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

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Abstract

Epistemology 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). Such classical temperamental and anxio-affective triad of dimensions (“Thought”, “Action”, “Mood”) constitutes the “dyn4-TAM-cube”-model, reflecting segregated cortico-striato-thalamo-cortical circuits. “dyn4-TAM-cube” harbors cycling “Appropriation Waves” transiting from private “4DThought” 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 “dyn4-TAM-cube” to psychotherapy and to thalamic (neuro-linguistics, as “dyn4-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-Thought” or “4DT~” (see abbreviation codes), 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-Action” or “5+A~” (Figure 1).

This enquiry uses “dyn4-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: Need-t~/a~/m~ (with mutants Worry-T~/a~/m~, Fear-t~/A~/m~, and Bliss-t~/a~/M~) and Pursuit-T~/A~/M~ (with mutants Joy-t~/A~/M~, Despair-T~/A~/m~, and Interest-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 dyn4-TAM-cube’s classical dimensions interpreted as logical operations: 4DT– from universals V creates a set of particulars Ξ, 5+–A– “either/or” Δ, and MOOD 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 (AWs, lower left). AWs swap from 4DT– to 5+–A– at Intention and back to 4DT– at Perceptions.

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 “Need-Pursuit-(Outcome)” along 2 to 14 corners.

Predecessors for triadic and/or sequential “affective” models include: Jean Fernel (16thc.); Jean-Pierre Falret (19thc.); Charles Sherrington, Wilhelm Weygandt, Emil Kraepelin, Hans Lungwitz (19th/20thc.); Silvan S. Tomkins, Ullrich Supprian (20th/21thc.); 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+DA” which generates a simple distance in approach, which in in dyn4 is defined by “either x or ¬x”. The simple modeling via “4D-T” instead in dyn4 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 dyn4 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.

1.3. Variably Resented Explaining Efforts

Beyond encoding for growth or destruction “Mood/M~” modulates the “T~/T~”-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 “Un-”and “Certainty-Orient” 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 “Mood”. In high spirits this contrast is increased, but loss-minimizing depression may invert this cognitive style. In terms of dyn4 thus “Mood” along AWs 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 “4DThought” (T–) and intuitive “5+DAction” (5+DA–) thus alternate [3] by crossing the “affordant” [19] interfaces “Perception” (A→T) and “Intention” (T→A). To modulate this cognitive alternation is a little recognized key function of “Mood”.
Importantly through repeated appropriations learned contents are fed from both $T \rightarrow A$-interfaces of $AW$s into $T \rightarrow$-about:

- a) Pavlovian cues, which besides being predictive of specific reward, maybe become incentive as predictors of tempting abstract discount of expected effort at “Intention” ($I(T \rightarrow A)$) as one can suspect from its utility at the onset of an $AW$, and

- b) Skinnerian instrumental appropriative movements for complex needs at “Perception” ($P \{A \rightarrow T\}$).

In fact “valuation”, ($P \{A \rightarrow T\}$ in the OFC/vmPFC and “selection”, $T \rightarrow$ in dlPFC (orbito-, ventromedial, and dorsolateral prefrontal cortex), are dissociable [20].

While sanguinics indulge in economic $4DT$-modeling of “value”, tempted by expected spared effort for future moves appropriating “worth” (itself processed in $5+D$s), choleric 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 (CSTCs) converge. In fact only cues which are incentive, i.e. especially in ST-rats, engage CSTCs [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 $5+DA$-. Cue-driven transient activity instead activates BG and dlPFC (representing $4DT$-) 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 $4DT$- and $5+DA$- [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 $4DT$- about “what” could operate. These alternate genetico-affectively with the brain’s more channel-driven modules for $5+DA$- 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 averisely 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 “$4D$-Thought” in dyn4 represents agentic density of thoughts commanding future actions – as
required e.g. by syllogistic relational processing [28].

As “4DT” 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+DA) lacks and therefore needs for wish-fulfilling sublation into positive Mood (Figures 1, 2).

2.3. Intuitive 5+D-Action Appropriates with Precision

“5+Action” refers to the intuitive, particularly human, parietal [29] high-dimensional cognitive processing required to understand [8,30] articulated body-chains through effference 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 dyn4 (Figure 2).

3. Triadic Signatures of Approach

The AWs inscribed in in dyn4-TAM-cube are full triadic signatures of affective traits and seemingly hardened [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 (dPFC), 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 dyn4-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 “Despair-T/¬A/¬m” e.g. states: “Something, (4DT), can be approached, (5+DA), but not sublated, (m–)” or “Joy–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].

5. The Tempting Value of Less Effort

The recurrent AWs of dyn4 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. STs show instrumental, but not Pavlovian extinction [75]. When frustration ceases, “taxic” cue-effects proportional to DA show exhaustion [76] and STs 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 (STs) rats [80,81] showed the peculiar behavior, not to explore the feeding magazine as much as goal-trackers (GTs), 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 STs on a “joy-stick-task” with “action discovery” [82,83] would not prove their homology with UOs [15] since STs display a co-bred non-novelty [82] attraction for cues. Neurons for the latter “cue-riosity” in the OFC, before decision (within 4DT-), 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.](http://example.com/table1.png)

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Abbreviation codes:
1. **Anatomoy, Neurochemistry**: ACC Anterior cingulate cortex; aINS Anterior insula; CST/C: Cortic-striato-thalamo-cortical circuits; HA Hippocampus; MC Mict cell; Nac Nucleus accumbens; OFC Orbitofrontal cortex; PVN paraventricular nucleus of thalamus; vmPFC ventromedial Pre-Frontal Cortex.
2. **Psychology / Ethology**: UO Uncertainty-Oriented Individuals (Richard M. Sorrentino); CO Certainty-Oriented Individuals (Richard M. Sorrentino); UO-versus-CO Uncertainty versus Certainty “orientation”; MBL Model-based learning; MFL Model-free learning; GTs goal-trackers; GF goal-tracking; STs sign-trackers; ST sign-tracking.
3. **Neuro-Economics**: Effne maximal expendable effort; RPE Reward Prediction Error; PE (~DA£Effne) RPE normalized to the maximum expendable effort.
4. **dyn4-TAM modeling**: dyn4TAM modified classic mixed bipolar disorder model; T-, 4DT symbolic 4-dimensional cognitive processing; 4D-Thought symbolic 4-dimensional cognitive processing; A-, 5+DA intuitive 5- or higher-dimensional cognitive processing; 5+D-Action intuitive 5- or higher-dimensional cognitive processing; M dichotomic negative or positive valence; T/A, A/M dichotomic realizations of T, A, and M in triples. P[A, T] Perception, i.e. transitions from 5+D-Action to 4D-Thought; I[Α, Τ] Intention, i.e. transitions from 4D-Thought to 5+D-Action; AW, AWs Appropriation Wave, Appropriation Waves; SHO Simple Harmonic Oscillator; Need-t–a–m– Need with low Thought, Action, and Mood; Worry-t–a–m– Worry with much Thought, low Action 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; 3, 4 True for at least one, for none; ~ Negation.