or μ_j-decomposition) in the form

$$\rho^{\mu_{j_1}}_{\text{MOp}}(\alpha, \mathfrak{I}_\alpha, \mathfrak{i}_\alpha, \mathfrak{C}_\alpha, \mathfrak{c}_\alpha, \mathfrak{E}_\alpha, \mathfrak{e}_\alpha) \rightleftharpoons \frac{\alpha;\ \alpha \Longrightarrow \begin{pmatrix} ((((((\alpha \models \mathfrak{I}_\alpha) \models \mathfrak{i}_\alpha) \models \mathfrak{C}_\alpha) \models \\ \mathfrak{c}_\alpha) \models \mathfrak{E}_\alpha) \models \mathfrak{e}_\alpha) \models \alpha \end{pmatrix}}{\mathfrak{I}_\alpha, \mathfrak{i}_\alpha, \mathfrak{C}_\alpha, \mathfrak{c}_\alpha, \mathfrak{E}_\alpha, \mathfrak{e}_\alpha}$$

where the number j_1 of possible causal interpretations (because of the definite particularization of operators ';', $\Longrightarrow$, and $\vdots\!\!=$ and the rule firmness) varies within the interval $1 \leq j_1 \leq 132$ $\left(= \frac{1}{7}\binom{12}{6}\right)$. The possible interpretations concern the metaphysicalistic formula ${}_{1}^{7}\mu_{\rightarrow}^{\circlearrowleft}(\alpha, \mathfrak{I}_\alpha, \mathfrak{i}_\alpha, \mathfrak{C}_\alpha, \mathfrak{c}_\alpha, \mathfrak{E}_\alpha, \mathfrak{e}_\alpha)$ (metaphysicalistic symbol μ comes instead of φ for a general symbol[7]).

In fact, the metaphysicalistic components are detached from several loops existing within (in the framework of) the main (one- or two-directional) loop [24], and also from the other parallel loops which particularly (characteristically) concern the interior informing of the entity. In this manner, the detachment of the inner operational components can not only be accomplished but further informationally refined within the process of informational arising, considering the ongoing informational happening, appearing, and phenomenalizing of the entity under the investigation. Thus, according to [25], the improved detachment of an one-directional metaphysicalism (six loops) of the entity delivers

$$\frac{\alpha;\ \alpha \Longrightarrow \begin{pmatrix} ((((((\alpha \models \mathfrak{I}_\alpha) \models \mathfrak{i}_\alpha) \models \mathfrak{C}_\alpha) \models \mathfrak{c}_\alpha) \models \\ \mathfrak{E}_\alpha) \models \mathfrak{e}_\alpha) \models \alpha; \\ (((\mathfrak{I}_\alpha \models \mathfrak{i}_\alpha) \models \mathfrak{C}_\alpha) \models \mathfrak{c}_\alpha) \models \mathfrak{I}_\alpha; \\ (((\mathfrak{C}_\alpha \models \mathfrak{c}_\alpha) \models \mathfrak{E}_\alpha) \models \mathfrak{e}_\alpha) \models \mathfrak{C}_\alpha; \\ (\mathfrak{I}_\alpha \models \mathfrak{i}_\alpha) \models \mathfrak{I}_\alpha; \\ (\mathfrak{C}_\alpha \models \mathfrak{c}_\alpha) \models \mathfrak{C}_\alpha; \\ (\mathfrak{E}_\alpha \models \mathfrak{e}_\alpha) \models \mathfrak{E}_\alpha \end{pmatrix}}{\mathfrak{I}_\alpha, \mathfrak{i}_\alpha, \mathfrak{C}_\alpha, \mathfrak{c}_\alpha, \mathfrak{E}_\alpha, \mathfrak{e}_\alpha}$$

This rule of the multiloop detachment could be systematically marked, according to the six loops, as

$$\rho_{\mathrm{MOp}}^{\mu_{j_1}, \mu_{j_{11}}, \mu_{j_{12}}, \mu_{j_{13}}, \mu_{j_{14}}, \mu_{j_{15}}}\left(\alpha, \mathfrak{I}_\alpha, \mathfrak{i}_\alpha, \mathfrak{C}_\alpha, \mathfrak{c}_\alpha, \mathfrak{E}_\alpha, \mathfrak{e}_\alpha\right)$$

where the second subscript q of $\mu_{j_{pq}}$ corresponds to a subloop in the main loop.

There is to stress that operands below the detachment line are separated by commas. This means that each of operands is detached separately, and that there is not meant the parallel system of the form $\mathfrak{I}_\alpha;\ \mathfrak{i}_\alpha;\ \mathfrak{C}_\alpha;\ \mathfrak{c}_\alpha;\ \mathfrak{E}_\alpha;\ \mathfrak{e}_\alpha$. This situation causes a complex and circularly interweaved graph structure (not so easily drawn on a piece of paper). Thus,

$$\frac{\alpha}{\beta, \gamma} \rightleftharpoons \left(\frac{\alpha}{\beta}; \frac{\alpha}{\gamma}\right)$$

where detachments $\frac{\alpha}{\beta}$ and $\frac{\alpha}{\gamma}$ are understood as the basic transitions at the parallelization of the rule. The system of the basic transitions for the discussed metaphysicalistic modus operandi is

