

POLITECNICO
MILANO 1863

The 2nd International Conference on Anticipation

Senate House, School of Advanced Study, London, UK 8 – 10 Nov, 2017

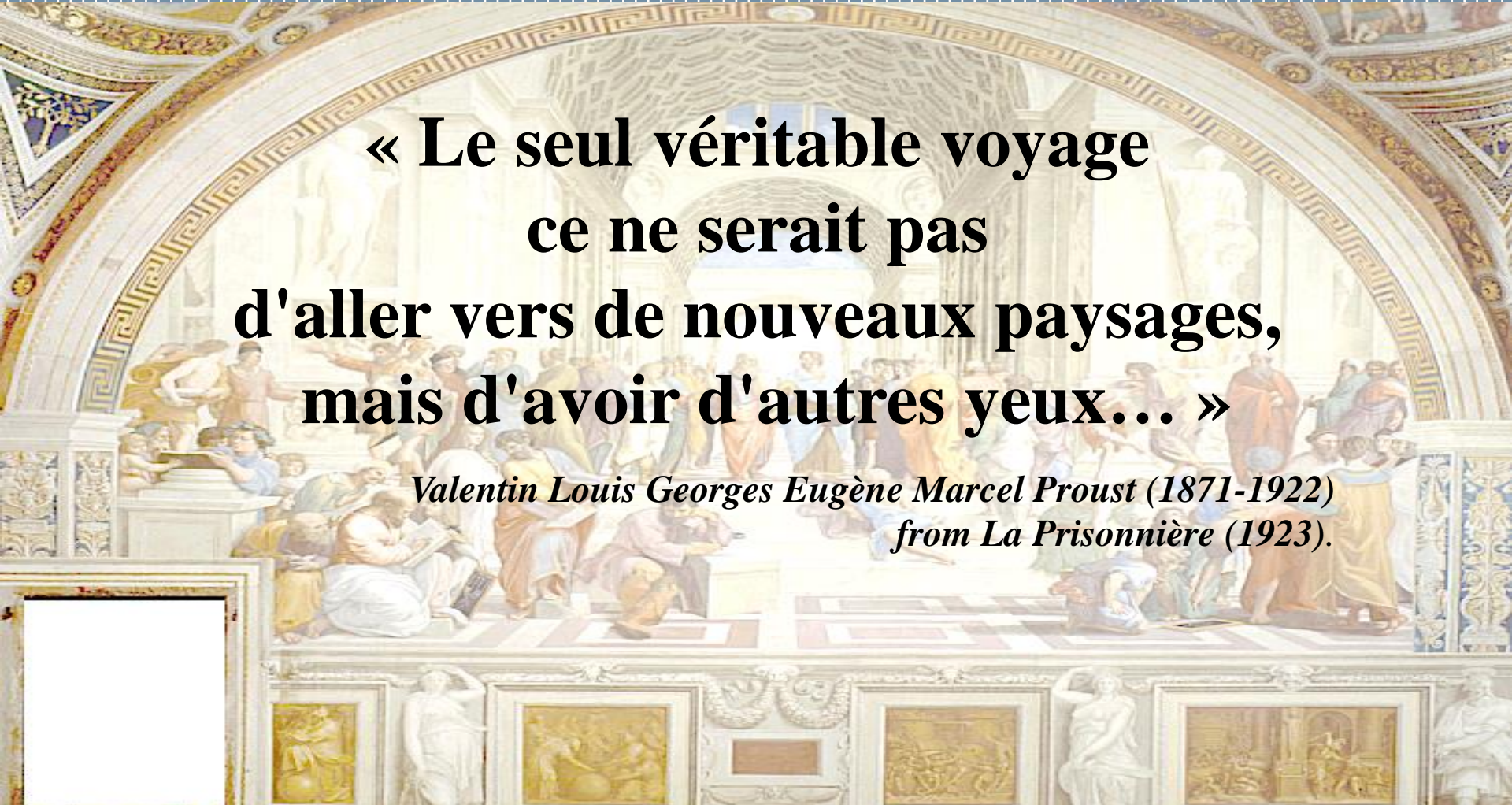
Anticipation
2017

**Cognitive Aspects of Anticipation by the
Klein Four-Group and the Elementary
Pragmatic Model**



Rodolfo A. Fiorini

Cognitive Aspects of Anticipation by the Klein Four-Group and the Elementary Pragmatic Model



**« Le seul véritable voyage
ce ne serait pas
d'aller vers de nouveaux paysages,
mais d'avoir d'autres yeux... »**

*Valentin Louis Georges Eugène Marcel Proust (1871-1922)
from La Prisonnière (1923).*

Cognitive Aspects of Anticipation by the Klein Four-Group and the Elementary Pragmatic Model



**« Observer
c'est pour la plus grande part,
imaginer ce que l'on s'attend à voir. »**

*Ambroise-Paul-Toussaint-Jules Valéry (1871-1945)
from "Degas, Danse, Dessin",
in Oeuvres de Paul Valéry (Librairie Gallimard, 1960), II, p. 1169.*

Cognitive Aspects of Anticipation by the Klein Four-Group and the Elementary Pragmatic Model

Presentation Outline

1. Introduction (07)

- EPM Awareness and Creativity
- EPM Logically Articulated Learning Support

2. Classic EPM Logical Structure (10)

- EPM Five-Level Model
- EPM Operative Validation

3. Predicative Competence (13)

- Piaget's KLEIN Four-Group Definition
- EPM Logical Architecture

4. Conclusion (02)

- Creativity Mind
- Neuralizer Work In Progress



Cognitive Aspects of Anticipation by the Klein Four-Group and the Elementary Pragmatic Model

1. Introduction (07)

- EPM Awareness and Creativity
- EPM Logically Articulated Learning Support

Cognitive Aspects of Anticipation by the Klein Four-Group and the Elementary Pragmatic Model

EPM Awareness & Creativity

Automatic vs. controlled, convergent vs. divergent, implicit vs. explicit, reflexive vs. reflective, etc. Many processing approaches correspond to theoretical cognitive dichotomies that have been around for a few generations and have contributed to the development of many neurocognitive models and systems in the past century.

Among them, the Elementary Pragmatic Model (EPM) was initially developed by Alberto Silvestri and Piero De Giacomo in the 1970s, following Gregory Bateson's systemic approach, according to Cybernetics and General Systems Theory requirements. (P. De Giacomo, 1992)

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EPM Awareness & Creativity

EPM was developed following Gregory Bateson's constructivist participant observer concept in the "**second order cybernetics**," to arrive to what was called "**new cybernetics**," according to cybernetics classical historical categorization.

Quite recently (2013), **EPM** intrinsic Self-Reflexive Functional Logical Closure contributed to find an original solution to the dreadful information double-bind (**IDB**) problem in classic information and algorithmic theory.

In scientific literature this distressing dilemma is called "**Computational Information Double-Bind**".(Fiorini, 2014) Early concepts based on reductionist inference systemic and classic cybernetic approaches have been largely revisited and overshadowed by more recent findings, creating a **brand new cultural approach**.

Cognitive Aspects of Anticipation by the Klein Four-Group and the Elementary Pragmatic Model

Usually, information uncertainty and incompleteness are approached by classic probability risk management techniques only. Unfortunately, unpredictable changes **cannot be managed by current risk management techniques** and they can be very disorienting at enterprise level. (Taleb et alii, 2012)

Initially **EPM** was used as a theoretical **family therapy** model to classify the outcomes of dyadic interactions in **psychology**. It was used successfully by a group of therapists in **family therapy** and in **clinical psychiatric training and applications** (e.g. schizophrenia, nervous anorexia, etc.) Later it was applied to develop interactive **psychotherapeutic** strategies, **online counseling** and **E-therapy**.

Since the beginning of the new millennium its application area has been extended to other disciplines and even to engineering problems like **user modeling**, **constraint requirements elicitation**, **software creativity** and **adaptive system** design and development.

EPM has shown to be a high versatile tool and new application areas are envisaged continuously.

Cognitive Aspects of Anticipation by the Klein Four-Group and the Elementary Pragmatic Model

EPM Awareness & Creativity

According to **Elementary Pragmatic Model (EPM)**,
two coupled fundamental processes are at the **core** of human **mind**:



Process A : Wiring and re-wiring of a **Focused Optimal Path (FOP)** to creatively reach a planned goal.

