For Value or for Worth? Part 1:
Speaking Syllogistic Attractors of Appropriations in a Thought-Action-Mood-Space

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Abstract Epistemiology requires trans-disciplinary logics for convergence. As a fundamental of the brain, this essay's hypotheses revisit the Goethean alternation between "Newtonian" symbolic frontal 4-dimensional (Halford) processing ("*4D*-Thought"), and parietal intellectual intuition ("*5D+*-Action") interpreting high-dimensional articulated motor-chains (Rizzolatti). SuchS a classical temperamental and anxio-affective triad of dimensions ("Thought", "Action", "Mood") constitutes the "*dyn*4-TAM-cube"-model, reflecting segregated cortico-striato-thalamo-cortical circuits. "*dyn*4-TAM-cube" harbors cycling "Appropriation Waves" transiting from private "*4D*Thought" to public "*5+*Action" and back. At "Intention" to act predictive Pavlovian cues, possibly tempting by discounted effort, incentivate, and at "Perception" Skinnerian learning relates "worth"-related outcome to effortful appropriations (see part2). Sorrentino's prime motivating "orientation" when facing the unexplained unknown dictates this balance. Thereby uncertainty- versus certainty-oriented actors ("UOs" vs. "COs") differ inversely and interactively in "Mood": whilst reducing future effortful "known unknowns" by models or by doing. Rats show a arguably homologous sign- versus goal-tracking dimension, as controlled by the thalamic paraventricular nuclei, where mast cells might mediate the reversal in orientation observed in depression. Natural language terms denoting the 8 corners and 56 intercalated processes link "*dyn*4-TAM-cube" to psychotherapy and to thalamic (neuro-)linguistics, as "*dyn*4-TAM-cube" via syllogisms of a doubled Square of Oppositions maps language to logical terms, which speak through the former.

Keywords Square of Oppositions, (Un-)certainty Orientation, Sign-tracker, Prediction Error, Neuro-economics, Neuro-linguistics, Cortico-subcortical-thalamo-cortical circuits, Mast Cell

1. Introduction and Methods

Convergence [1] requires trans-disciplinary logically transposable frameworks for behavioral sciences.

1.1. A Triadic Model for Appropriating Behavior

This essay accordingly and boldly explores aspects of the mind through the, logically structured and bio-neuro-linguistically expanded pendulum model. Its integration of thought, action, and mood stems from the French Enlightenment and is related to temperament and bipolar disorders [2].

It thereby revisits the Goethean [3] fundamental alternation between two kinds of thinking:
- a) the "Newtonian" symbolic frontal processing, limited to 4 dimensions [4,5,6], here called "*4D*-**T**hought" or "*4D***T**~" (see abbreviation codes[i]), and
- b) the aesthetic intellectually intuitive "*Anschauung*" [7] mastering the meaning of high-dimensional articulated motor-chains mostly in the parietal lobe [8], here called "*5+D*-**A**ction" or "*5+***A**~"(Figure 1).

This enquiry uses "*dyn*4-TAM-cube", an own spatial classical *thought-action-mood*-model, which contains its own critique. Herein e.g. much "**T**~", little "**A**~", and positive "**M**~" results in the state of "**Interest**-T~/a~/M~" at one of eight corners of a cube. Their non-clinical names and codes are: **N**eed-t~/a~/m~ (with mutants **W**orry-T~/a~/m~, **F**ear-t~/A~/m~, and **B**liss-t~/a~/M~) and **P**ursuit-T~/A~/M~ (with mutants **J**oy-t~/A~/M~, **D**espair-T~/a~/m~, and **I**nterest-T~/a~/M~).

Each corner sends seven transitional processes towards peers, corresponding to 8 plus 56 *natural language* terms (Figure 3) [2, Table 1].