$$\boxed{\begin{array}{ll} \alpha \Vdash \alpha, \mathfrak{I}_\alpha, \mathfrak{C}_\alpha, \mathfrak{E}_\alpha; & \alpha \Longrightarrow \alpha, \mathfrak{I}_\alpha, \mathfrak{C}_\alpha, \mathfrak{E}_\alpha; \\ \mathfrak{I}_\alpha \Vdash \mathfrak{C}_\alpha, \mathfrak{E}_\alpha; \mathfrak{c}_\alpha \Vdash \mathfrak{E}_\alpha; & \dfrac{\alpha, \mathfrak{I}_\alpha, \mathfrak{C}_\alpha, \mathfrak{E}_\alpha}{\mathfrak{I}_\alpha, \mathfrak{i}_\alpha, \mathfrak{C}_\alpha, \mathfrak{c}_\alpha, \mathfrak{E}_\alpha, \mathfrak{e}_\alpha}; \end{array}}$$

$$\begin{array}{ll} \alpha \models \mathfrak{I}_\alpha;\ \mathfrak{I}_\alpha \models \mathfrak{i}_\alpha; & \mathfrak{i}_\alpha \models \mathfrak{C}_\alpha;\ \mathfrak{C}_\alpha \models \mathfrak{c}_\alpha; \\ \mathfrak{c}_\alpha \models \mathfrak{E}_\alpha;\ \mathfrak{E}_\alpha \models \mathfrak{e}_\alpha; & \end{array}$$

$$\boxed{\begin{array}{ll} \mathfrak{E}_\alpha \models \alpha;\ \mathfrak{c}_\alpha \models \mathfrak{I}_\alpha; & \mathfrak{e}_\alpha \models \mathfrak{C}_\alpha;\ \mathfrak{i}_\alpha \models \mathfrak{I}_\alpha; \\ \mathfrak{c}_\alpha \models \mathfrak{C}_\alpha;\ \mathfrak{e}_\alpha \models \mathfrak{E}_\alpha & \end{array}}$$

The system in the first frame includes 35 basic transitions and represents the part of the rule outside the formula ${}_{1}^{7}\mu_{\rightarrow}^{\circlearrowleft}(\alpha, \mathfrak{I}_\alpha, \mathfrak{i}_\alpha, \mathfrak{C}_\alpha, \mathfrak{c}_\alpha, \mathfrak{E}_\alpha, \mathfrak{e}_\alpha)$, with exception of parallel (semicolon) operators of the formula. In the second frame the "feedback" transitions of the formula ${}_{1}^{7}\mu_{\rightarrow}^{\circlearrowleft}$ occur. Finally, on the basis of the described parallel system, the graph of the rule can be drawn.

9.9 Graph for Informational Modus Vivendi

An *informational modus vivendi* [18] concerns the information of life (e.g., autopoietic informational entity α) in environmental, individual, technological, and social circumstances. Informational problems of social transition [26] are typical forms of modi vivendi when the governing totalitarian ideological pattern of understanding has to be replaced with a more flexible and life-suited paradigm of social and environmental survival.

The basic living information—conscious as subconscious—existing everywhere the life arises, may be recognized as autopoietic or self-organizing information. It does not organize only the organism for the suited behavior in life circumstances but organizes, through the pressure of the environment, also the information itself for a proper organism behavior, for instance, building up the so-called metaphysicalism μ of autopoietic entity α, marked μ_α or together with sensory informational entity σ_α.

[7]Metaphysicalistic formula ${}_{1}^{7}\mu_{\rightarrow}^{\circlearrowleft}\left(\alpha, \mathfrak{I}_\alpha, \mathfrak{i}_\alpha, \mathfrak{C}_\alpha, \mathfrak{c}_\alpha, \mathfrak{E}_\alpha, \mathfrak{e}_\alpha\right)$ already considers the semantically determined components (operands) of informing, counterinforming, and embedding.

It is to understand that, in the beginning, α and σ_α impact the arising of μ_α, and then μ_α essentially impacts the emerging of both α and σ_α, thus a basic circular system of the form

$$((\alpha \models \sigma_\alpha) \models \mu_\alpha(\sigma)) \models \alpha$$

is reasonable. Within this cycle, metaphysicalism $\mu_\alpha(\sigma)$ is a constitutive part of α, e.g. $\mu_\alpha(\sigma)$, which has to be extracted from α by a modus vivendi, being essential for survival and adaptation of α in the environment. This rule must belong to α itself as a particular informational entity, being able to identify instantaneous $\mu_\alpha(\sigma)$ during its emerging in life circumstances. This rule is

$$\rho_{\mathrm{MV}}(\alpha, \sigma_\alpha, \mu_\alpha(\sigma)) \rightleftharpoons \frac{(\alpha, \sigma_\alpha); (\alpha, \sigma_\alpha \models \mu_\alpha(\sigma))}{\mu_\alpha(\sigma)}$$

The graph for this rule is presented in Fig. 24. It

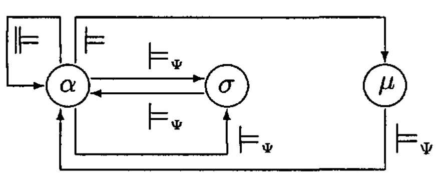


Figure 24: *Informational graph for the discussed modus vivendi.*

is an initial scheme only which can be decomposed to further details (informationally particularized).