Process B : **Process A** rational assessment and endorsement (checking + **FOP** updating if needed).

(Piero De Giacomo, 1979)

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EPM Awareness & Creativity

According to **Elementary Pragmatic Model (EPM)**,
two coupled fundamental processes are at the core of human mind:

Process A is fed by **definition doubting** and **compromising** mainly; the availability of an **environmental chaotic information redundant support is required** (RATL, Right Anterior Temporal Lobe):

emotion → FOP (re-)wiring → sensation → action (survival oriented).

Process B is based on **opposing, complementing and commanding**; **clearly defined formal rules are required** to actively operate:

emotion → sensation → perception → action (learning oriented)

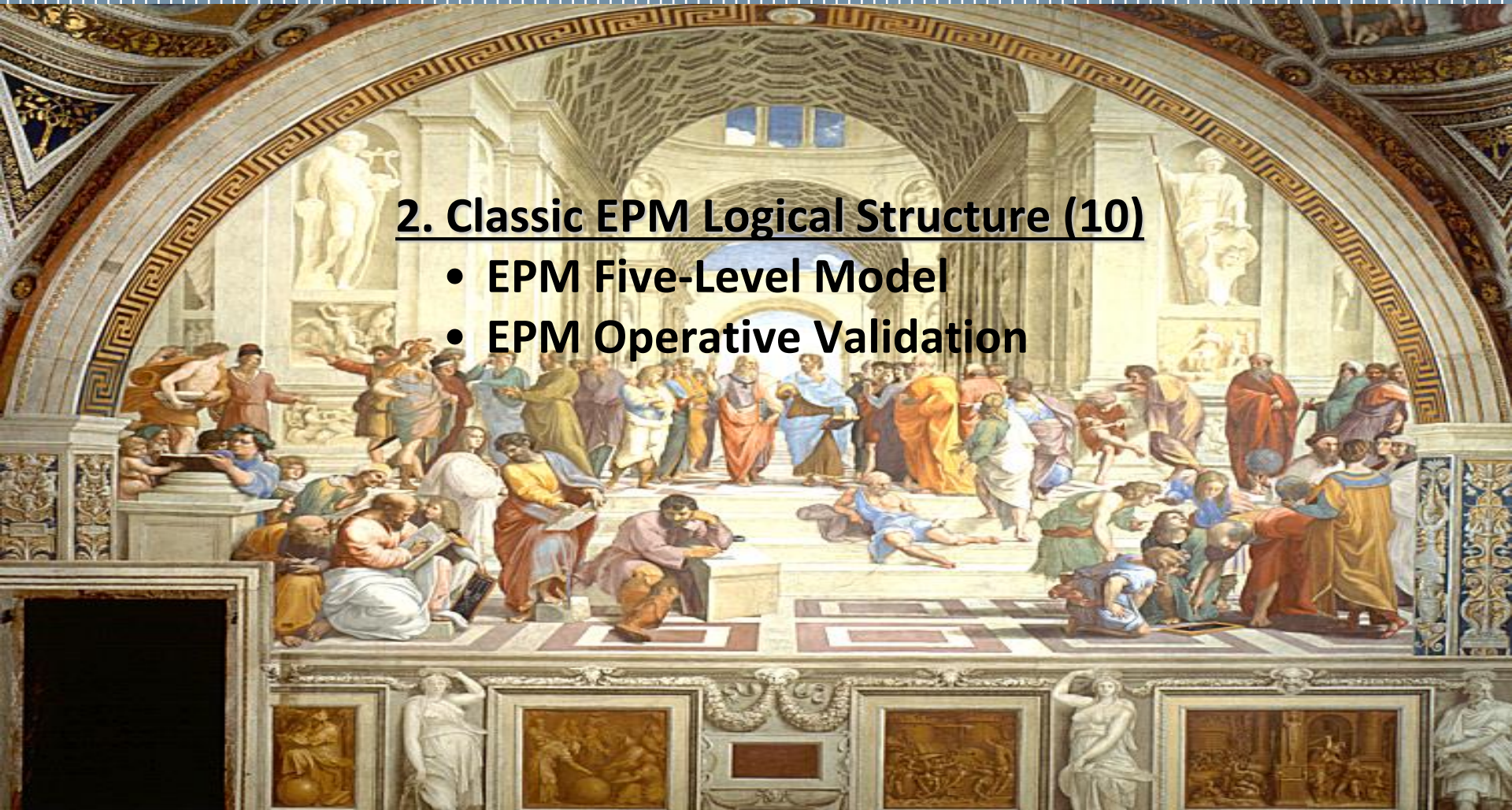
(i.e. solution path logical articulation → checking → difference learning).

(Piero De Giacomo, 1979)

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2. Classic EPM Logical Structure (10)

- EPM Five-Level Model
- EPM Operative Validation



Cognitive Aspects of Anticipation by the Klein Four-Group and the Elementary Pragmatic Model

EPM Logically Articulated Awareness Support Level 1 - Basic Triad

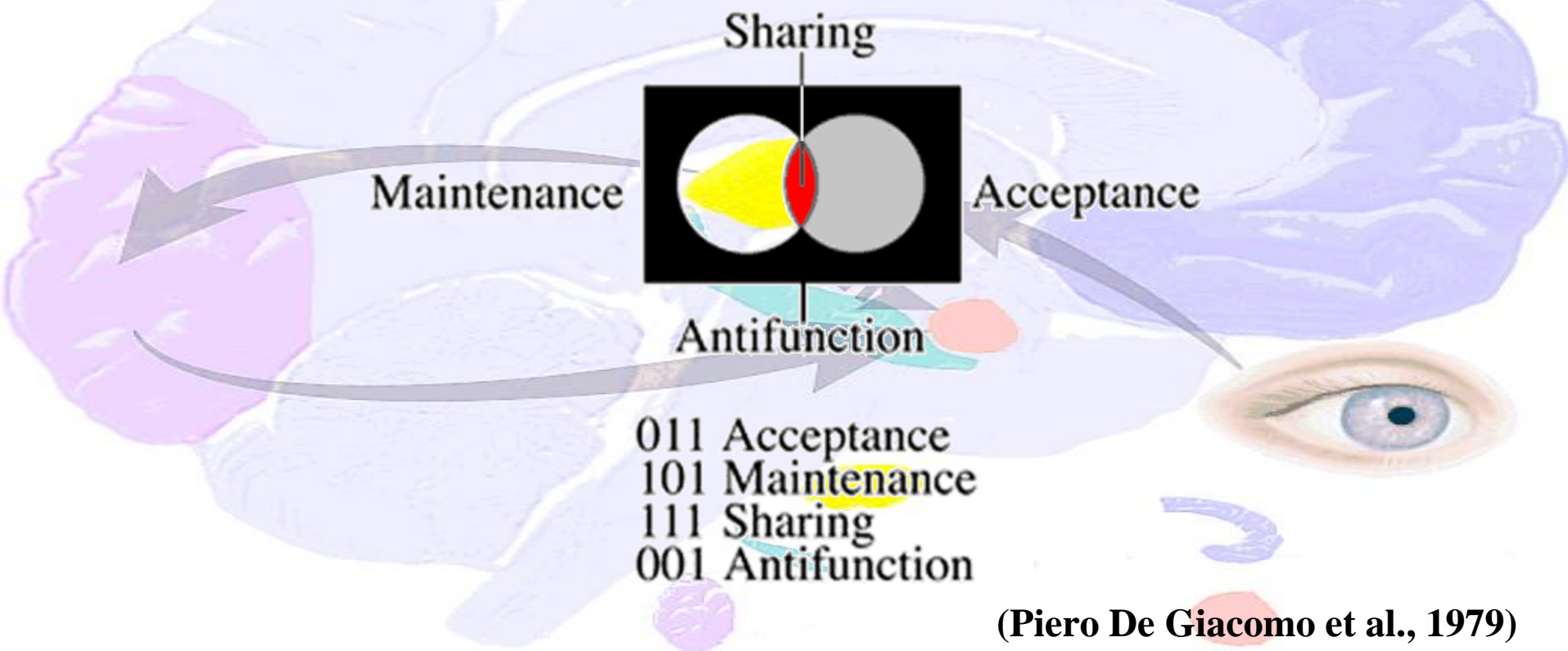
Subject A \rightleftharpoons **Subject B** \rightleftharpoons **Subject A¹**