The cube, following "Fig. 228" illustrating bipolar mixed states [9], also contains an inscribed simple harmonic

oscillator (SHO) reflecting the momentary or averaged "Appropriation Wave" (**AW**). This SHO, with bound frequencies and amplitudes, represents [10,11] the engine of appropriation, related to oscillating indirect and direct cortico-striatal pathways [12].
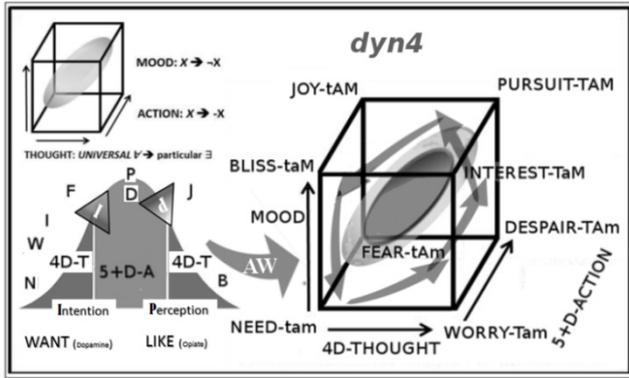

Figure 1. The *dyn*4-**TAM**-cube's classical dimensions interpreted as logical operations: *4D***T**~ from universals ∀ creates a set of particulars ∃, *5+***A**~ "either/or" ∆, and **M**OOD sublation (x➔¬x) The dichotomic permutations at each corner declare spoken psychological stances (N,W, I, F, P, D, J, B) which attract or repel appropriative cycles (**AW**s, lower left). **AW**s swap from *4D***T**~ to *5+***A**~ at **I**ntention and back to *4D***T**~ at **P**erceptions.

The cube's dichotomous permutations (T~/t~, A~/a~, M~/m~) attract or repel the hereby shaped **AW** (Figure 1), as do framing paths to and fro "**N**eed-**P**ursuit-(Outcome)" along 2 to 14 corners.

Predecessors for triadic and/or sequential "affective" models include: Jean Fernel (16[th]c.); Jean-Pierre Falret (19[th]c.); Charles Sherrington, Wilhelm Weygandt, Emil Kraepelin, Hans Lungwitz (19th/20[th]c.); Silvan S. Tomkins, Ullrich Supprian (20th/21[th]c.); Richard Depue, Sydney Axinn, Richard M. Sorrentino, and Joaquin Fuster.

1.2. The Syllogistic Formalization of Approach

Furthermore a formalization of such relations in approach can be achieved through an Aristotelian use of syllogisms adapted from Sydney Axinn [13], who to this end doubled the "square of oppositions" (**SquOpp**). Similarly one square by doubling achieves a dimension of "*5+D***A**" which generates a simple distance in approach, which in in *dyn*4 is defined by "*either x or -x*". The simple modeling via "*4D-***T**" instead in *dyn*4 is conceived as the attributive transition from "*true for all*" (∀) to "*true for at least one*" (∃) during the foundation of a set. Finally positive M~ in *dyn*4 results from a *sublation* (negation) of a state of need "x" (¬x).

Hereby, by negations, on each face a *graduation* of applicable truth results: For all (∀), NOT for all (¬∀), for some (∃), "NOT even for some, for none" (¬∃) (Figure 2).

"Not for all" in this is assumed to be understood as *more comprehensive* than "for some." The thus generated triadic logical structure evokes the *natural language* terms at the corners and of the processes which swap these. Hereby syllogistic neuro-linguistical operations are convergently predicted, which emerge from studies of the thalamus.
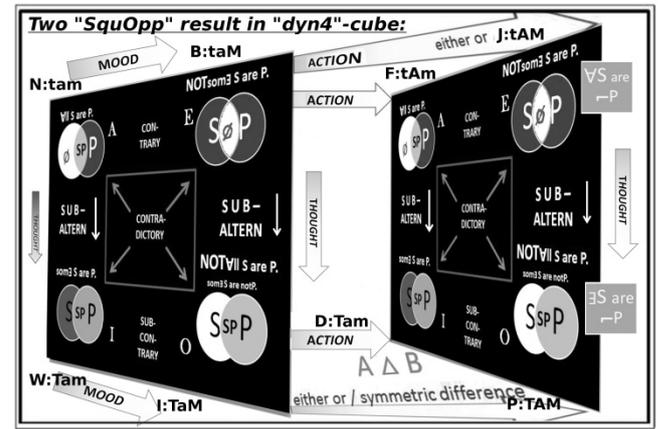

Figure 2. Square of Opposition (**SquOpp**) about Subjects & Predicates maps on **M**ood and **T**hought. It graduates the **either-or** of approaching **A**ction generated by its doubling. A tilted *dyn*4-**TAM**-cube results with permutations: **N**eed-t~/a~/m~ (**N:tam**) to **P**ursuit-T~/A~/M~ (**P:TAM**).