A logically more consistent (rationalistic) form of modus vivendi would, for instance, require a rule of the form

$$\frac{(\alpha, \sigma_\alpha); (\alpha, \sigma_\alpha \Longrightarrow \mu_\alpha(\sigma))}{\mu_\alpha(\sigma)}$$

representing a kind of modus ponens in the framework of modus vivendi.

9.10 Graph for Informational Modus Necessitatis

By a necessity, the 'must' is compelled. In this respect, the meaning of the verb *must* becomes necessity by itself in the realm of the theory of informational. Necessity as informational phenomenon is a pressure of circumstances, which can be grasped also as an essential impossibility of a contrary informational position. It appears as an urgent informational experience, emotion, memory, need and desire (the consciousness of the must), in such a way, that it as a particular informational entity cannot inform outside itself, that is, in an another direction. Within the causalism, necessity can be comprehended as an inevitable informational consequence.

Modus necessitatis is that principle of inference which in several situations can coincide with discussed principles hidden in other modi informationis. Intentionality, which comes to the surface in modus ponens and modus rectus, can be grasped as a particular case of necessity, being consistently bound to the so-called logical mind of human, in the sense of the "best" rationalistic tradition. A more detailed discussion (also formalized) is given in [18]. The attentive reader is already able to proceed into the philosophy of informational, its formalization, and construction of informational graph by himself/herself.

9.11 Graph for Informational Modus Possibilitatis

Possibility is a modal informational phenomenon which opposes the instantaneous reality (essentialness, existentiality) and necessity. A modality (potentiality) by itself is a mood of revealing of experience, emotion, consciousness, and in more general form, of Being, thinking, occurrence; it is a mood of game with conditionalities.

In logic, modality of propositions means the degree of trustability of propositions in regard to possibility, existence, and to necessity. Such a proposition of the possibility is, for instance, $\alpha \models_{\mathrm{can\_be}} \beta$, read as α can be β, or informationally consequently as α informs that there could be β. An asserting (existential) proposition is, for example, $\alpha = \beta$ with the meaning α is β or, consequently formally, $\alpha \models\!\!\!\rightrightarrows \beta$. An apodictic (necessity) proposition is $\alpha \models_{\mathrm{must\_be}} \beta$.

Modus possibilitatis is that modus which opens the realm of informational potentiality, including views of exaggeration, inauthenticity, unreliability, controversialism, but also unreasonableness, insolence, and mania. All this concerns the informationally active (intense) and quality creative possible consciousness searching. In this respect, modus possibilitatis can become bound to modus obliquus and modus vivendi, but also to the noninforming (negative) possibilities of modus necessitatis. A basic rule for such a kind of inference is described in [18] in the form

$$\frac{(\alpha,\beta);(\alpha,\beta\models\alpha)\models_\pi\gamma}{\gamma\models_\pi\gamma_1,\gamma_2,\cdots,\gamma_n}$$

where α is the subject entity, β its exterior impact, γ an entity induced as possibility, components $\gamma_1, \gamma_2, \cdots, \gamma_n$ its informational derivatives, while $\models_\pi$ represents a possible informing (possibility operator).

10 An Informational Case for Strategy Decision Making

Maruyama (1993) has invented a practical computer supported scheme for simulation of strategy decision making for business executives and governmental planners. Let us show this concept of a typical computer supported simulation program in the realm of an informational formula system and the corresponding graph, where substantial conceptual changes in understanding the informational nature of the decision making problem take place.

The informing scheme of the problem can be presented in an informationally condensed form in Fig. 25 and parallelized according to the particular entities $\mathfrak{e},\mathfrak{f},\mathfrak{g},\mathfrak{h},\mathfrak{j},\mathfrak{k},\mathfrak{m},\mathfrak{n},\mathfrak{r},\mathfrak{v},\mathfrak{x},\mathfrak{z}$[8]. According to the graph in Fig. 25, the adequate formal description of the graph $\mathfrak{G}$ becomes, considering the gestalt Γ of the formula system,

$$\mathfrak{G}\left(\Gamma\left(\begin{array}{l}\models\mathfrak{e},\mathfrak{f},\mathfrak{g},\mathfrak{h},\mathfrak{j},\mathfrak{k},\mathfrak{m},\mathfrak{n},\mathfrak{r},\mathfrak{v},\mathfrak{x},\mathfrak{z};\\ \mathfrak{e},\mathfrak{f},\mathfrak{g},\mathfrak{h},\mathfrak{j},\mathfrak{k},\mathfrak{m},\mathfrak{n},\mathfrak{r},\mathfrak{v},\mathfrak{x},\mathfrak{z}\models;\\ \left(\left(\begin{array}{l}\mathfrak{e};\\ \mathfrak{f};\\ \mathfrak{h};\\ \mathfrak{k}\end{array}\right)\models\mathfrak{j}\right)\models\left(\begin{array}{l}\mathfrak{f};\\ \mathfrak{g};\\ \mathfrak{h};\\ \mathfrak{m};\\ \mathfrak{e}\end{array}\right);\\ \left(\left(\begin{array}{l}\mathfrak{h};\\ \mathfrak{r};\\ \mathfrak{x}\end{array}\right)\models\mathfrak{z}\right)\models\left(\begin{array}{l}\mathfrak{e};\\ \mathfrak{m};\\ \mathfrak{v}\end{array}\right);\\ (\mathfrak{v}\models\mathfrak{n})\models\left(\begin{array}{l}\mathfrak{x};\\ \mathfrak{g}\end{array}\right);\left(\begin{array}{l}\mathfrak{g};\\ \mathfrak{k}\end{array}\right)\models\mathfrak{k};\\ (\mathfrak{m}\models\mathfrak{f})\models\mathfrak{r}\end{array}\right)\right)$$

The scheme in Fig. 25 presents a complex and completely circularly structured informational graph (Subsection 6.7, with additional input and output paths for each involved entity).