The triads of Elementary Pragmatic Model

(Piero De Giacomo et al., 1979)

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EPM Logically Articulated Awareness Support Level 2 - Basic Four Interaction Coordinates



Cognitive Aspects of Anticipation by the Klein Four-Group and the Elementary Pragmatic Model

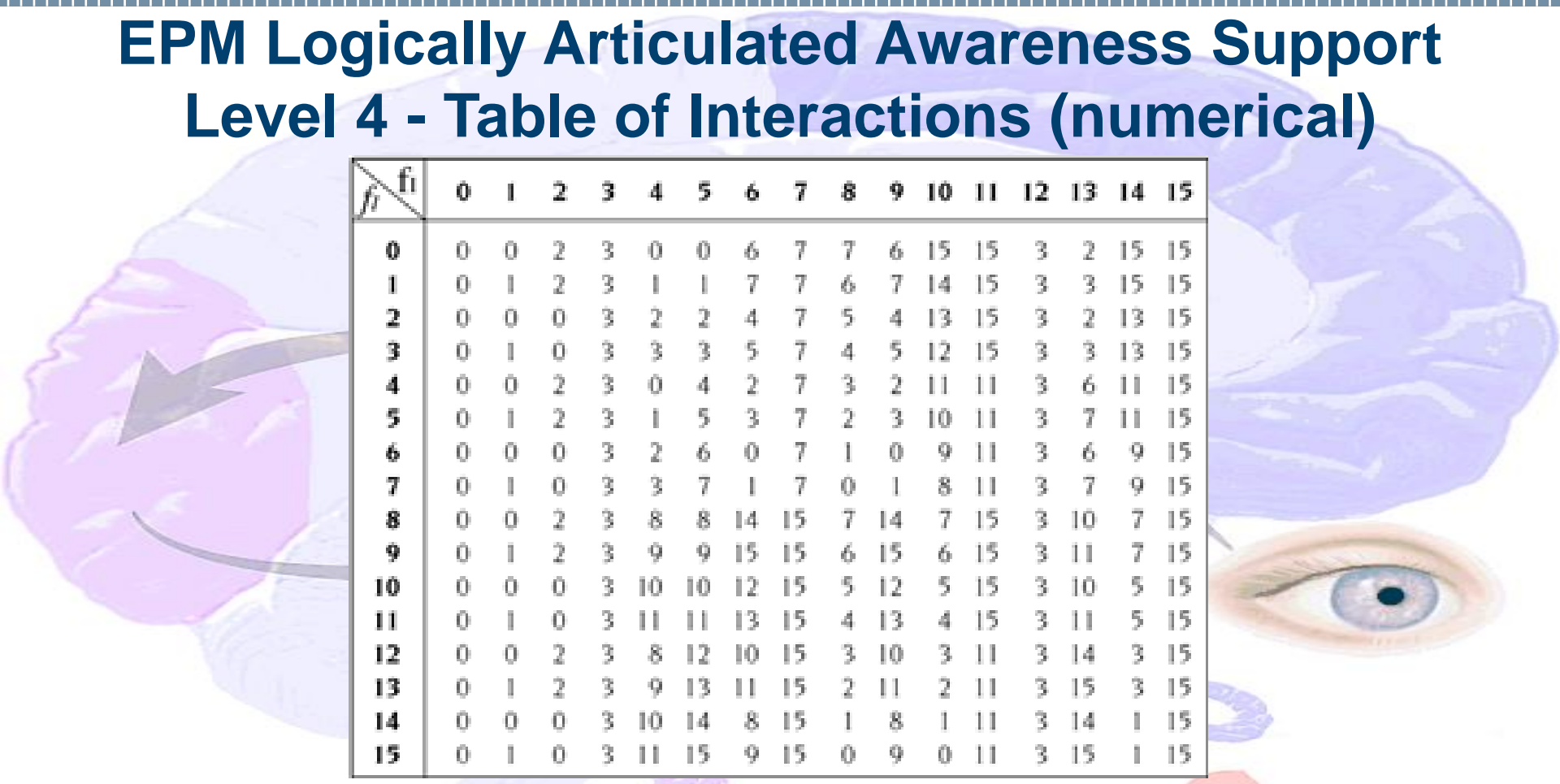
EPM Logically Articulated Awareness Support Level 3 - Sixteen Relational Style Functions

Tabula Rasa	F ₀			F ₈	Absolute Abstraction
Total Sharing	F ₁			F ₉	Creatively Shared Milestones
Introvert Maintainer, Autism	F ₂			F ₁₀	Total Opposition
Egoview Maintainer	F ₃			F ₁₁	Total Dictator
Unsharing Acceptor	F ₄			F ₁₂	Pseudo-Unselfish Person
Sharing Acceptor	F ₅			F ₁₃	Exceedingly Acceptor
Unsharing & Doubting	F ₆			F ₁₄	Unsharing Metaphoric Acceptor
Mediator	F ₇			F ₁₅	Total Acceptor

(Piero De Giacomo et al., 1979)

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EPM Logically Articulated Awareness Support Level 4 - Table of Interactions (numerical)