1.3. Variably Resented Explaining Efforts

Beyond encoding for growth or destruction "**M**ood/**M**~" modulates the "**T**~/**A**~"-alternation in a way increasing *collective fitness* through *inter-individual variation* e.g. in foraging. During symbolic modeling for future physical effort-reduction *choleric* "soldiers" [14] worsen their mood as if they resented *cognitive effort*, while that of *sanguinic* "philosophers" improves – unless depression doesn't reverse these relations.

Such temperamental differences in the *motivational attitude towards unexplained* "(un)knowns" have been localized between the dimensional extremes of "**U**n-"and -**C**ertainty-**O**rientation" by Richard M. Sorrentino [15,16]. He qualified this as the decisive trait-like motivator in human appropriative approach, only subordinate to the valence of "**M**ood". In high spirits this contrast is increased, but loss-minimizing depression may *invert* this cognitive style. In terms of *dyn*4 thus "**M**ood" along **AW**s interactively participates in the balance of low- to high-dimensional cognitive processing.

While *cognitive effort* [17] and incentivization seem central to this *orientation*, their relation is complicated by the role of con- and dissonance and the "loyalty" towards beliefs held in modeling modules MBL [18].

1.4. Moody Learning at Dimensional Transition Points

Symbolic "*4D***T**hought" (**T**~) and intuitive "*5+D***A**ction" (*5+D***A**~) thus alternate [3] by crossing the "affordant" [19] interfaces "**P**erception" (A➔T) and "**I**ntention" (T➔A). To modulate this cognitive alternation is a little recognized key function of "**M**ood".

Importantly through repeated appropriations *learned* contents are fed from both **T**~/**A**~-interfaces of **AW**s into **T**~ about:

- a) Pavlovian cues, which besides being predictive of specific reward, maybe *become incentive* as predictors of *tempting abstract discount of expected effort* at "**I**ntention" (**I**{T➔A}) as one can suspect from its utility at the onset of an **AW**, and

- b) Skinnerian *instrumental appropriative movements for complex needs* at "**P**erception" (**P**{A➔T}).

In fact "valuation", (**P**{A➔T} in the OFC/vmPFC and "selection", **T**~ in dlPFC (orbito-, ventromedial, and dorsolateral prefrontal cortex), are dissociable [20].

While *sanguinics* indulge in economic *4D***T**-modeling of "value", tempted by expected spared effort for future moves appropriating "worth" (itself processed in 5+ dimensions), *cholerics* prefer to rely on engrained complex instrumental habits.

1.5. Neuro-Economy of the Unknown: Uncertain Signs vs. Certain Goals?

Through the purported homology of rodent "sign-tracking" [21] with human "**UO**-vs.-**CO**"-behavior this framework can mobilize support from neuroscience, while it generates a critique of the "collapsing" use of Bayesian "prediction errors" in neuro-economics.

1.6. Do Thalamic Mast Cells Provide The Moody Switch?

The *thalamic paraventricular nuclei* (PVT), beyond their key role as bio-economical subcortical hubs [21,22,23], provide a central switch for "orientation" towards cues. They show chemical connectivity with the shell of the Nucleus accumbens (Nac) in "Sign-tracker" (**ST**) rats with **UO**-like behavior and with e.g. prelimbic PFC **CO**-like "Goal-trackers" (**GT**s) [24,25]. Exitotoxic lesioning of the PVT in training slowly increases the former **UO**-like behavior in all, while applied later it increases **UO**-like, whereas it decreases **CO**-like behavior, for the *acquisition* of which an intact PVT was needed [26].

The orientation of humans towards un-/certainty becomes reversed when minimizing losses as in depression [15]. This might occur through stimulation from peripherally imprinted mast cells reaching the PVT along the outside of posterior arteries, where the Cortico-striato-thalamo-cortical circuits (**CSTC**s) converge. In fact only cues which are *incentive*, i.e. especially in **ST**-rats, engage **CSTC**s [22], possibly to process a discount in specific effort expected for appropriation. In **CO**-like **GT**-rats this therefore doesn't seem to occur. The lack of sexual dimorphism in **ST** [27] in the realm of affective disorders fits with bipolar depression, but not with other disorders.

2. Balancing Complexity in Approach

Appropriative approach requires varying balances

between low- and high-dimensional processing.