11 An Example of Association Graph

Informational connection means entities being operationally linked and joined together through causal or logical relations or sequences. By informational *association* such a connection between informational entities is meant which has a relation in similarity, contrariety, contiguity, causation, etc. For example, a thought (process) is linked in the mind or memory with the other thoughts in the process of thinking (e.g. associative components, an associative system, encoding consciously apprehended information, in [10], pp. 137–138). Further, the sensory and the motor areas of the cortex are supposed to be connected with ideation, etc. For these associative phenomena a general type of the informational circular graph can be constructed in which the so-called parallel association arrays occur as presented in Fig. 26.

Let us describe the graph in Fig. 26 in more detail, concerning a process of thinking association. Let be given a sentence in which operands (language entities like nouns, adjectives, pronouns, etc.)

[8]Maruyama (1993) has given the following meaning to the operand markers (informational entities in our case): $\mathfrak{e}$—exchange rate (value of county's own currency); $\mathfrak{f}$—inflation (price); $\mathfrak{g}$—government subsidy of inefficient firms; $\mathfrak{h}$—import restriction; $\mathfrak{j}$—amount of import; $\mathfrak{k}$—efficiency of business; $\mathfrak{m}$—money supply; $\mathfrak{n}$—nationalism; $\mathfrak{r}$—interest rate; $\mathfrak{v}$—international balance of payment; $\mathfrak{x}$—restriction of investment from foreign countries; $\mathfrak{z}$—foreigners' deposits in banks and purchase of government securities, stocks and other investment. As understood, the model was reduced to the corresponding numerical values and by three influence parameters (particularized operators between operands) by which the character of the impact onto the informed operand has been qualified.

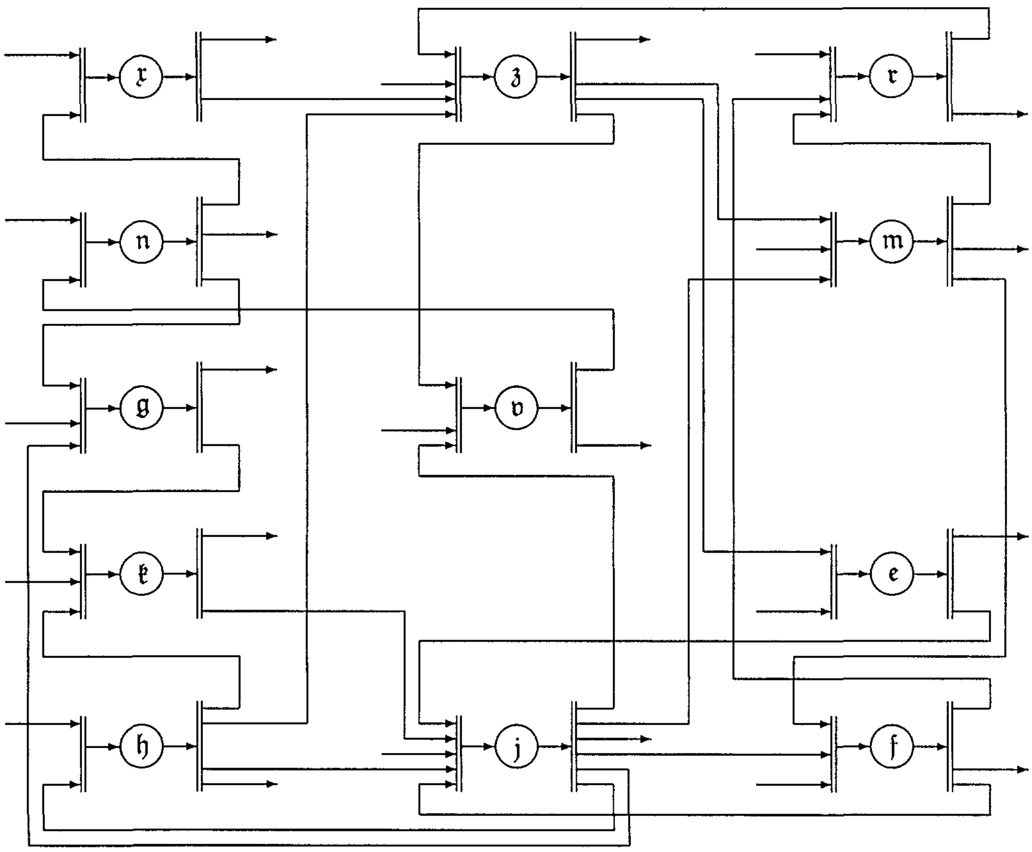


Figure 25: *A parallelized scheme of the graph concerning an example of strategic decision making, according to Maruyama (1993), and with explicit input and output informing of the 12 involved informational entities,* $\mathfrak{e}, \mathfrak{f}, \mathfrak{g}, \mathfrak{h}, \mathfrak{j}, \mathfrak{k}, \mathfrak{m}, \mathfrak{n}, \mathfrak{r}, \mathfrak{v}, \mathfrak{x}, \mathfrak{z}$.