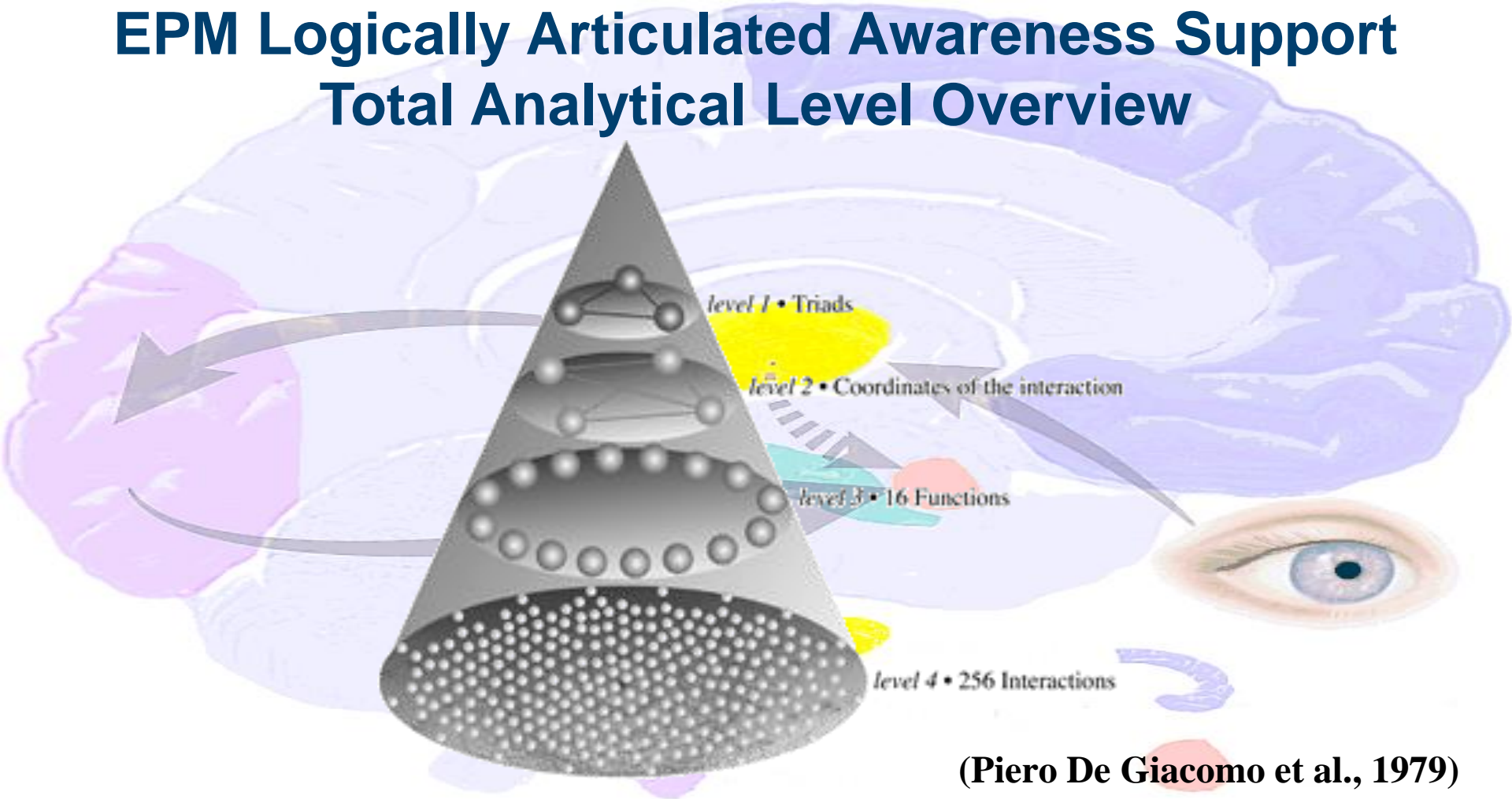


$f_i \backslash f_j$	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0	0	0	2	3	0	0	6	7	7	6	15	15	3	2	15	15
1	0	1	2	3	1	1	7	7	6	7	14	15	3	3	15	15
2	0	0	0	3	2	2	4	7	5	4	13	15	3	2	13	15
3	0	1	0	3	3	3	5	7	4	5	12	15	3	3	13	15
4	0	0	2	3	0	4	2	7	3	2	11	11	3	6	11	15
5	0	1	2	3	1	5	3	7	2	3	10	11	3	7	11	15
6	0	0	0	3	2	6	0	7	1	0	9	11	3	6	9	15
7	0	1	0	3	3	7	1	7	0	1	8	11	3	7	9	15
8	0	0	2	3	8	8	14	15	7	14	7	15	3	10	7	15
9	0	1	2	3	9	9	15	15	6	15	6	15	3	11	7	15
10	0	0	0	3	10	10	12	15	5	12	5	15	3	10	5	15
11	0	1	0	3	11	11	13	15	4	13	4	15	3	11	5	15
12	0	0	2	3	8	12	10	15	3	10	3	11	3	14	3	15
13	0	1	2	3	9	13	11	15	2	11	2	11	3	15	3	15
14	0	0	0	3	10	14	8	15	1	8	1	11	3	14	1	15
15	0	1	0	3	11	15	9	15	0	9	0	11	3	15	1	15

(Piero De Giacomo et al., 1979)

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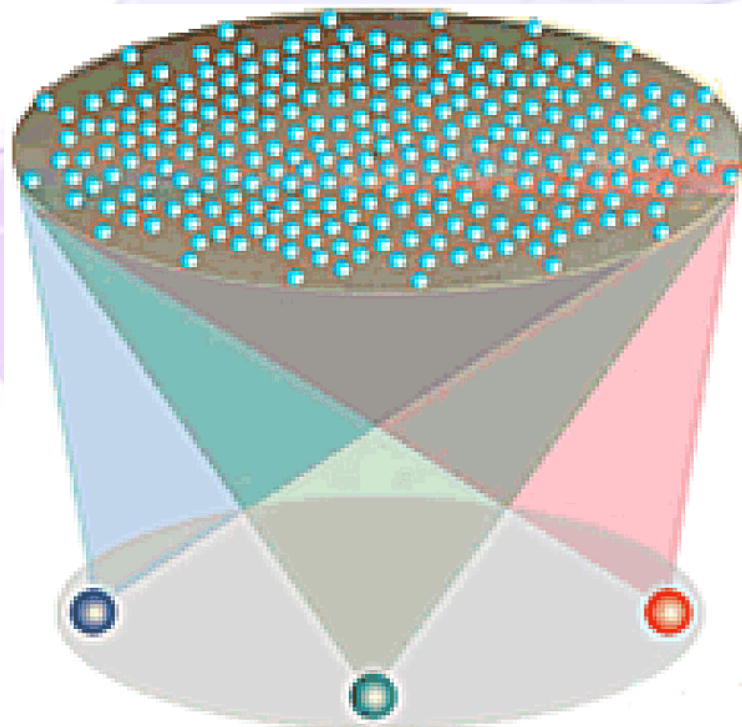
EPM Logically Articulated Awareness Support Total Analytical Level Overview



Cognitive Aspects of Anticipation by the Klein Four-Group and the Elementary Pragmatic Model

EPM Logically Articulated Awareness Support Level 5 - Final Synthesis

Three Long-Term Final Attractors



(Piero De Giacomo et al., 1979)

Cognitive Aspects of Anticipation by the Klein Four-Group and the Elementary Pragmatic Model

EPM Logically Articulated Awareness Support Human Subject Profiling Process

ELEMENTARY PRAGMATIC MODEL (EPM)

Table of Interactions.

Interactions are transformed into sentences by a mental process based on EPM logic and Operator's experience and creativity.

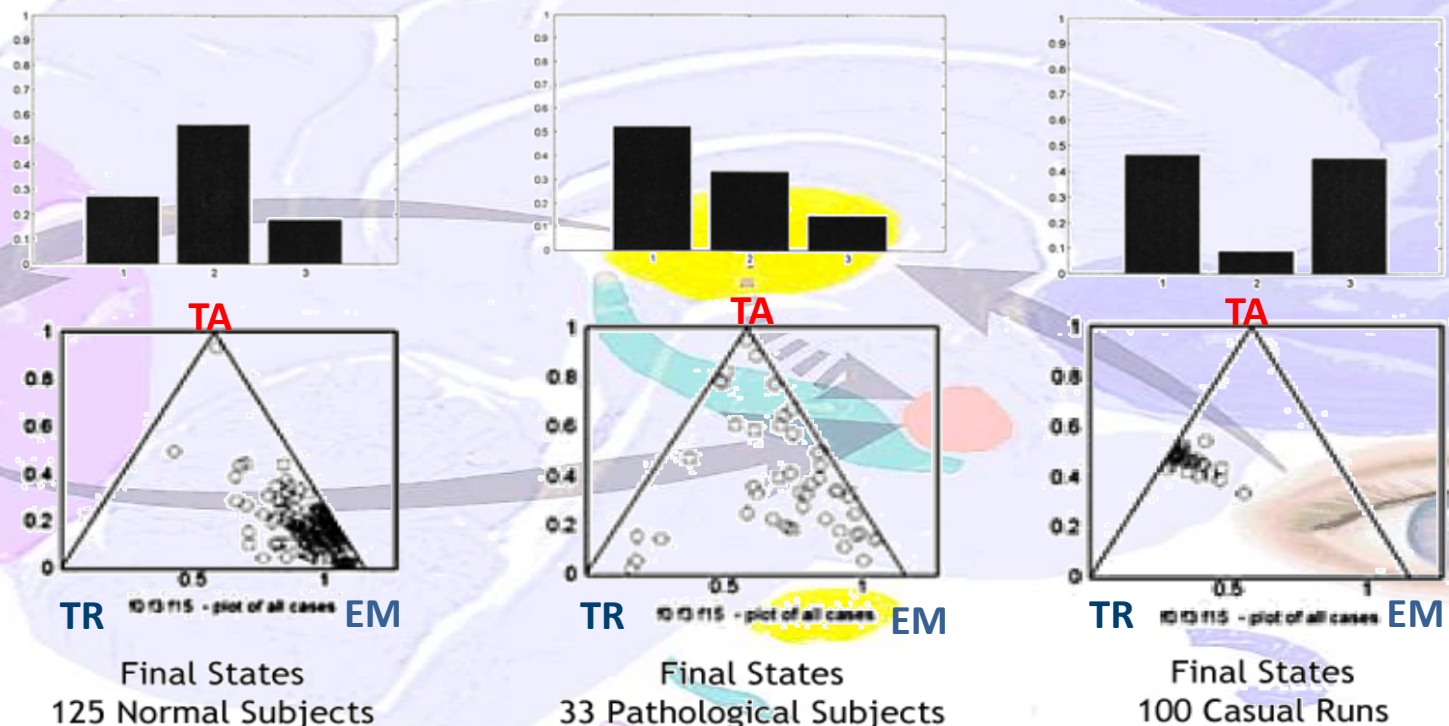
Many sentences emerge out of this process, but those ones significant to human mind only are selected by Operator. Then they are presented to Subject under profiling.

The Subject selects those sentences that exert the strongest impact to him/her. They can represent a sort of mariner's compass in Subject's life (Compass-like Statement).