2.1. dyn4-TAM Appears as neuro-biologically hard-wired

Unlike anticipated reward or final outcome *anticipated effort per se,* independently of valence, lights up: in the ACC, supplementary motor area (SMA), and dorsal putamen, while the ventral putamen appears more active with RPEs whilst perceiving unexpectedly better than worse outcomes, but less so after strong effort [36]. Cued *temptation* also correlates with activity in the mesolimbic output structure ventral putamen [37]. In primates and rats [38] the ventral striatum and ACC seem central to effort-discounting, while in fMRI [39] the posterior OFC and insula seemingly are ignited by anticipated *worth* processed in *5+D***A**~. *Cue*-driven transient activity instead activates BG and dlPFC (representing *4D***T**~) bilaterally [40], which possibly relates to processing *less* anticipated into 1-dimensional *economies* themselves "unrelated to the performance of the action" [41].

Genetico-affective biaxiality between *4D***T**~ and *5+D***A**~ [42] can be reinforced by an overlay [10] with *phylogenetic biaxiality*. In the amygdala e.g. subjective goals are set [43] and within this "what"-planning amygdalo-dorsal *developmental* stream [44] more *receptor*-driven modules for 4D**T**~ about "what" could operate. These *alternate genetico-affectively* with the brain's more *channel*-driven modules for 5+D**A**~ within the "where"-processing hippocampo-ventral stream, supported respectively by the anterior and medio-dorsal thalamic nuclei [45].

Within the evolving concepts of CSTCs [46,47] the thalamus [48] harbors the incompletely segregated more-from-than-to final relays back to the cortex whilst interacting with partners also in reward circuitry. In fact dopaminergic projections not only to the ventral, but also non-segregated nigro-striatal mood-regulating ones to the dorsal striatum pertaining to the CSTCs were found. These also fire proportionally to approach or *aversively little*, whilst not encoding aversion per se [49]. Furthermore blocking DA2-receptors diminishes the "willingness to engage" in effort [50]. Therefore a decrease in expected effort both for approach or retreat could in part be encoded by DA (see part 2), while stimulation near the substantia nigra pars compacta results in instrumental learning [48]. Effort itself is emerging as a result of specifically *patterned* glutamatergic input on midbrain DA-neurons [51].

2.2. Symbolic *4D*-Thought graduates the Vague Future

Ideas have often used triadic concepts, which including time, put 4-dimensional strains on our often conscious operative "symbol-handling" resources, which cannot deal with more independent processes [4,5,6]. This low-complexity faculty "*4D*-**T**hought" in *dyn*4 represents *agentic density of thoughts commanding future actions* – as

required e.g. by syllogistic relational processing [28].

As "*4D**T**~*" generates the passage from universals (∀) to meaningful particulars (∃) and their negation within the **SquOpp**. It provides a *4-step graduation* of applicable truth: For all (∀), NOT for all (¬∀), for some (∃), "NOT even for some, for none" (¬∃), which the rigid "either/or" in spatial approach (and its processing by *5+D**A**) lacks and therefore needs for wish-fullfilling sublation into positive **M**ood (Figures 1, 2).

2.3. Intuitive 5+D-Action Appropriates with Precision

"5+**A**ction" refers to the intuitive, particularly human, parietal [29] high-dimensional cognitive processing required to understand [8,30] articulated body-chains through efference copies [31].

Also aesthetics, dealing with intellectual intuition in "free", non-"burdensome" non-craft, non-"mercenary art" [32], essentially involves kinetic complexity [33,34,35].

By switching one face of Sydney Axinn's [13] relationally doubled square of (syllogistical) oppositions (**SquOpp**) a spatial logical structure is achieved which can be mapped to the *dyn*4 (Figure 2).

3. Triadic Signatures of Approach

The **AW**s inscribed in in dyn4-TAM-cube are full triadic signatures of affective traits and seemingly hardwired [52] within the three "temperamental" CSTCs [53].

These have been mapped [54,55] through *lesions* [56,57]: disorganized "Thought" to the dorso-lateral prefrontal cortex (dlPFC), non-cognitive abulia, muting "Action", to the anterior cingulate cortex (ACC), and anhedonia or instinct- and "Mood"-driven impulsivity to the orbitofrontal PFC (OFC). The OFC links informative sensations to outcomes, which fits with the definition of emotions as "analogue amplifiers" [58], and resonates with the amygdala, which is more flexible in learning aversive versus attractive contingencies [85] than the OFC.