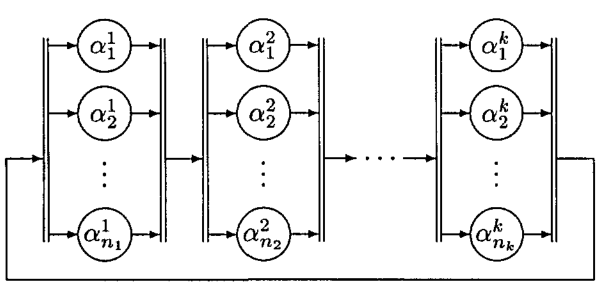


Figure 26: *The graph of parallel associative arrays in an associative serial loop.*

$$\begin{array}{l} \alpha_1^1, \alpha_2^1, \cdots, \alpha_{n_1}^1, \\ \alpha_1^2, \alpha_2^2, \cdots, \alpha_{n_2}^2, \\ \vdots \\ \alpha_1^k, \alpha_2^k, \cdots, \alpha_{n_k}^k \end{array}$$

perform as certain sentence words, but between them the operators (language entities like verbs, adverbs, prepositions, etc.) are set. In the graph, operators are presented by vectors and the nature (meaning) of them depends on operands which they connect.

A strict causal scheme of an associative mediation of the sentence, presented by the graph in Fig. 26 is

$$\left(\left(\cdots\left(\left(\begin{matrix}\alpha_1^1;\\ \alpha_2^1;\\ \vdots\\ \alpha_{n_1}^1\end{matrix}\right) \models \left(\begin{matrix}\alpha_1^2;\\ \alpha_2^2;\\ \vdots\\ \alpha_{n_2}^2\end{matrix}\right)\right) \models \cdots \left(\begin{matrix}\alpha_1^{k-1};\\ \alpha_2^{k-1};\\ \vdots\\ \alpha_{n_{k-1}}^{k-1}\end{matrix}\right)\right) \models \left(\begin{matrix}\alpha_1^k;\\ \alpha_2^k;\\ \vdots\\ \alpha_{n_k}^k\end{matrix}\right)\right) \models \left(\begin{matrix}\alpha_1^1;\\ \alpha_2^1;\\ \vdots\\ \alpha_{n_1}^1\end{matrix}\right)$$

As one can see, while the associationism of the operands α_j^i is explicit, the associationism of operators $\models$ remains implicit and depends on the chosen operands, also on well-formed connections of operands, which the operator connects. It is certainly possibly to foresee the adequate grouped associative operators. Such an operators associative scheme would take the form

$$\Bigg(\Bigg(\cdots\Bigg(\Bigg(\begin{matrix}\alpha_1^1;\\ \alpha_2^1;\\ \vdots\\ \alpha_{n_1}^1\end{matrix}\Bigg)\begin{pmatrix}\models_1^1\\ \models_2^1\\ \vdots\\ \models_{m_1}^1\end{pmatrix}\begin{pmatrix}\alpha_1^2;\\ \alpha_2^2;\\ \vdots\\ \alpha_{n_2}^2\end{pmatrix}\Bigg)\Bigg)\begin{pmatrix}\models_1^2\\ \models_2^2\\ \vdots\\ \models_{m_2}^2\end{pmatrix}\cdots$$
$$\begin{pmatrix}\alpha_1^{k-1};\\ \alpha_2^{k-1};\\ \vdots\\ \alpha_{n_{k-1}}^{k-1}\end{pmatrix}\Bigg)\Bigg)\begin{pmatrix}\models_1^k\\ \models_2^k\\ \vdots\\ \models_{m_k}^k\end{pmatrix}\begin{pmatrix}\alpha_1^k;\\ \alpha_2^k;\\ \vdots\\ \alpha_{n_k}^k\end{pmatrix}\Bigg)\Bigg)\begin{pmatrix}\models_1^1\\ \models_2^1\\ \vdots\\ \models_{m_1}^1\end{pmatrix}\begin{pmatrix}\alpha_1^1;\\ \alpha_2^1;\\ \vdots\\ \alpha_{n_1}^1\end{pmatrix}$$

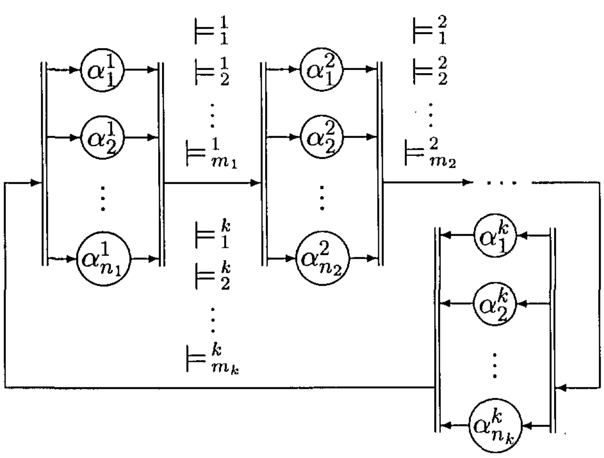


Figure 27: *The graph of parallel associative arrays with marked operator arrows in an associative serial loop.*