(Piero De Giacomo et al., 1979)

Cognitive Aspects of Anticipation by the Klein Four-Group and the Elementary Pragmatic Model

EPM Logically Articulated Awareness Support Dynamic Subject Profiling (DSP) Assessment

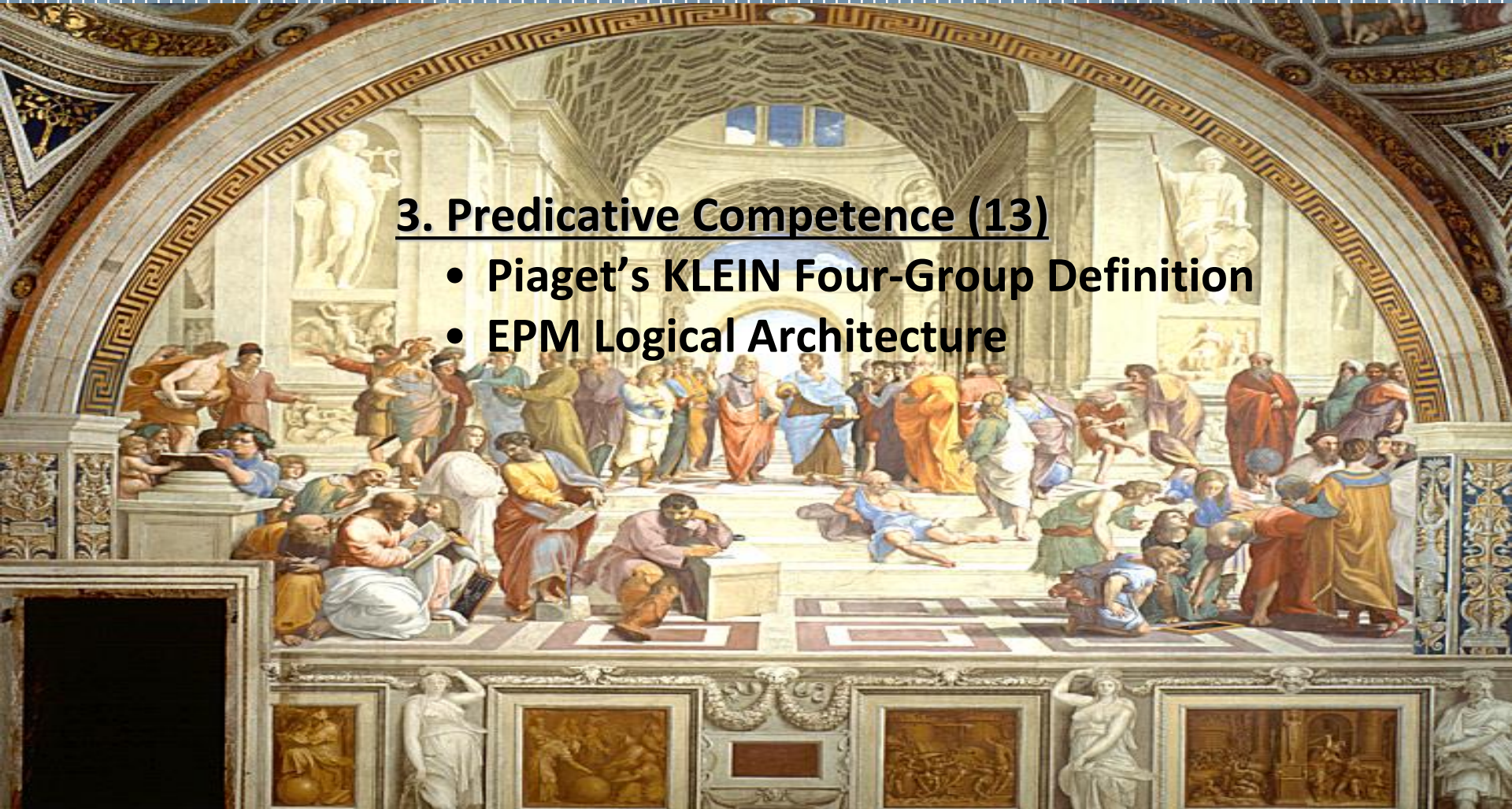


(Piero De Giacomo et al., *Riv Psichiatr* 2013; 48(1): 67-72)

Cognitive Aspects of Anticipation by the Klein Four-Group and the Elementary Pragmatic Model

3. Predicative Competence (13)

- Piaget's KLEIN Four-Group Definition
- EPM Logical Architecture



Cognitive Aspects of Anticipation by the Klein Four-Group and the Elementary Pragmatic Model

According to Swiss clinical psychologist **Jean Piaget**, human adults normally know how to use properly classical propositional logic. **Piaget also held that the integration of algebraic composition and relational ordering in formal logic is realized via the mathematical Klein group structure** (Inhelder and Piaget, 1955).

In the last fifty years, many experiments made by psychologists of reasoning have often shown most adults commit logical fallacies in propositional inferences. **These experimental psychologists have so concluded, relying on many empirical evidences, that Piaget's claim about adults' competence in propositional logic was wrong and much too rationalist.**

In other words, according to experimental psychologists, **Piaget was overestimating the logical capacities of average human adults in the use of classical propositional logical connectives.**

But, doing so, **they forgot Piaget's rigorous and important analysis of the Klein group structure at work in logical competence.**

Cognitive Aspects of Anticipation by the Klein Four-Group and the Elementary Pragmatic Model

The Klein four-group is the smallest non-cyclic group, and every non-cyclic group of order 4 is isomorphic to the Klein four-group.

The cyclic group of order 4 and the Klein four-group are therefore, up to isomorphism, the only groups of order 4. Both are abelian groups in mathematics.

Piaget applied the Klein four-group to binary connectives, so that a given connective is associated first with itself (in an identical (**I**) transformation) and then with its algebraic complement (its inverse (**N**) transformation), also with its order opposite (its reciprocal (**R**) transformation) and finally, with the combination of its N and R transformations (that Piaget calls its "correlative" or C transformation) (Inhelder and Piaget, 1955, ch.17.) This correlative corresponds to what logicians usually call the "dual" (**D**) transformation (Robert and Brisson, 2016).

The Klein group structure generates Squares Of Opposition (SOOs), and an important component of human rationality resides in the diagram of the SOO, as formal articulations of logical dependence between connectives (Beziau and Payette, 2012).

Cognitive Aspects of Anticipation by the Klein Four-Group and the Elementary Pragmatic Model