This triadic structure can also be read from the insular cortex [59].

4. Thalamic Appropriative Language?

Since the above *dyn*4-transitions generate *56 natural language* terms (Figure 3) through dichotomous expression of *triple permutations* of *particulars*, *approach*, and successful appropriative *sublation* [60], these not only "speak through syllogistic states", but also predict *putative neuro-linguistic* operations emerging from convergent research [61].

Coding true as bold upper and false as lower case letters, the corner "**D**espair-T~/A~/m~" e.g. states: "Something, (*4D**T**~), can be approached, (*5+D**A**~), but *not sublated*, (m~)!" or "**J**oy-t~/A~/M~: "All, (t~), is approached, (**A**~), and sublated, (**M**~)!". Finally "Rescue" (**D**➔**J**) and "Frenzy" (**J**➔**D**) denote the transitions between these two.

4.1. The Thalamus Emerges as Syllogistic Speaker

The linguistic *thalamus* in fact responds to complex permutations [62], transmits cortico-cortically [63], sharpens the focus through the CSTCs, joins cognitive and motor processing [64], chooses words [65] or syntax [66] intending minimized efforts [67]. Direct tracts connect Broca's region to the anterior thalamus [68]. The thalamus reciprocally [69] engages cortical modules, and e.g. diverges widely to cortical layer 1 after intralaminar thalamic nucleus gating [70].
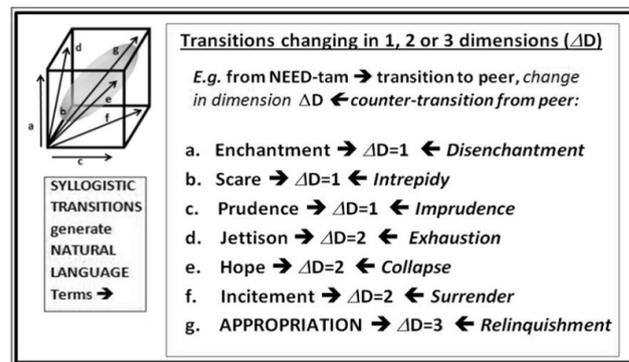

Figure 3. Seven one-step transitions from each syllogistic stance involve up to four nodes (or swaps over 1 to 3 dimensions) generating 56 psychologically meaningful processes and counter-processes. These – e.g. starting from "depressive" NEED – generate psychological natural language terms.

5. The Tempting Value of Less Effort

The recurrent **AW**s of *dyn*4 require an early computation, as related to the ventral striatum [71], of an opportunity as ratio of *specific reward-worth to a priceable proportion of own expendable maximal effort*. Whilst processing in the ventral striatum occurs early *before intention*, its scope from *outcome* seems provided by OFC [72,73]. Specific opportunities therefore will be perceived as attached to, thus conditioned and *fetishized*, cues, helping to overcome effort through the signaling of opportune expenditure, but not through resulting rewards - or punishments [74] – *per se*. **ST**s show instrumental, but not Pavlovian extinction [75]. When *frustration* ceases, "taxic" cue-effects proportional to DA show exhaustion [76] and **ST**s in fact fail to suppress CR after outcome devaluation [77] or even when *punished* for approach [78], arguably because the cue-associated relief of effort-related suffering becomes even *more* attractive in the context of *additional* suffering, like the one caused by periods of non-reward, to which they show a sluggish extinction of response [34].

6. Uncertainty-oriented Sign-tracking of Discounts?

Many insights into appropriative Perceptions ("**A**➔**T**") of external cues, driving the "*wanting*" of dopaminergic

incentive appetite, and of the internal opioidergic consummatory pleasure of "*liking*" stem from the Ann Kelley lab [21,79]. Their *sign-tracking* (**ST**s) rats [80,81] showed the peculiar behavior, not to explore the feeding magazine as much as *goal-trackers* (**GT**s), but to focus on more distant cues only vaguely and transiently associated with the "conditioning" chew – even when actions on the cue-contingent lever would cancel reward [80].