In Fig. 27 the operator paths are marked by the adequate operators which can appear between operands (entities α_j^i). The number of possible operators is given by

$$m_1 \le n_1 \cdot n_2;\; m_2 \le n_2 \cdot n_3;\; \cdots;\; m_k \le n_k \cdot n_1$$

In case of the circular association graph in Fig. 27, we have to determine the transition through the graph from an initial operand, for example, $\alpha_{j_1}^{i_1}$. It is possible to take as an example the sentence

$$\left(\left(\cdots\left(\alpha_{j_1}^{i_1} \models_{q_1}^{p_1} \alpha_{j_2}^{i_2}\right) \models_{q_2}^{p_2} \cdots \alpha_{j_{k-1}}^{i_{k-1}}\right) \models_{q_{k-1}}^{p_{k-1}} \alpha_{j_k}^{i_k}\right) \models_{q_k}^{p_k} \alpha_{j_1}^{i_1}$$

where for the associative operands and the corresponding associative operators the choices of the sort

$$\begin{array}{l}\alpha_{j_1}^{i_1} \in \{\alpha_1^1, \alpha_2^1, \cdots, \alpha_{n_1}^1\};\\ \models_{q_1}^{p_1} \in \{\models_1^1, \models_2^1, \cdots, \models_{m_1}^1\};\\ \alpha_{j_2}^{i_2} \in \{\alpha_1^2, \alpha_2^2, \cdots, \alpha_{n_2}^2\};\\ \models_{q_2}^{p_2} \in \{\models_1^2, \models_2^2, \cdots, \models_{m_2}^2\};\\ \vdots\\ \alpha_{j_k}^{i_k} \in \{\alpha_1^k, \alpha_2^k, \cdots, \alpha_{n_k}^k\};\\ \models_{q_k}^{p_k} \in \{\models_1^k, \models_2^k, \cdots, \models_{m_k}^k\}\end{array}$$

are on disposal. In a natural language, such choices are nothing other than the adequate synonym and antonym word entities, by which the association process in the next associative cycles can come to the surface. It is evident that through such an informational processing the very initial sentence can not only meaningly change in a substantial way, but can, through the use of antonyms and again synonyms, pass through various mutually oppositional meanings. This process reminds on or approaches to a real associative mediating in the living brain when linguistic thinking is performed on the conscious level (and, for example, by the use of dictionaries).

It is important to stress that a cyclic graph hides the informing of an undetermined length. It only insists to make at least one informational cycle. Afterwards, the informing can still be cyclic, but it can also stop at any operand or operator entity, not closing the ongoing cyclic informing. In this case the part of the last cycle is serial. On the other hand, to some extent, cyclic informing is causal, depending on the concrete form of the cyclic formula, which can not be directly recognized from the graph.

12 Conclusion

Problems of informational graphs reveal the complexity of informational phenomenalism and make the appearance of circularity and possible spontaneity of emerging and arising informational entities more transparent as a pure informational formula and formula system approach could do in such an evident way. On the other hand, graphs as graphical informational entities can have their own informational presentation and can perform as regular informational entities (systems).

The history of the informational theory (since 1987) has gone through substantial principled (axiomatic) and formalistic innovations, so today it can fit the most pretentious requirements for the formalization in the area of consciousness phenomena (e.g., formalistic and graphical treatment of psychological, psychiatric, understanding, economical informational models, presented in [25]). The exposed formalism together with informational graphs (a kind of conscious imprints, expressed as the extremely possible parallel form) seems to be appropriate for defining, handling and observing the problems of consciousness with various consciousness components and systems concerning, for instance, experience, emotion, memory, association, qualia, sensitivity, awareness, attention, intention, significance, meaning, discourse, understanding, self, subconsciousness, unconsciousness, etc., being connected into a complex system of consciousness (conscious thinking). In the discussed sense, the informational graphs could be incorporated into the 'hot' ($T < 0_-$) theory of the brain and society ([12, 13]) in a fuzzy disperse pattern.

Wheeler [16] has argued persuasively that physics stands to learn a great deal about the world by looking it in terms of information. Information occupies a wonderfully ambiguous place somewhere between the concrete and the subjective [6]. He suggested [17] that information is fundamental to the physics of the universe so that in a double-aspect theory, proposed by Slechta [14] and Chalmers [2, 3], information has both physical and experiential aspects. Hameroff and Penrose [5] stress how experiential phenomena and the physical universe are inseparable (e.g., the duality of energy and information in [14]), and this may imply a necessary non-computability in conscious thought processes; and they argue that this non-computability must also be inherent in the phenomenon of quantum state *self*-reduction — the 'objective reduction'.

Besides others, the theory of the informational fulfills these requirements and the concept of informational graph not only widens the instrumentality of the theory but makes the formalistic approach more evident (technical).

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Appendix A

A General Overview Concerning Formula Markers, Graphs, Causal Coefficients, etc.

In this papers several characteristic formula markers, other symbols, and informational graphs have been introduced. To keep them in mind together with their meaning a special table (on the next page) could be helpful. It can serve the reader as a dictionary of the main notions and concepts presented in the paper.

Figure 28 is a comprehensive table reminder of the most often used graphs and their informational symbols belonging to formulas. The reader will easily find the entities concerning informational axiomatism, serialism, circularism, causalism, parallelism, and gestaltism, together with the corresponding graphs. Markers of specific formulas and formula systems used in the paper are systematically structured and can be unambiguously distinguished from one another. These markers are shortcuts for standardized formulas and formula systems and will be used, from now on, always consequently in the same form.