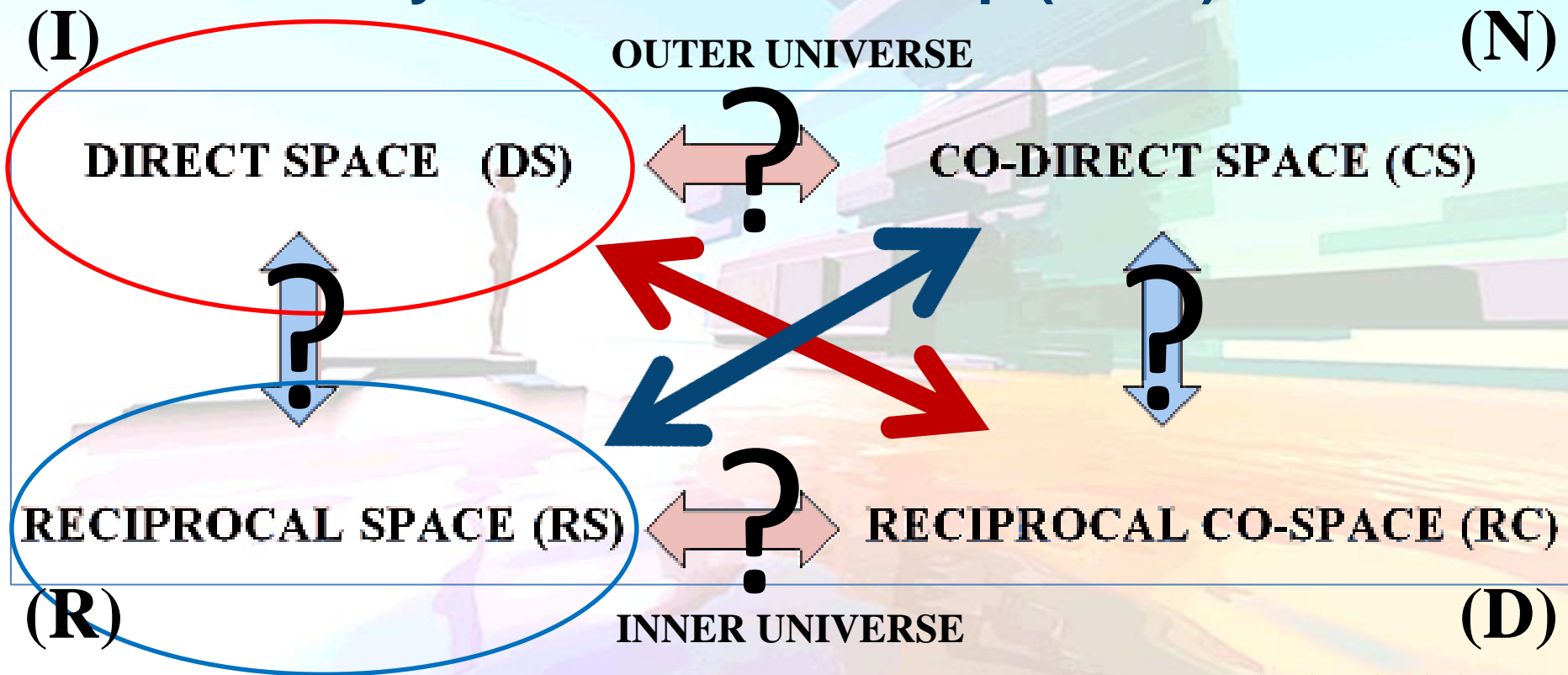
Piaget's KLEIN Four-Group Definition

X	I	N	R	D
I	I	N	R	D
N	N	I	D	R
R	R	D	I	N
D	D	R	N	I

Inhelder and Piaget, 1955

Cognitive Aspects of Anticipation by the Klein Four-Group and the Elementary Pragmatic Model

INNER vs. OUTER UNIVERSE (IOU) Mapping By KLEIN Four-Group (CICT)



(R.A. Fiorini, 2014)

Cognitive Aspects of Anticipation by the Klein Four-Group and the Elementary Pragmatic Model

As a matter of fact, English talking people tend to treat conditionals as equivalences and inclusive disjunctions as being exclusive (Robert and Brisson, 2016).

We inevitably see the universe from a human point of view and communicate in terms shaped by the exigencies of human life in a natural uncertain environment. The diagram of the SOO is basic to formal articulations of logical dependence between connectives.

But the formal rationality provided by the SOO is not spontaneous and therefore, should not be easy to learn for adults.

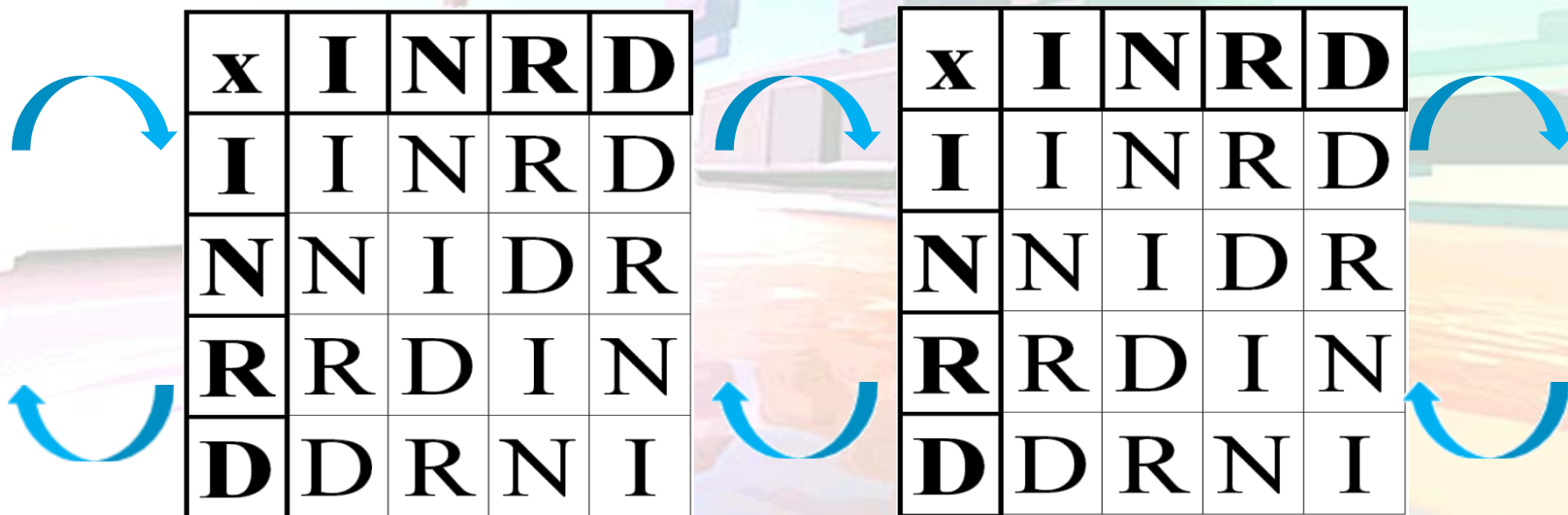
This is the main reason why we need reliable and effective training tools to achieve full propositional logic proficiency in decision making, like the elementary pragmatic model (EPM) and the Evolutive EPM (E²PM) (De Giacomo and Fiorini, 2017).

Cognitive Aspects of Anticipation by the Klein Four-Group and the Elementary Pragmatic Model

EPM as The Interaction Between Two Subjects and Their Environment by KLEIN Four-Group

SUBJECT A

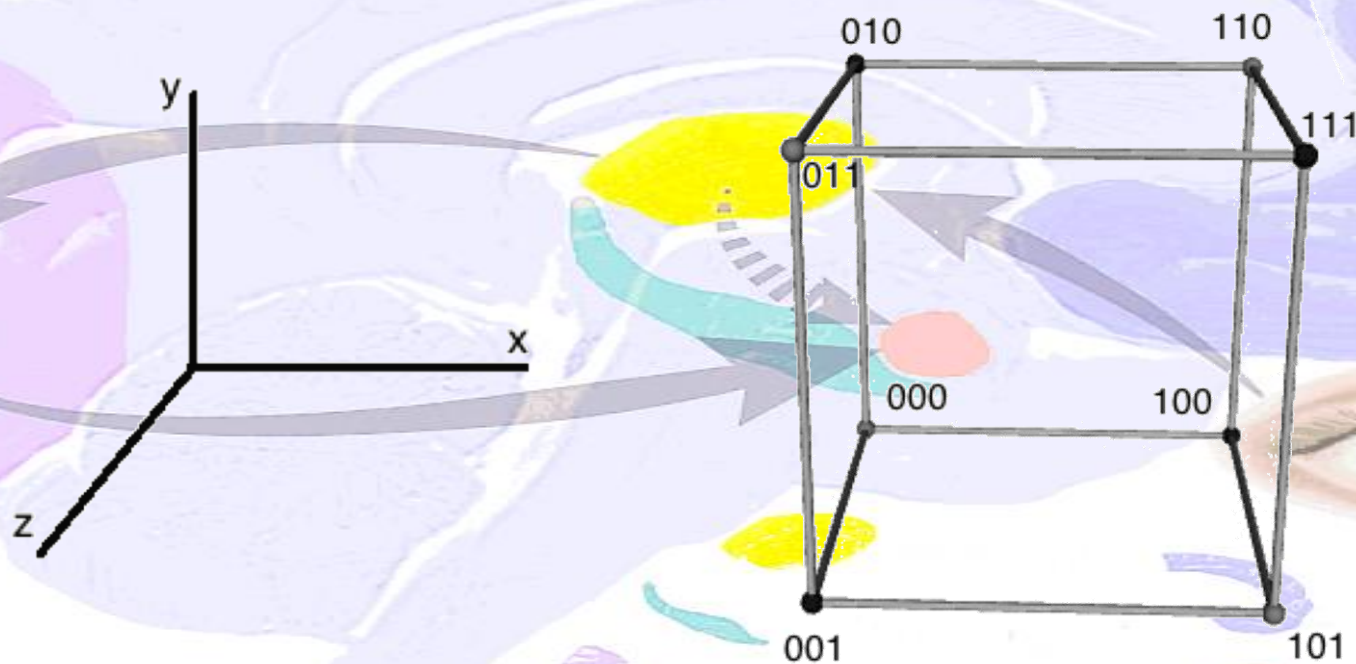
SUBJECT B



Cognitive Aspects of Anticipation by the Klein Four-Group and the Elementary Pragmatic Model

EPM Logical Architecture

Classic EPM associated Boolean Algebra $B_3 \equiv \varphi(\{1, 2, 3\})$ can be represented (LTR) by cube C_3 with its bitstring decoration in R^3 .