High performance of **ST**s on a "joy-stick-task" with "action discovery" [82,83] would *not* prove their homology with **UO**s [15] since **ST**s display a co-bred *non*-novelty [82] attraction for cues. Neurons for the latter "*cue-riosity*" in the OFC, before decision (within *4D***T***~*), fire "*orthogonally*" [84] i.e. in disregard of decisional context (within *5+***A***~*). Processing aversive circumstances, which considers effort too, shows overlap with that of rewards [85].

Part 2 of this essay explores consequences for some of the current neuro-economical and neuro-biological debates.

Table 1. Synopsis of natural language terms denoting transitions in the dyn4-TAM-cube.

	Bliss	Joy	Pursuit	Interest	Need	Fear	Despair	Worry
Bliss	→to / from	Exaltation	Prosely-tism	Committ-ment	Disenchant-ment	Startle	Fanatism	Nostalgia
Joy	Hypostasis	→to / from	Dedication	Flow	Exhaustion	Arrest	Frenzy	Doubt
Pursuit	Epiphany	Neglect	→to / from	Scatti-ness	Relinquish-ment	Shock	Defiance	Damnation
Interest	Stultifi-cation	Jubilation	Applica-tion	→to / from	Sobering	Awe	Aberrancy	Insolva-bility
Need	Enchant-ment	Jettison	**APPRO-PRIATION**	Reflection	→to / from	Scare	Incense-ment	Prudence
Fear	Confi-dence	Escape	Salvation	Cogni-zance	Freezing	→to / from	Entangle-ment	Attrition
Despair	Valoriza-tion	Rescue	Redemp-tion	Hope	Surren-der	Self-muting	→to / from	Brooding
Worry	Providence	Relief	Reme-diation	Solvability	Impru-dence	Enactment	Vengeance	→to / from

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[i] Abbreviation codes:

1. Neuroanatomy, Neurochemistry: ACC Anterior cingulate cortex; aINS Anterior insula; **CSTC:**Cortico-striato-thalamo-cortical circuits; HA Histamine; MC Mast cell; Nac Nucleus accumbens; OFC Orbitofrontal cortex; **PVT** paraventricular nucleus of thalamus; vmPFC ventromedial Pre-Frontal Cortex.

2. Psychology / Ethology: UOs Uncertainty-Oriented Individuals (Richard M. Sorrentino); **CO**s Certainty-Oriented Individuals (Richard M. Sorrentino); **UO-versus-CO** Uncertainty versus Certainty "orientation"; MBL Model-based learning; MFL Model-free learning; **GT**s goal-trackers; **GT** goal-tracking; **ST**s sign-trackers; **ST** sign-tracking.

3. Neuro-Economics: Effme maximal expendable effort; **RPE** Reward Prediction Error; **PE(−Δ%Effme)** RPE normalized to the maximum expendable effort.

4. dyn4-TAM modeling. *dyn*4TAM modified classic mixed bipolar disorder model; **T**~, *4D***T** symbolic 4-dimensional cognitive processing; *4D***-**Thought symbolic 4-dimensional cognitive processing; **A**~, *5+D***A** intuitive 5- or higher-dimensional cognitive processing; *5+D***-A**ction intuitive 5- or higher-dimensional cognitive processing; **M**ood dichotomic negative or positive valence; **M**~ dichotomic negative or positive valence; T/t, A/a, M/m dichotomic realizations of T, A, and M in triples. **P**{A➔T} Perception, i.e. transitions from 5+-Action to *4D*-Thought; **I**{T➔A} Intention, i.e. transitions from *4D*-Thought to 5+-Action; **AW**, **AW**s Appropriation Wave, Appropriation Waves; **SHO** Simple Harmonic Ooscillator; **Need**-t~a~m~ Need with low Thought, Action, and Mood; **Worry**-T~a~m~ Worry with much Thought, low Action and Mood; **Fear**-t~A~m~ Fear with much Action, low Thought and Mood; **Bliss**-t~a~M~ Bliss with elated Mood, low Thought and Action; **Pursuit**-T~A~M~ Pursuit with much Thought, Action, and Mood; **Joy**-t~A~M~ Joy with low Thought, much Action and Mood; **Interest**-T~a~M~ Interest with low Action, much Thought and Mood; **Despair**-T~A~m~ Despair with low Mood, much Thought and Action.

5. Logic: SquOpp Square of Oppositions (Aristotle); ∀, ¬∀ True for all, not for all; ∃, ¬∃ True for at least one, for none; ¬ Negation.