Complex symbols in Fig. 28 can be typographically standardized for later use. For instance:

```
^{^ n}_{_i}\!\varphi_{_{_{\!\to}}}
```
${}^{n}_{i}\varphi_{\to}$

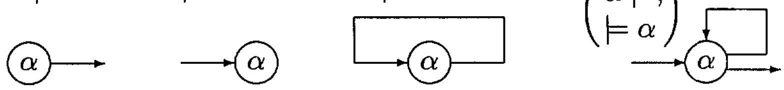
```
^{^{\;\;\; n}}_{_{N_{_{_{\!\!\to\!}}}}}%
   \!\varphi_{_{_{\!\to}}}
```
${}^{\;\;n}_{N_{\to}}\varphi_{\to}$

```
^{^{\,n+1}}_{_{N_{_{\!\!\to}}^{^{\circlearrowleft%
   }}}}\!\varphi{^{^{\circlearrowleft}}_{_{_{\!\to}}}
```
${}^{n+1}_{N^{\circlearrowleft}_{\to}}\varphi^{\circlearrowleft}_{\to}$

etc.

Informational Axiomatism

Externalism	Internalism	Metaphysicalism	Phenomenalism
$\alpha \models$	$\models \alpha$	$\alpha \models \alpha$	$\begin{pmatrix} \alpha \models; \\ \models \alpha \end{pmatrix}$



Serial Formula Systems

${}^{n}_{i}\varphi_{\rightarrow}$; ${}^{n+1}_{i}\varphi^{\circlearrowright}_{\rightarrow}$; $\Gamma({}^{n}_{i}\varphi_{\rightarrow})$; $\Gamma\left({}^{n+1}_{i}\varphi^{\circlearrowright}_{\rightarrow}\right)$; $\Gamma^{\circlearrowright}\left({}^{n+1}_{i}\varphi^{\circlearrowright}_{\rightarrow}\right)$; $\Gamma^{*}\left({}^{n+1}_{i}\varphi^{\circlearrowright}_{\rightarrow}\right)$

Parallel Formulas

${}^{n}\varphi'_{\parallel}$; ${}^{n+1}\varphi^{\circlearrowright\prime}_{\parallel}$

Informational Serialism

${}^{n}_{i}\varphi_{\rightarrow}(\alpha, \alpha_1, \cdots, \alpha_n)$;

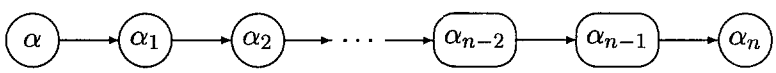
$1 \le i \le N_{\rightarrow}$; $\boxed{N_{\rightarrow} = \frac{1}{n+1}\binom{2n}{n}}$

$${}^{n}_{1}\varphi_{\rightarrow} \rightleftharpoons ((\cdots((\alpha \models \alpha_1) \models \alpha_2) \models \cdots \alpha_{n-1}) \models^{*} \alpha_n);$$

$${}^{n}_{2}\varphi_{\rightarrow} \rightleftharpoons ((\cdots((\alpha \models \alpha_1) \models \alpha_2) \models \cdots \alpha_{n-2}) \models^{*} (\alpha_{n-1} \models \alpha_n));$$

$$\cdots;\ {}^{n}_{N_{\rightarrow}}\varphi_{\rightarrow} \rightleftharpoons (\alpha \models^{*} (\alpha_1 \models (\alpha_2 \models \cdots (\alpha_{n-1} \models \alpha_n)\cdots)))$$

(G1)



$$\Gamma({}^{n}_{i}\varphi_{\rightarrow}(\alpha, \alpha_1, \alpha_2, \cdots, \alpha_n)) \rightleftharpoons \left({}^{n}_{1}\varphi_{\rightarrow};\ {}^{n}_{2}\varphi_{\rightarrow};\ \cdots;\ {}^{n}_{\frac{1}{n+1}\binom{2n}{n}-1}\varphi_{\rightarrow};\ {}^{n}_{\frac{1}{n+1}\binom{2n}{n}}\varphi_{\rightarrow}\right)$$

Circular Serialism

${}^{n+1}_{i}\varphi^{\circlearrowright}_{\rightarrow}(\alpha, \alpha_1, \cdots, \alpha_n)$;

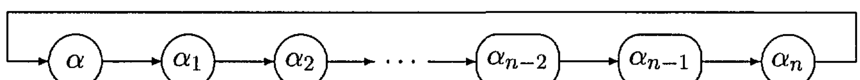
$1 \le i \le N^{\circlearrowright}_{\rightarrow}$; $\boxed{N^{\circlearrowright}_{\rightarrow} = \frac{1}{n+2}\binom{2n+2}{n+1}}$

$${}^{n+1}_{1}\varphi^{\circlearrowright}_{\rightarrow} \rightleftharpoons (((\cdots((\alpha \models \alpha_1) \models \alpha_2) \models \cdots \alpha_{n-1}) \models \alpha_n) \models^{*} \alpha);$$

$${}^{n+1}_{2}\varphi^{\circlearrowright}_{\rightarrow} \rightleftharpoons (((\cdots((\alpha \models \alpha_1) \models \alpha_2) \models \cdots \alpha_{n-2}) \models \alpha_{n-1}) \models^{*} (\alpha_n \models \alpha));$$

$$\cdots;\ {}^{n+1}_{N^{\circlearrowright}_{\rightarrow}}\varphi^{\circlearrowright}_{\rightarrow} \rightleftharpoons (\alpha \models^{*} (\alpha_1 \models (\alpha_2 \models \cdots (\alpha_{n-1} \models (\alpha_n \models \alpha))\cdots)))$$