(R.A. Fiorini, 2014)

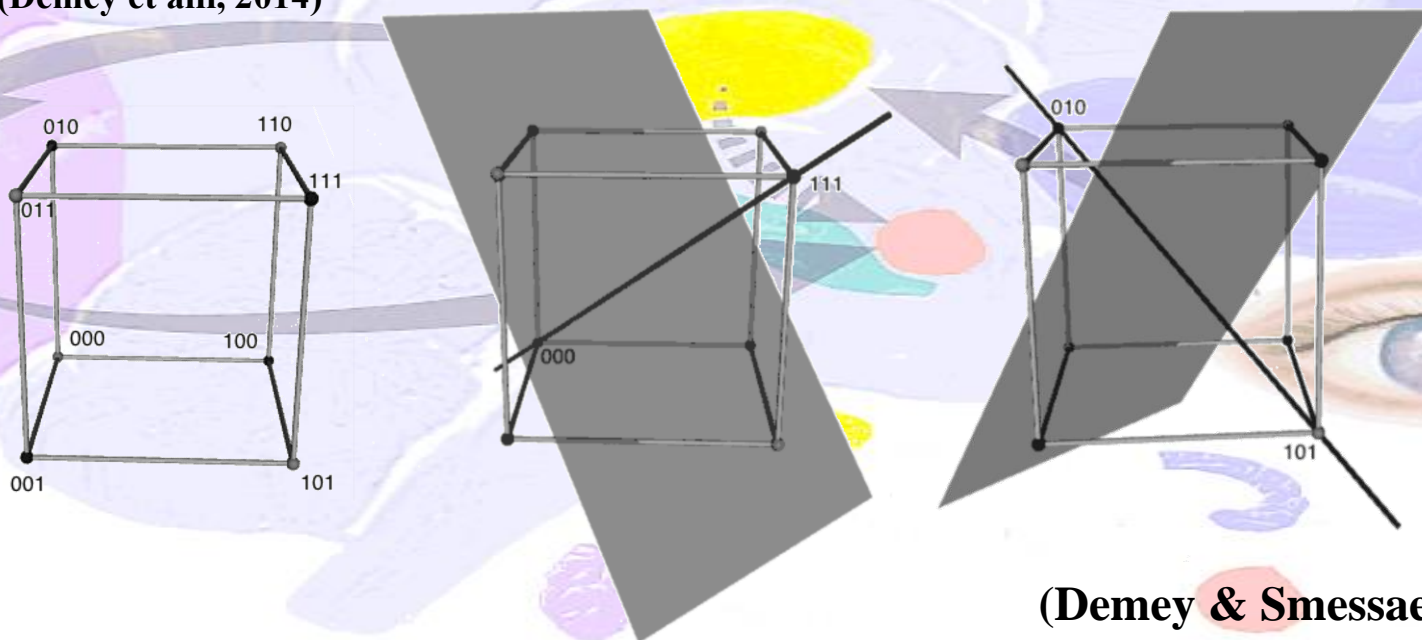
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EPM Cube Projections

Hasse Diagrams $n = 3$

On the center, cube projection axis and projection plane corresponding to Aristotelian Diagram.

On the right, cube projection axis and projection plane related to Hasse Diagram.(Demey et alii, 2014)

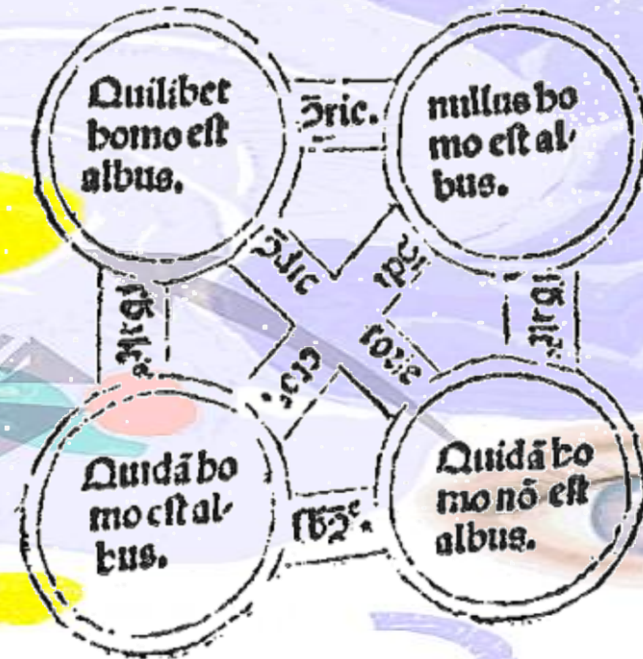
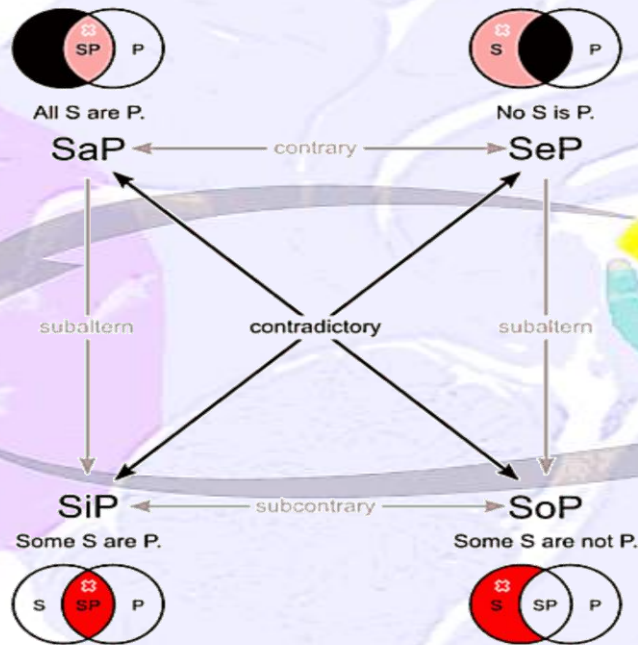


(Demey & Smessaert, 2014)

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Aritotele's Syllogism: LOGIC

C_3 is an extension of basic Aristotele's "Square of Oppositions"



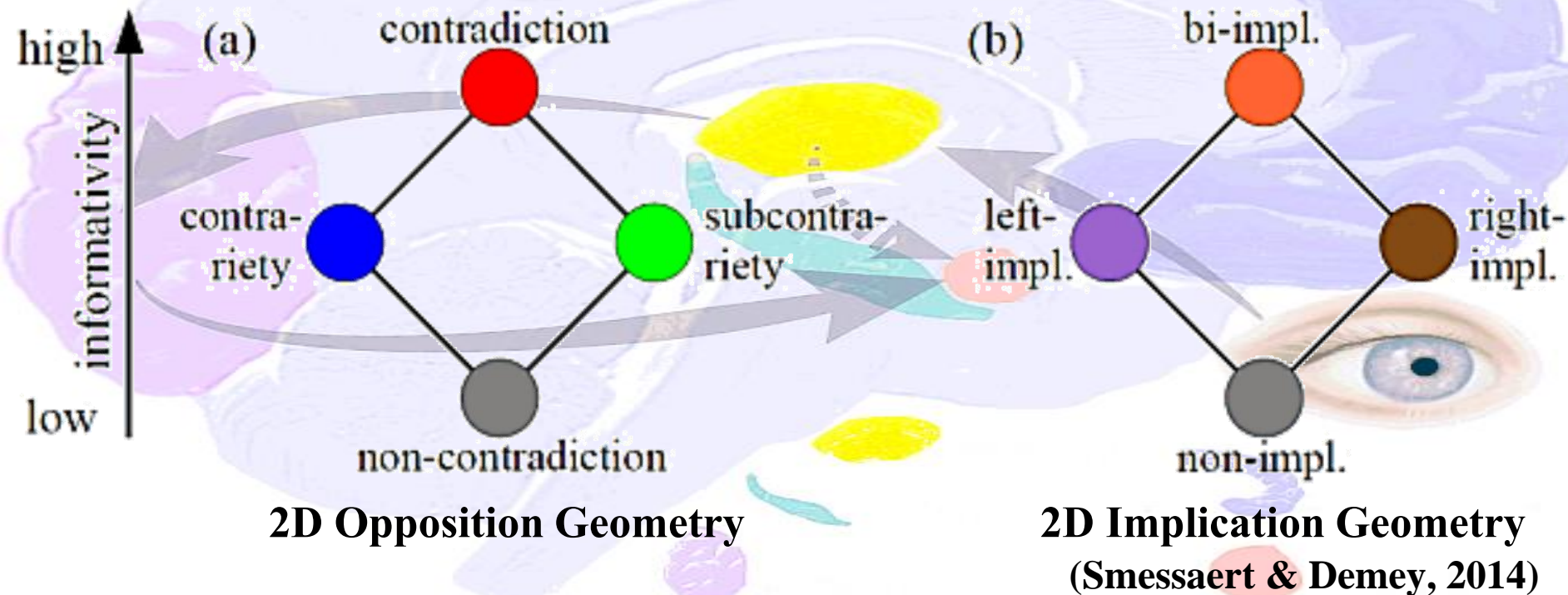
(Black areas are empty, red areas are nonempty) — Johannesmagistris-Square (15th century)

(R.A. Fiorini, 2014)

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Aritotele's Syllogism: LOGIC

Informativity of the Opposition and Implication Relations from 2D Square of Opposition Dual Pair



Cognitive Aspects of Anticipation by the Klein Four-Group and the Elementary Pragmatic Model

Duality in Logic and Language

Based on Two Coupled Irreducible Complementary Subsystems

N-Opposition Geometry

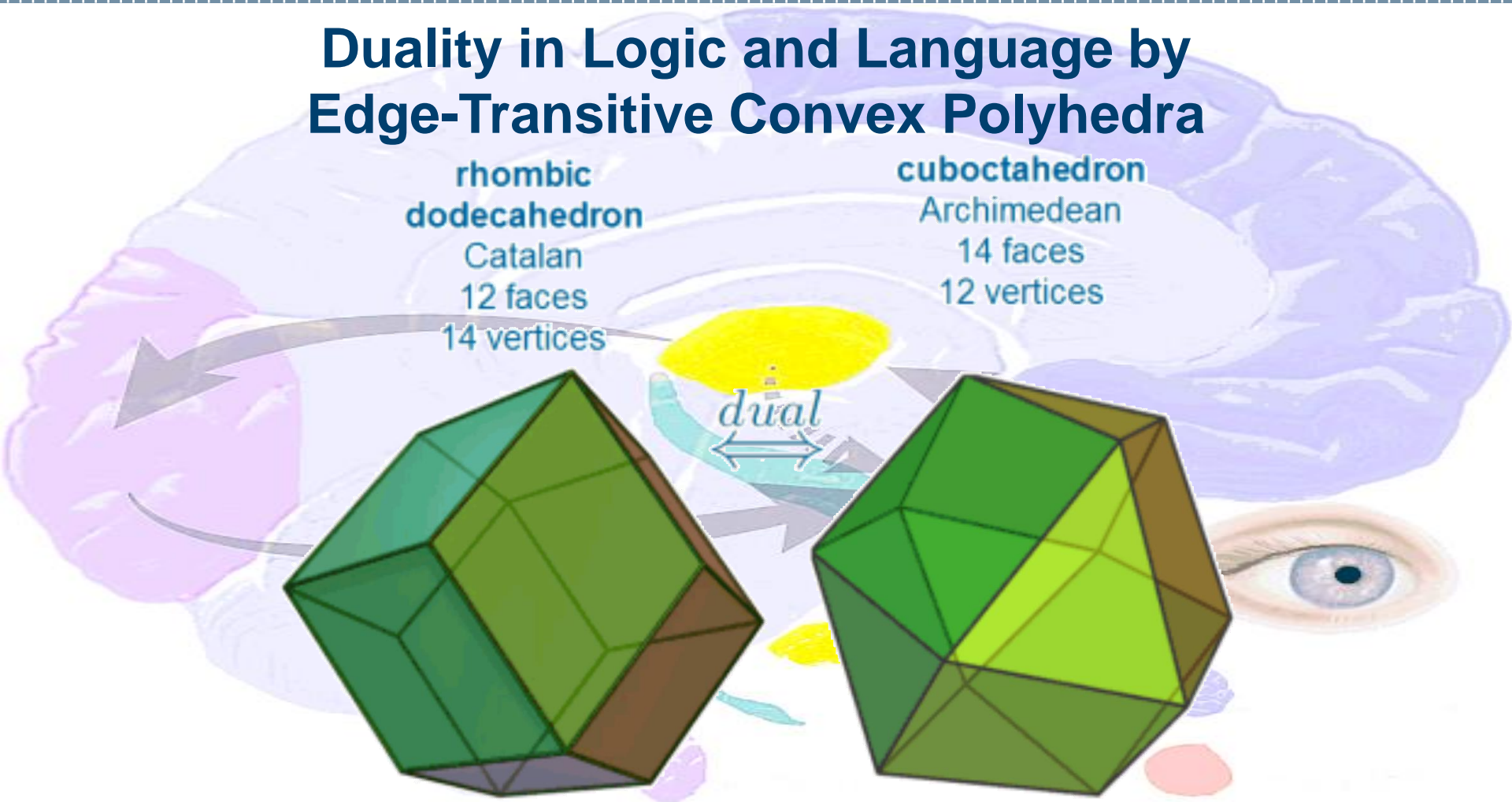
N-Opposition Relations: Being True/False Together

N-Implication Geometry

N-Implication Relations: Truth Propagation

Cognitive Aspects of Anticipation by the Klein Four-Group and the Elementary Pragmatic Model

Duality in Logic and Language by Edge-Transitive Convex Polyhedra



Cognitive Aspects of Anticipation by the Klein Four-Group and the Elementary Pragmatic Model

Duality in Logic and Language by Edge-Transitive Convex Polyhedra

cuboctahedron

Archimedean

14 faces

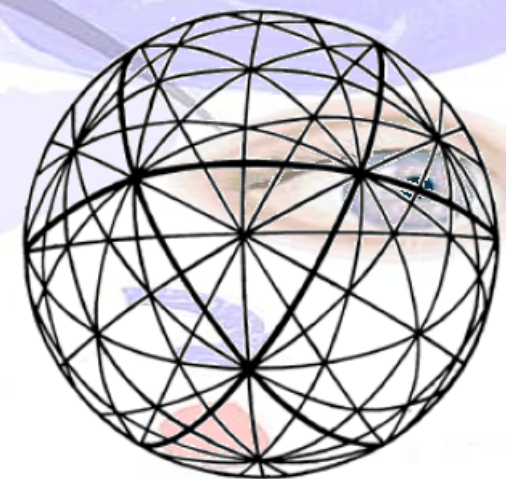
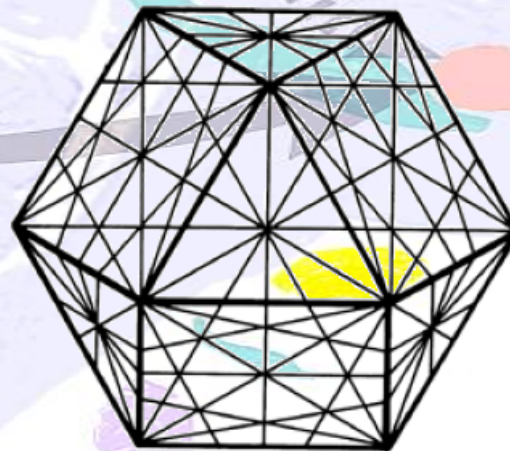
12 vertices

Vector Equilibrium in Synergetic Geometry

Dymaxion

“dynamic, maximum, and tension”

Richard Buckminster "Bucky" Fuller (1895–1983)



Cognitive Aspects of Anticipation by the Klein Four-Group and the Elementary Pragmatic Model

4. Conclusion (04)

- Creativity Mind
- Neuralizer Work In Progress



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Piero De Giacomo
Rodolfo A. Fiorini

CREATIVITY MIND

(PREVIEW)



Cognitive Aspects of Anticipation by the Klein Four-Group and the Elementary Pragmatic Model

Neuralizer Work In Progress



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**Thank You for
Your Attention**