(G2)

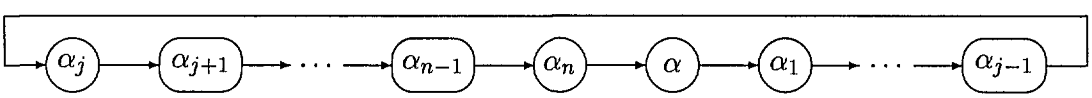


$$\Gamma\left({}^{n+1}_{i}\varphi^{\circlearrowright}_{\rightarrow}(\alpha, \alpha_1, \alpha_2, \cdots, \alpha_n)\right) \rightleftharpoons \left({}^{n+1}_{1}\varphi^{\circlearrowright}_{\rightarrow};\ {}^{n+1}_{2}\varphi^{\circlearrowright}_{\rightarrow};\ \cdots;\ {}^{n+1}_{\frac{1}{n+2}\binom{2n+2}{n+1}-1}\varphi^{\circlearrowright}_{\rightarrow};\ {}^{n+1}_{\frac{1}{n+2}\binom{2n+2}{n+1}}\varphi^{\circlearrowright}_{\rightarrow}\right)$$

Circulating the Main Operand α_j $(\alpha_0 = \alpha)$

${}^{n+1}_{i_j}\varphi^{\circlearrowright}_{\rightarrow}(\alpha_j, \alpha_{j+1}, \cdots, \alpha_{n-1}, \alpha_n, \alpha, \alpha_1, \cdots, \alpha_{j-1})$; $1 \le i_j \le N^{\circlearrowright}_{\rightarrow}$; $j = 0, 1, \cdots, n$

(G3)



$\boxed{{}^{\circlearrowright}N^{\circlearrowright}_{\rightarrow} = \frac{n+1}{n+2}\binom{2n+2}{n+1}}$

$$\Gamma^{\circlearrowright}\left({}^{n+1}_{i}\varphi^{\circlearrowright}_{\rightarrow}(\alpha_j, \alpha_{j+1}, \cdots, \alpha_{n-1}, \alpha_n, \alpha, \alpha_1, \cdots, \alpha_{j-1})\right) \rightleftharpoons$$

Circular Causalism

$$\left(\Gamma\left({}^{n+1}_{i}\varphi^{\circlearrowright}_{\rightarrow}(\alpha_j, \alpha_{j+1}, \cdots, \alpha_{n-1}, \alpha_n, \alpha, \alpha_1, \cdots, \alpha_{j-1})\right);\ j = 0, 1, 2, \cdots, n\right)$$

Primitive Informational Parallelism

$$\Pi'({}^{n}_{i}\varphi_{\rightarrow}(\alpha, \alpha_1, \cdots, \alpha_{n-1}, \alpha_n)) \rightleftharpoons (\alpha \models \alpha_1; \alpha_1 \models \alpha_2; \cdots; \alpha_{n-1} \models \alpha_n); \qquad \text{(G1)}$$

$${}^{n}\varphi'_{\parallel}(\alpha, \alpha_1, \cdots, \alpha_{n-1}, \alpha_n) \rightleftharpoons \Pi'({}^{n}_{i}\varphi_{\rightarrow}(\alpha, \alpha_1, \cdots, \alpha_{n-1}, \alpha_n));$$

$$\Gamma({}^{n}_{i}\varphi_{\rightarrow}(\alpha, \alpha_1, \cdots, \alpha_{n-1}, \alpha_n)) \subset {}^{n}\varphi'_{\parallel}(\alpha, \alpha_1, \cdots, \alpha_{n-1}, \alpha_n);$$

$$\Pi'\left({}^{n+1}_{i}\varphi^{\circlearrowright}_{\rightarrow}(\alpha, \alpha_1, \cdots, \alpha_n)\right) \rightleftharpoons (\alpha \models \alpha_1; \alpha_1 \models \alpha_2; \alpha_{n-1} \models \alpha_n; \alpha_n \models \alpha); \qquad \text{(G2, G3)}$$

$${}^{n+1}\varphi^{\circlearrowright\prime}_{\parallel}(\alpha, \alpha_1, \cdots, \alpha_{n-1}, \alpha_n) \rightleftharpoons \Pi'\left({}^{n+1}_{i}\varphi^{\circlearrowright}_{\rightarrow}(\alpha, \alpha_1, \cdots, \alpha_{n-1}, \alpha_n)\right);$$

$$\Gamma\left({}^{n+1}\varphi^{\circlearrowright\prime}_{\parallel}(\alpha, \alpha_1, \cdots, \alpha_{n-1}, \alpha_n)\right) \subset {}^{n+1}\varphi^{\circlearrowright\prime}_{\parallel}(\alpha, \alpha_1, \cdots, \alpha_{n-1}, \alpha_n)$$

Figure 28: *An overview of markers, formulas, formula systems, and graphs concerning axiomatism, serialism, circularism, causalism, parallelism, and gestalitsm. By* $\models^{*}$ *the main operator* $\models$ *is marked.*